CSSTEAP

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

(AFFILIATED TO THE UNITED NATIONS)

MEMOIRS

Twenty Fifth Post Graduate Course in Remote Sensing & Geographic Information System 2021 - 2022

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 FIFTH POST GRADUATE COURSE IN REMOTE SENSING &
GEOGRAPHIC INFORMATION SYSTEM
OCTOBER 2021 TO JUNE 2022

Conducted at

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

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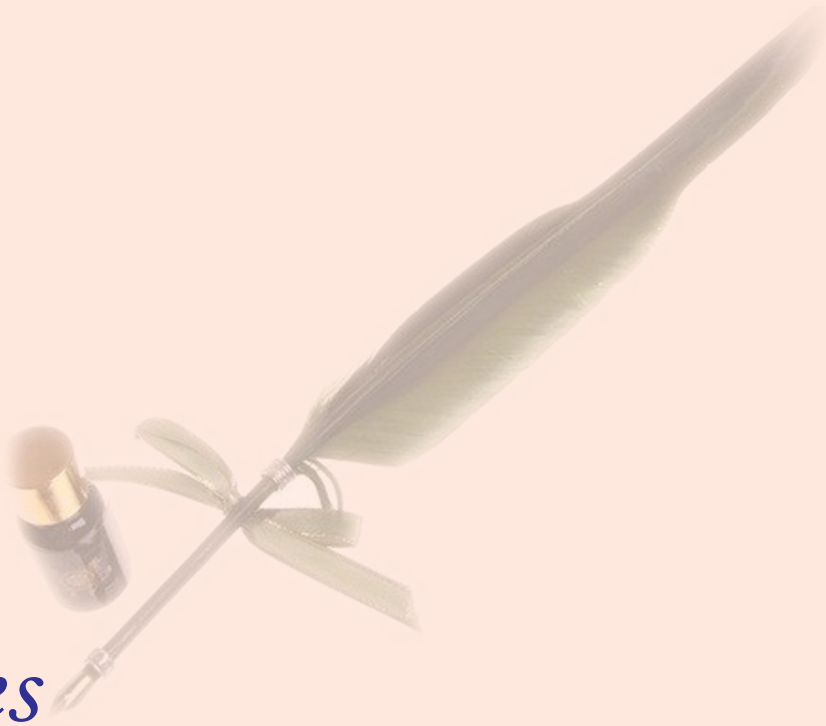
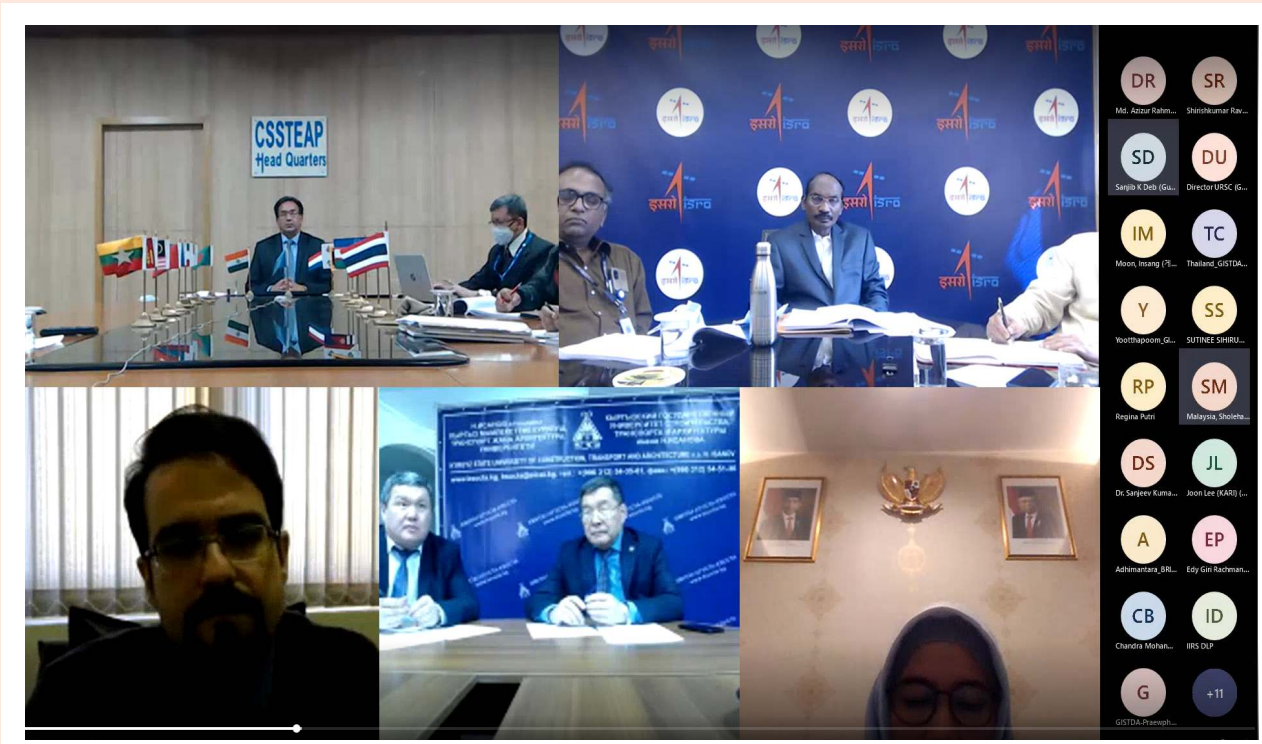


Messages



Governing Board Members and Special Invitees during 26th Governing Board Virtual Meeting held on December 22, 2021

सोमनाथ. एस
SOMANATH. S

सत्यमेव जयते
भारत सरकार
Government of India

अध्यक्ष
अंतरिक्ष आयोग
व
सचिव, अंतरिक्ष विभाग
GChairman Space Commission
&
Secretary, Department of Space

Message

I am pleased to note that the 25th Post-Graduate Diploma course on "Remote Sensing and Geographic Information System" of the Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), conducted by Indian Institute of Remote Sensing (IIRS)/ ISRO, Dehradun, in hybrid mode since October 1, 2021, is being successfully concluded on June 30, 2022. The course has benefited eighteen participants from eleven countries.

The course addresses various aspects of Remote Sensing & Geographical Information Systems and its applications. I am sure that the participants have greatly benefited from the course and the pilot projects carried out during the last phase of the course.

I am sure that the participants will be able to utilize the knowledge that they gained through the course towards initiating Geospatial application programmes in their countries, and also will further disseminate the knowledge to wider audience.

I wish the participants all the success in their future endeavors and hope they will strive towards utilization of the acquired knowledge for the benefit of their countries and regions. I appreciate the IIRS team and the faculty of the course for designing and successfully delivering.

Dated : June 07, 2022

सोमनाथ एस. / Somanath S.
Chairman, CSSTEAP Governing Board

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UNITED NATIONS
Office for Outer Space Affairs

Message

The United Nations Office for Outer Space Affairs (UNOOSA) warmly congratulates all participants for completing the 25th Post-Graduate Course on Remote Sensing and Geographic Information System Sciences and being awarded the Post-Graduate diploma certificates. We highly value the effort of CSSTEAP as a capacity developer in the Asia-Pacific Region and as a facilitator in 'bringing the benefits of space to humankind', fully in line with the vision of the United Nations Office for Outer Space Affairs.

I hope that this post graduate course has provided you with the necessary knowledge and skills for the future steps in your lives. I encourage you to utilize the experiences from this training programme in developing your pathway and contributing to the sustainable development efforts of your countries.

I extend my sincere gratitude to the Director of CSSTEAP, the course coordinators and the faculties of CSSTEAP for making this programme successful. I close this message by thanking the Chairman of the Indian Space Research Organisation for his support of CSSTEAP.

Niklas Hedman
Acting Director
United Nations Office for Outer Space Affairs

Message

Geoinformatics technology is an essential tool for supporting scientific inquiries in the digital age, as well as assisting in the resolution of complex social and environmental challenges and issues. As a result, this technology plays a significant role in many disciplines when they want to achieve success in sustainable development or solving spatial based problems. To leverage egional development and extend worldwide connections of the scientific community, increasing the number of scientists in the domain of Earth Observation Science is therefore a core mission.

The 25th batch of the Post Graduate Course in Remote Sensing and Geographic Information Systems included 18 students from 11 nations. On top of gaining academic information, the program has provided an essential opportunity for participating scholars to learn from foreign professionals in the fields of space technology and geoinformatics, as well as forming multicultural cooperation.

Lastly, I would like to express my congratulations to all participants again. You have earned your special key to broaden pathways of your career, future education, and networks. May you all succeed in the years ahead.

Pakorn Apaphant, Ph.D.
Executive Director
Geo-Informatics and Space Technology Development Agency
(GISTDA)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ ҮНДІСТАН РЕСПУБЛИКАСЫНДАҒЫ
ТӨТЕНШЕ ЖӘНЕ ӨКІЛЕТТІ ЕЛШІСІ

AMBASSADOR EXTRAORDINARY AND PLENIPOTENTIARY OF THE REPUBLIC OF KAZAKHSTAN TO THE REPUBLIC OF INDIA

Нью-Дели қаласы

New Delhi

Space exploration is one of the brightest pages in the mankind history. After the launch of the first artificial satellites and the first manned flights in near-Earth orbits, people in the most remote corners of the planet were seized with a sense of community and pride. They admired the power of the human mind and were shocked by the greatness of the universe, which seemed to come very close to the Earth. But only a few at that time guessed what great changes cosmonautics brings to the way of life that has developed for centuries, how deeply it will enter into the life of literally every family.

The modern world is unthinkable without space communication systems, research spacecraft. Literally every new step in the development of modern technologies is associated with discoveries made during the exploration of the Universe.

Since its foundation in 1995, the Center for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) has been making a worthy contribution to the development of space science for the benefit of all mankind, providing associated countries with the opportunity to train their specialists in advanced sciences using space technologies.

Kazakhstan pays special attention to the development of space. Space research has been conducted in our country for more than a dozen years. Many applied projects are being implemented. At the same time, the issue of training highly qualified personnel remains relevant. In this regard, Kazakhstan expresses its appreciation for the CSSTEP's efforts aimed at training highly qualified specialists in the space industry. CSSTEAP has affirmed its importance with a quality approach to work and the perspective of educational programs being organized.

I wish CSSTEAP success in its future work, continuing to be the center of space science and the implementation of ideas for the benefit of all mankind!

भौतिक अनुसंधान प्रयोगशाला
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जे. सी. बोस नेशनल फेलो / J. C. Bose National Fello
निदेशक / Director

Message

It is a great pleasure to know that the 25th PG Course on Remote Sensing (RS) and Geographic Information System (GIS) being conducted from October 01, 2021, at IIRS, Dehradun in hybrid mode is scheduled to be completed on June 30, 2022, with the participation of 18 students from 11 countries.

In emerging countries, the techniques of RS and GIS are increasingly being used for planning, managing and forecasting of natural resources disaster management and mitigation, and environmental protection for sustainable development. 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 the successful organization of this course and extend my best wishes to all the participants in their future endeavours.

Date : May 27, 2022

27/5/2022

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Message

I am happy to know that the IIRS, Dehradun is completing its 25th Batch of PG Course In Remote Sensing and Geographic Information System on 30th June, 2022 with a total of 18 participants pursuing this course from 11 countries. It is also happy to note that the institute is bringing out a Memoir on this occasion which is a treasury of memories containing information about the participants, faculty, abstract of their pilot projects and their experience.

Congratulations to the Director, CSSTEAP, the Course coordinator for organizing the course successfully by overcoming the COVID-19 challenges.

I wish the participants a prosperous life and career.

Date : June 8, 2022

(P.V.G.D. PRASAD REDDY)

CSSTEAP: A Brief

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

Dr. Prakash Chauhan
Director, CSSTEAP

The spread of Covid Pandemic and international travel restrictions posed many challenges as well as gave an opportunity to adapt to the social distancing norms while continuing learning using digital technology. Amidst Covid lockdown CSSTEAP undertook several initiatives to bridge the gap in capacity building by launching various new online short courses. Massive Open Online Courses (MOOC) on "Geospatial Applications for Disaster Risk Management" designed and organised by CSSTEAP and UNOOSA jointly was one of such special courses which received overwhelming response globally. The course content was delivered by highly experienced 18 resource persons from 12 organizations. The rich content from highly experienced resource persons, and the concept of learning at any time, anywhere and at your own comfort made available through a customized learning management system (LMS) made MOOC very popular since its launch among disaster professionals. About 13,576 participants from 148 countries benefited from the two phases of MOOC. Considering the continuity of pandemic restrictions and outbreak of new variants, the CSSTEAP PG Diploma programs were initiated in hybrid mode in which first six months the participants were imparted the lectures and customized demonstrations in online mode and with the ease of Covid restrictions the participants were brought to campus for carrying out the three months pilot project work.

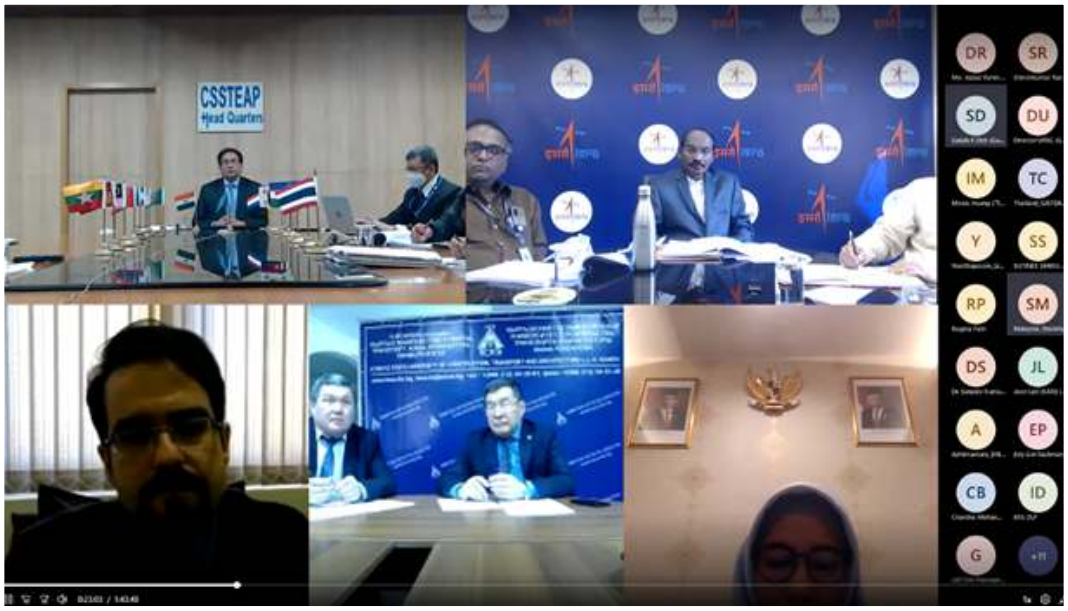
Focusing attention on Asia and the Pacific (AP) region of the globe, this region has become a hub of innovation which is transforming the way in which people live, work, and relate to one another. Recent advancement in digital innovation such as artificial intelligence, big data analytics, the internet of things and cloud computing show promise to bring new and innovative solutions to pressing regional problems. Faster and more versatile digital connectivity, satellite-derived data, geographic information systems and spatial analysis have become increasingly accessible and available, generating more evidence-based data to support real-time decision-making. Geospatial information has also increasingly been incorporated in development planning, which has led to more accurate monitoring and evaluation of development interventions. As a result, geospatial information applications have come to play a more prominent role in the implementation and realization of the 2030 Sustainable Development Agenda (SDGs).

Despite advances in the availability and quality of space-derived information, several gaps and challenges remain for their effective use at the AP regional and national level. A lack of capacity and resources in terms of finance, space-derived data, knowledge and expertise, specific tools and well trained human resources is a common problem. Many developing countries in the AP region still do not have the capacity to utilize, analyze and interpret space-derived data. Other challenges include issues related to policies, procedures, guidelines and standards for acquiring, sharing and utilizing space-derived products and services, and the lack of procedural harmony between agencies and countries. A comprehensive training and education in Remote

Sensing & Geographic Information System (RS & GIS) would enable developing countries to build a capability in the field, and to educate and stimulate participants in other disciplines as well.

Considering the importance and use of space science, technology and applications in promoting social and economic development, the United Nations, through its Office for Outer Space Affairs (UN-OOSA), facilitated the establishment and operation of the Regional Centres for Space Science and Technology Education. 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), six Regional Centres for Space Science and Technology Education have been established in the regions that correspond to the United Nations Economic Commissions for Asia and the Pacific (India and China), Africa (Morocco, Nigeria) and Latin America and the Caribbean (with offices in Brazil and Mexico) and Jordan for the West Asia region. The Centres are affiliated to the United Nations through UN-OOSA. Centre for Space Science & Technology Education in Asia and the Pacific (CSSTEAP) is the first Centre and was established on November 1, 1995 in India and has been Centre for Space Science and Technology Education in Asia and the Pacific imparting education/training in the areas of RS & GIS, Satellite Communications, Satellite Meteorology and Global Climate, Space and Atmospheric Science, Navigation and Satellite Positioning System and Small Satellite Missions using modern infrastructure, technology and training tools and practices. The Centre has announced a new Post Graduate course on Global Navigation Satellite Systems (GNSS) from 2015 and is hosted by Space Applications Centre, ISRO Ahmedabad.

The Centre's headquarter is located in Dehradun, India, and its programmes are executed by faculty of the Department of Space (DOS) at campuses in Dehradun, Ahmedabad and Bengaluru. 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) and Navigation and Satellite Positioning Systems (NAVSAT) short courses; with Physical Research Laboratory (PRL), Ahmedabad for Space & Atmospheric Science course and UR Rao Satellite Centre (URSC), Bengaluru for short course on Small Satellite Missions. The Centre also 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



Dr. K. Sivan, Chairman, ISRO/Secretary, Department of Space and Chairman CSSTEAP Governing Board during 25th GB Meeting conducted online from CSSTEAP Headquarters

specialized agencies. Under the agreement the Centre also has access to facilities, infrastructure and expertise of DOS/ISRO institutions, including IIRS, SAC, PRL and URSC. The Centre has a Governing Board consisting of signatories from **17** countries from Asia-Pacific region and two observers, (UN-OOSA & ITC, The Netherlands). The Centre has formal UN affiliation with UN-OOSA for developing the CSSTEAP model and extending support in terms of expert advice, technical assistance, relevant documentation and future directions. The countries have agreed to the goals and objectives of the Centre by endorsing a cooperation agreement through which the Centre was established. The technical activities of the Centre are guided by an International Advisory Committee (AC) consisting of subject experts that critically reviews the curricula, technical facilities, expertise in terms of faculty, etc.

The course curricula developed by the Centre and endorsed by the United Nations are adapted for the educational programmes. The educational programmes of the Centre are oriented towards the dissemination of knowledge in relevant aspects of space science and technology. The Centre offers Post Graduate level courses in these five areas. The model of the PG courses is designed as to emphasize university educators, researchers and application scientists on the development and enhancement of knowledge and skills coupled with an application project with a small component (3 months) in India and major one (one year) in their home country with a view to transfer the technology in their home organization. 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. Besides the Post Graduate level courses, the Centre also conducts short courses, workshops, awareness programmes on specific themes in the four areas, highlighting how space-based information can be used for national development. These educational programmes have benefited many scientists/engineers who will be the future policy & decision makers in several countries.

CSSTEAP conducts all of its educational programmes in close collaboration with one of the DOS institutions and thus has direct access to their physical facilities and intellectual capabilities. In addition to providing facilities, infrastructure and skilled manpower, the Government of India, through the Department of Space provides most of the funding. 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 also provides funding for travel of the participants. Other agencies financially contribute include are UN Agencies like UNSPIDER, Beijing, China; UN-ESCAP in Bangkok, Thailand, UNESCO and UNDP.

Educational Programmes

The Centre offers 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).

Apart from these, Centre conducts short courses on different themes of Remote Sensing and GIS, Small Satellite Missions and Navigation and Satellite Positioning system on regular basis. The structure of PG Diploma and the short term programs is given in (Fig. 1 & 2). The Centre also organizes workshops & awareness programmes from time to time.

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. 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 (M.Tech.) 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

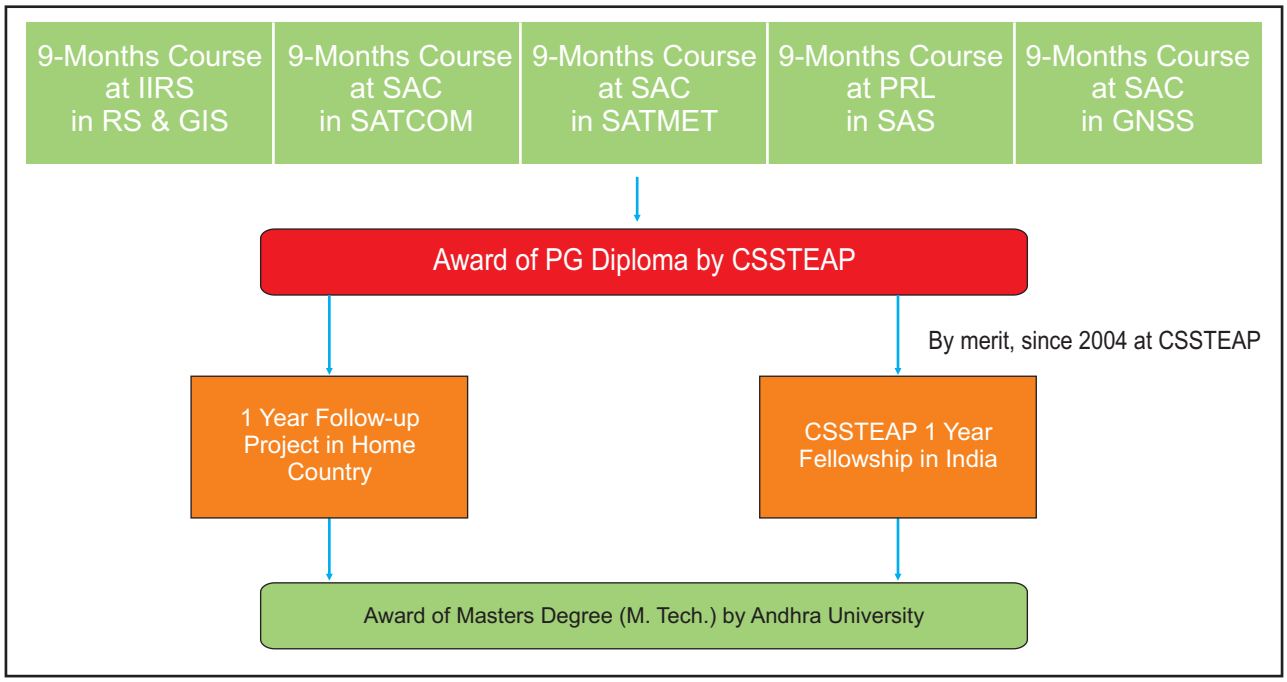


Fig. 1: Structure of PG diploma educational programmes at CSSTEAP

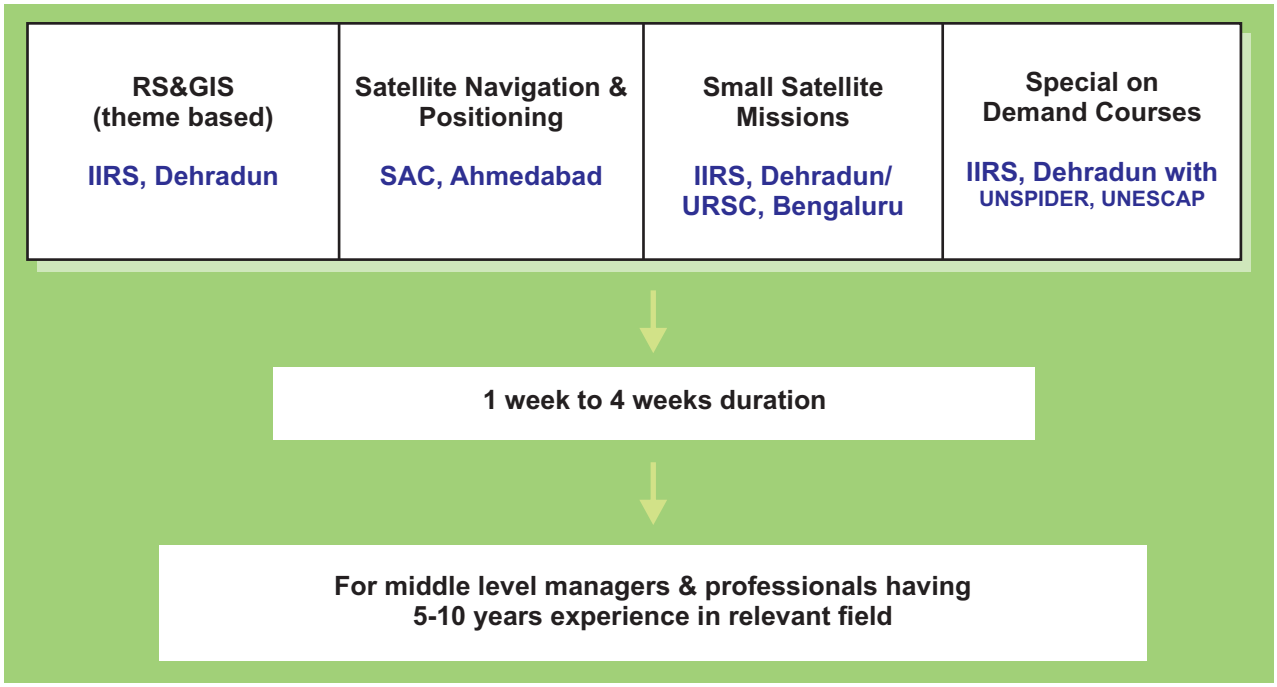


Fig. 2: Short-term training programmes at CSSTEAP

technology. This project has to be approved by CSSTEAP and AU, and the research is supervised by designated academic staff of CSSTEAP, AU and the institution where the research is carried out. 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 M.Tech thesis work at CSSTEAP.

Till date 190 participants from 17 countries have been awarded M. Tech. Degree in the 5 disciplines (85 participants in RS & GIS; 51 in SATCOM; 22 in SATMET; 27 participants in SAS and 04 in GNSS). (Fig. 3)

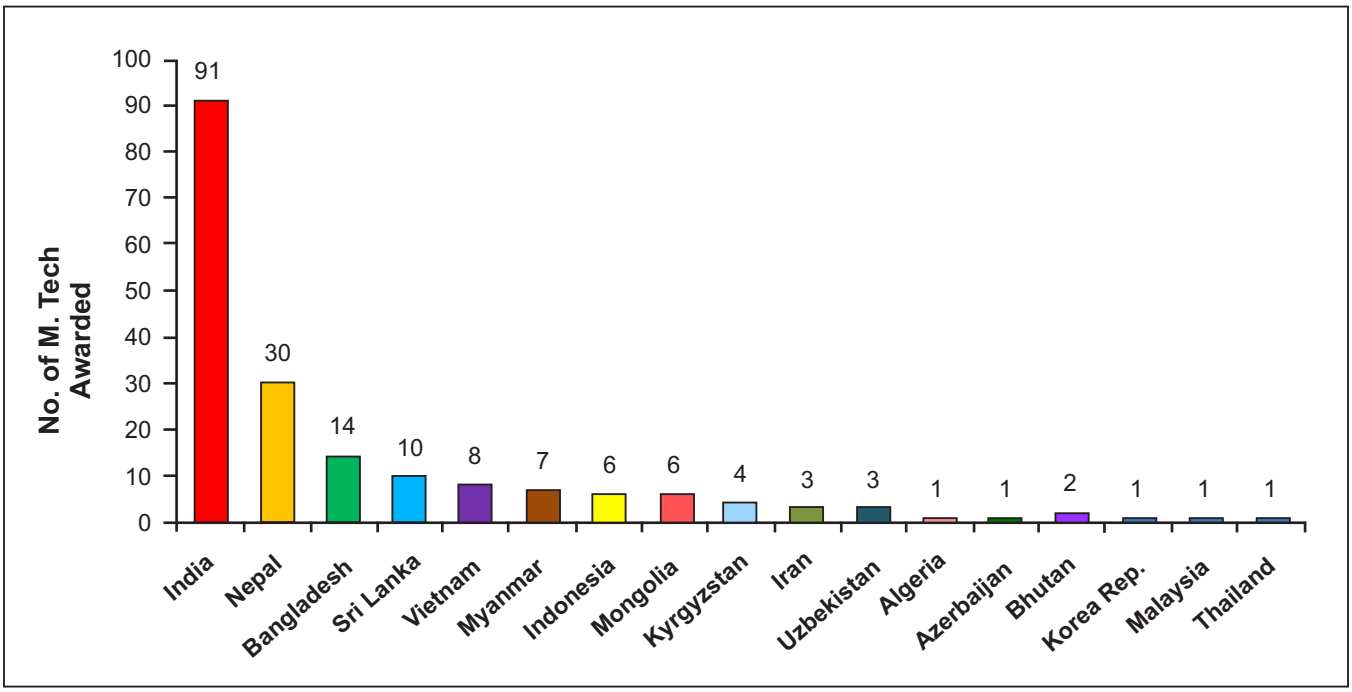


Fig. 3. Status of M. Tech. degree awarded

Remote Sensing and GIS course

The RS & GIS course is directed towards mid-career professions including university educators and researchers, natural resources managers to learn about environmental management and to support disaster management. The Post Graduate course is divided into two semesters (semester-I of four months and semester-II of five months including three months pilot project work). Semester-I covers principles of RS, photogrammetry, image analysis, GIS and GPS, recent trends in RS & GIS technology, satellite meteorology, earth processes, natural disaster and environmental analysis, monitoring and analysis. Each of the course participants chooses one optional thematic application discipline in semester-II based on his/her academic qualification, professional experience and requirement of his/her parent organization. The thematic optional streams cover RS & GIS applications to (i) Agriculture and Soils, (ii) Forestry Ecosystem Assessment & Management, (iii) Geosciences & Geo-hazards, (iv) Water Resources, (v) Urban & Regional Studies (vi) Marine & Atmospheric Science, (vii) Satellite Image Analysis & Photogrammetry and (viii) Geoinformatics. This also consists of a pilot project which forms the basis for a one year project to be carried out in their home country of the course participant. A new thematic area in technology Satellite Image Analysis & Photogrammetry was added from the year 2012.

The RS&GIS syllabus of CSSTEAP is updated after every three years to review the RS&GIS syllabus in accordance with latest development in space technology related to sensors, technology and newer applications. The 12th Board of Studies (BOS) meeting of PG course in Remote Sensing & GIS of CSSTEAP was held on September 28, 2021 in Online Mode. The recommendations of BOS were further put in front of the Advisory

Participants of 25th RS&GIS PG Course with Director, CSSTEAP

Committee of the Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) held during its 14th meeting on November 25, 2021 through Virtual Mode from CSSTEAP HQ., Dehradun. The RS&GIS syllabus is now modified in light of changes recommended and will be implemented for the 26th RS&GIS course to start from August 01, 2022.

Achievements

Till date the Centre has been conducted 61 PG Courses: 24 in RS&GIS, 12 in SATCOM, 11 each SATMET and SAS and 03 in Global Navigation Satellite System. Currently 25th RS&GIS course at Dehradun, 12th SATMET at SAC Ahmedabad and 12th SAS course at PRL, Ahmedabad are in progress. In addition, the Centre has conducted 70 short courses including webinar and workshops in the past 27 years. These programmes have benefited more than 2800 participants from a total of 37 countries in the Asia-Pacific region and 48 participants from 23 countries outside Asia Pacific region have also benefited from these educational programmes.

In order to obtain first hand feedback, understand the alumni role in promoting space technology in their countries and to develop a network & establish meaningful linkages between CSSTEAP & its alumni, CSSTEAP has taken initiative to hold alumni meets in different countries of the region.

Pilot research case studies in the form of student project work showing the potential application of space science and technology in natural resources management, improved meteorological, communications studies etc., in Asia-Pacific region is being done by the Centre. The Centre initiated research activities in the form of Phase-II of PG course i.e., M.Tech research work by eligible PG participants. 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.). During the 2020-21, total 11 participants have been supported with CSSTEAP M.Tech fellowship namely eight participants from India, one each from Nepal, Bhutan and Mongolia.

To generate awareness among users, researchers, engineers, professionals, decision makers and academicians, in year 2020-21, the Centre organized a following short course on specialized areas of Remote Sensing & its applications:

2021-22 Short Courses

- Online Short Course on Space Application for Forest Monitoring and Assessment during April 12-16, 2021. (56 participants from 8 countries)

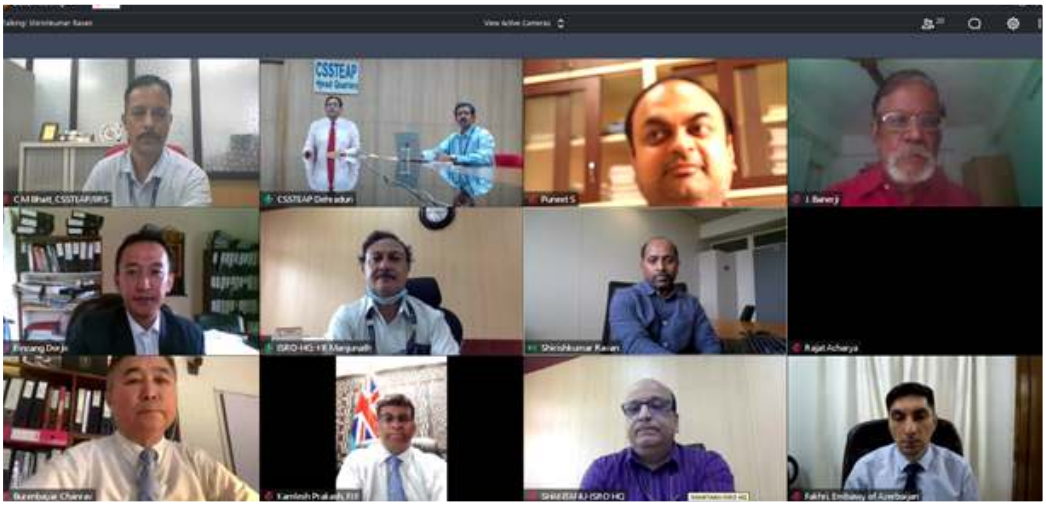
- Online Short Course on Space Technology for Disaster Management during April 19 to 30, 2021. (45 participants from 11 Countries)
- Use of Space Technology for weather and Climate Studies during May 17 to 31, 2021. (43 participants from 10 Countries)
- Online Short Course on Coastal Zone Management in Response to Natural Hazards and Climate Variability during July 26 to August 06, 2021. (43 participants from 7 countries)
- Online Short Course on Introduction to Satellite Navigation during September 13-24, 2021. (45 participants from 13 countries)
- Online Short Course on 'Open Source GIS technology & Geoweb Services' April 25 - May 06, 2022. (53 participants from 8 Countries)
- Online course on 'Hyperspectral Remote Sensing Techniques and Applications' during May 16- June 03, 2022. (75 Applicants from 12 Countries)
- Phase-I of Massive Open Online course (MOOC) on Geospatial Applications for Disaster Risk Management was jointly organised by CSSTEAP and UNOOSA during October 13 – December 31, 2020. A total 11892 participants from 148 countries were benefitted from MOOC.
- Phase II of MOOC on Geospatial Applications for Disaster Risk Its Management" on June 01, 2021 which continued until November 30, 2021. A total 1684 participants from 148 countries were benefitted from Phase 2 of MOOC.
- Online Training Course on Remote Sensing Applications for Crop Mapping and Monitoring. (Jointly with UNOOSA) held on October 5 and October 7, 2021. (64 Participants from 20 countries)

Launch of MOOC Phase-1 Program on Geospatial Application for Disaster Risk Management

Launch of MOOC Phase-2 Program on Geospatial Application for Disaster Risk Management

Outreach Meet with officials of Foreign Missions in India

CSSTEAP organized an Outreach Meet with officials of Foreign Missions in India through virtual mode on September 30, 2021 to inform about the initiatives taken by CSSTEAP for capacity building in Asia Pacific region.



Outreach Meet with officials of Foreign Missions in India

Participation in RESAP

Director CSSTEAP attended the 25th session of ICC on RESAP through virtual mode held on 24-27 August, 2021 to brief about the CSSTEAP capacity building activities being undertaken in the field of space applications.

Support to UN Workshop

CSSTEAP has also provide support for regional workshop and capacity-building programme on the “Enhancing Preparedness for Climate Related Disasters Using Space-Based Technologies”, conducted in virtual mode on 17th February, 2021. under the umbrella of the SAARC Disaster Management Center and the United Nations Office for Outer Space Affairs (UNOOSA), through its UN-SPIDER programme attended by 63 participants from disaster management authorities and space agencies in SAARC Member States, academic institutes, and regional and international organizations.


INDIA

Capacity Building and Learning Opportunities at IIRS

Capacity Building and Learning Opportunities at IIRS

Dr. Raghvendra Pratap Singh
Director, 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. 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.

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.

While nurturing its primary endeavour to build capacity amongst the user community by training mid-career professionals, the Institute has enhanced its capability and evolved many training and education programmes that are tuned to meet the requirements of various target groups, ranging from fresh graduates to policy makers including academia. 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 3100 institutions/ organizations are networked with IIRS.

The Institute has a multi-disciplinary and problem oriented research agenda that focuses on technology development as well as land/ocean/atmosphere applications in the area of geo-information (GI) science and

earth observation. From the perspective of technology development, commendable research in GI science is pursued at the Institute, like advanced image processing techniques, digital photogrammetry, microwave remote sensing, radar interferometry, hyperspectral remote sensing, LiDAR data processing, spatial data mining, spatial data modelling, spatial decision support systems, etc. On the applications front, the Institute has proven its leadership in the country in developing key societal applications, like watershed management, ground water exploration, modelling urban dynamics, coastal zone management, irrigation water management, biodiversity characterisation, geo-hazards monitoring, assessment and modelling, to name a few.

IIRS is involved in a number of research projects of ISRO/ DOS such as Earth Observation Application Mission, Disaster Management Support, National Carbon Project (ISRO-GBP) and other Mission Projects such as SARAL-ALTIKA & INSAT INSAT-3D Utilization Projects etc. In addition to these ISRO/ DOS projects, IIRS scientists have significantly contributed in the research activity through various Technology Development Programmes (TDPs) and other in-house research projects. IIRS is publishing about 60-70 peer reviewed research publication annually in various national and International high impact research journals.

IIRS is also involved in active research in planetary geoscience with focus on the Moon and Mars utilizing hyperspectral and high-resolution remote-sensing planetary data from Indian and International missions. Important highlights of the recently conducted research includes, mineral detection using Chandrayaan-2 IIRS reflectance data; unambiguously detect, completely characterize and quantify lunar hydration (2.8-3.5µm region) attributed to the presence of OH and/or H2O using Chandrayaan-2 IIRS data and development of new algorithm to utilize IIRS data to estimate lunar surface temperature and generate global surface temperature maps for both the equatorial and polar regions from the available IIRS data strips.

The Institute campus also houses the headquarters of the Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), affiliated to the United Nations and first of its kind established in the region in 1995. IIRS provides support to conduct all its remote sensing and GIS training and education programmes at postgraduate level. The headquarters of Indian Society of Remote Sensing (ISRS), one of the largest non-governmental scientific society in the country, is also located in the Institute campus.

Brief History & Milestones

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.

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.

Vision

Achieve excellence and remain in the forefront for capacity building through training, education and research in the field of Remote Sensing and Geoinformatics and their applications".

Mission

Education for acquiring knowledge and translating it into practical applications for solving real world problems for sustainable development.

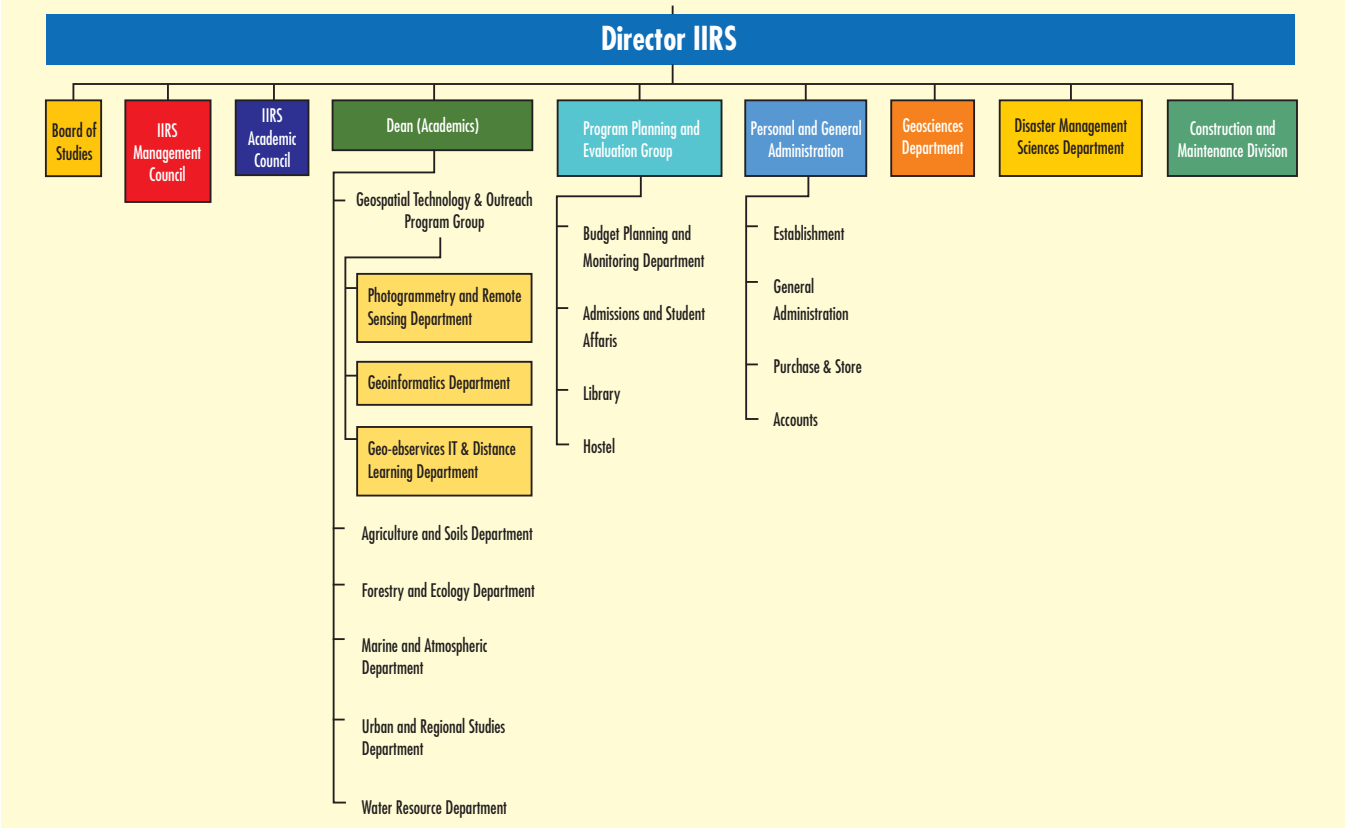
Objectives

Capacity building in the field of remote sensing and Geoinformatics through:

1. Quality education and training programmes as per the need of stakeholders, through regular feedback and updation.
2. Ensure quality of education and training programmes through regular evaluation of the student performance, improved infrastructure and linkage with institutes of high repute.
3. Ensure quality of trainers / faculty through regular training/seminar/publication in peer review journals.

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 60 multidisciplinary scientists and engineers contribute towards realizing the Institute's objectives.



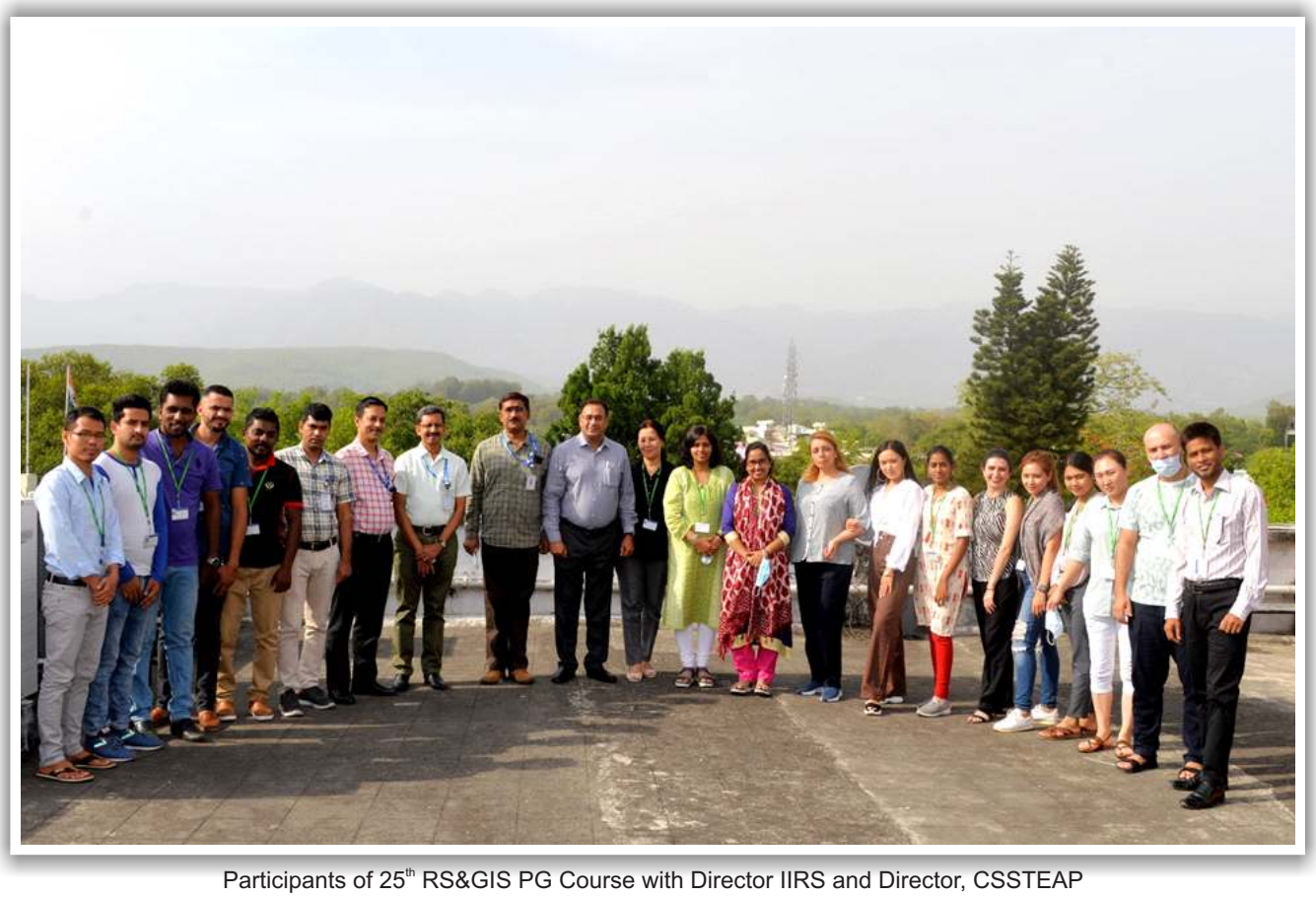
Capacity Building Programmes of the Institute

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 sixty-four 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 10,591 professionals including 1003 from abroad representing 95 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 3100 institutions and organizations spread across India are networked with IIRS. More than 4.97lakh participants have benefitted so far from IIRS Outreach Programmes. To ignite the imagination and spread awareness on space technology



Participants of 25th RS&GIS PG Course with Director IIRS and Director, CSSTEAP

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 Institute also provides opportunities to external students to pursue their research under the guidance of IIRS faculty. IIRS is a recognized centre for carrying out research leading to PhD by Forest Research Institute (Deemed University), University of Pune, Doon University, Kumaon University, Uttarakhand Technical University and IIT, Roorkee. About 50 researchers who have worked under IIRS faculty have received PhD degrees till date from different universities. External Post-graduate/ Graduate students are also given opportunity to conduct their project work under the guidance of IIRS faculty.

In addition, the Institute also provides support to the Centre for Space Science and Technology Education in Asia and The Pacific (CSSTEAP), affiliated to the United Nations, to conduct the RS & GIS training & education programmes at postgraduate level. IIRS hosts Headquarters of Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), affiliated to the United Nations in its campus. CSSTEAP has mandate for capacity building in Asia-Pacific Region countries. CSSTEAP takes the advantage of the technical manpower and the facilities of four major centres of DOS/ISRO viz., Indian Institute of Remote Sensing (IIRS), Space Application Centre (SAC), U R Rao Satellite Centre (URSC) and Physical Research Laboratory (PRL). The Centre conducts Post- Graduate and short courses in five disciplines viz., Remote Sensing & Geographical Information System (RS & GIS), Satellite Communications (SATCOM), Satellite Meteorology and Global Climate (SATMET), Space & Atmospheric Science (SAS) and Global Navigation Satellite System. The Centre has conducted several short courses and workshops in the past. These programmes have benefitted around 2898 participants from 37 countries in the Asia-Pacific Region. In addition to that, 48 participants from 23 countries outside Asia-Pacific Region also have benefitted. CSSTEAP maintains an interface with the ISRO Centres and United Nations Offices to conduct these courses.

The research and pilot projects carried out by the officer trainees and students of various courses are mainly focused towards exploring the potentials, including developing new methods and applications, of Indian EO data. Apart from regular programmes, special/ tailor-made courses are designed and conducted to explore the use of new sensors launched on Indian EO satellites and also based on the need of the stakeholder/ user departments.

The international partner of IIRS, The University of Twente (UT) is known as 'the enterprising university' in The Netherlands. Established in 1961 at Enscheda, UT is one among the top 25 of the 250 biggest European universities. Education and research at UT takes place in its six faculties/institutes with the focus on nanotechnology, information technology, biomedical technology and technical medicine, sustainable energy and smart devices, governance, behavioural sciences and geo-information science/earth observation. ITC (http://www.itc.nl/), a leading international institute focusing on capacity building and institutional development in the field of geo-information science and earth observation, is embedded as the sixth faculty of UT since 1st January 2010.

Andhra University (AU), established in 1926, has five constituent colleges – Colleges of Arts and Commerce, College of Science and Technology, College of Engineering, College of Law and the College of Pharmaceutical Sciences. The five colleges' together offer about 300 courses at undergraduate and postgraduate levels, besides research programmes leading to Ph.D degree. The Centre for Remote Sensing and Information system in the Department of Geo-Engineering, with whom IIRS is partnering for M.Tech Programme in Remote Sensing and GIS is one of the Centres of Excellence in the AU. The Master's Degree programmes are run in collaboration with – (1) Andhra University, Visakhapatnam, India (for M.Tech. Degree in Remote Sensing & GIS). Both the capacity building partners of IIRS, i.e. Andhra University (http://www.andhrauniversity.info/) and University of Twenty (http://www.utwente.nl/), are the premier education and research institute in India and The Netherlands, respectively.

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 Organisation (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 date, IIRS has successfully conducted 140 outreach programmes through live and interactive classroom mode (also known as EDUSAT programme) benefitted more than 4.97 lakh participants from 3050 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 are 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 has conducted International Distance learning programme under “ISRO-IIRS Space Application Training (ISAT)” programme. A dedicated portal, Learning Management System (LMS) and E-CLASS International platform was utilised for International users. IIRS has conducted Massive Open Online Courses (MOOC) under ISAT programme on “Geospatial Applications for Disaster Risk Management (Phase I and II) in collaboration with United Nations Office for Outer Space Affairs and the Centre for Space Science and Technology Education for Asia and the Pacific. IIRS has also conducted MOOC course on SAR data processing and applications. Around 47,000+ participants have registered for these MOOC courses and 14,500+ participants received certificates after completing the course.

IIRS eLearning course “Comprehensive course on Remote Sensing and GIS” was approved by All India Council for Technical Education (AICTE) as a 04 credit course and made available on SWAYAM portal of MHRD. In the year 2021, around 23,000 participants were registered for the course through SWAYAM portal. The examination was conducted by National Testing Agency and around 500 participants successfully completed the course and received certificate from AICTE.

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

S.No.	Programme	Duration	No. of Seats
1.	**M.Tech. 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.	11 months	30
4.	**Post-Graduate Diploma in Geo-Information Science & Earth Observation (Affiliated with ITC, University of Twente, The Netherlands)** Specialization in - Geoinformatics	10 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 in Geosciences 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 IIRS-Management Council

The activities of the Institute are guided by the IIRS-Management Council (IIRS-MC). It has the following role:

- To review the institute's programmes (ongoing and new initiatives);
- To review the annual budget proposals and manpower requirements; and
- To provide overall direction for the development of the Institute.

The Academic Council

The academic programmes of the institute are guided by an Academic Council consisting of leading experts in the field. The Academic Council has the following terms of reference:

- To provide the overall guidance to the academic programmes of the Institute and suggest revisions as and when required;
- To review and implement the recommendations of the Board of Studies;
- To advise on the research and faculty improvement programmes; and
- To recommend pedagogy, quality and standards, admission and evaluation policies and academic equivalencies.

The Board of Studies

The Board of Studies (BoS) consisting of domain experts reviews and approves the course curriculum and syllabus of different academic programmes designed by the faculty in consultation with the external experts from academia and industry. The BoS has the following terms of reference:

- To review the course contents and curricula based on the latest developments in the RS & GIS technology and applications;
- To review the quality and contents of lecture materials, practicals and tutorials; and
- To analyse the effectiveness of teaching methods, conduct of examinations and students' feedback of the courses.

IIRS Academia Meet (IAM) 2022

Course Report

25th Post Graduate Course on Remote Sensing & Geographic Information System (RS & GIS)

Due to Covid-19 pandemic spread and international travel restrictions, the CSSTEAP 25th PG Diploma RS&GIS course was planned to initiate in hybrid mode having a mix of online and on-campus training depending on the situation and guidelines from government. The 25th PG Diploma RS&GIS course formally started on October 01, 2021 in a combined virtual inaugural program conducted along with the inaugural of 12th SATMET and 12th SAS courses. Director CSSTEAP, Dr. Prakash Chauhan, Director SAC, Shri Nilesh Desai and Director PRL, Dr. Anil Bharadwaj, Program Coordinator Dr. Ariit Roy, were present in the inaugural function along with the Course Directors, Course Coordinators, faculty members and course participants.

25th RSGIS PG Course virtual inaugural program

The 25th PG course on Remote Sensing and Geographic Information System had about 18 participants from eleven countries which included 16 participants from 10 countries of Asia-Pacific Region (three participants from Sri Lanka, two participants each from Bangladesh, India, Myanmar and Uzbekistan, one each from Mongolia, Tajikistan, Nepal, Kazakhstan and Philippines) and two participants from outside Asia-Pacific Region i.e. Mexico. Theses participants were from various departments working broadly in the field of meteorology, geology, hydrology, rice research, disaster management, geoinformatics, agricultural sciences and information technology in various capacities in their respective organizations.

The course started with an induction programme giving and overview of the course, briefing about the CSSTEAP campus and the hybrid mode of teaching. To look after the IT requirements of online attendance, session logging and software license sharing for the participants a special Technical Officer from GIT&DL Department. There were detailed sessions on familiarization of participants with the online teaching methods, where the participants were given the login credentials and briefed in detail about the various modules on attending the classes, accessing the course material, uploading the assignments and online assessment methods. Induction and online orientation program was followed with commencement of Semester-I consisting of module-IA and module-IB. Module-IA covered the fundamental concepts of Remote Sensing (RS) and Geographic Information System (GIS) technology with lecture, practical, tutorial and field excursions. The participants had several field excursions for ground truth collection and for interpretation and analysis of remote

sensing satellite data. Module-IB covered the recent trends in RS & GIS and Environmental assessment and Monitoring with special emphasis on Sustainable Development Goals (SDGs). Participants were given an overview on how space technology can be useful in addressing SDGs. The participants were assessed through internal assessment followed by semester end assessment and practical examinations.

The Semester-II started from January, 2022, wherein the participants based on their academic background, technical requirement of their parent organization and their professional experience, chose one of the eight available electives i.e. Agriculture & Soils, Forestry & Ecology, Geosciences & Geohazards, Marine & Atmospheric Science, Water Resources, Urban & Regional Planning, Satellite image analysis & photogrammetry and Geo-informatics. In the present batch, 9 participants opted for Geoinformatics, 2 participants for Satellite Image Analysis & Photogrammetry, for 4 Agriculture & Soils, 3 for Forest Ecosystem Assessment & Management. 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. During this module the participants were assessed through internal assessment followed by semester end assessment and practical examinations.

With the easing of Covid pandemic situation and availability of vaccines and opening of international flight, necessary arrangements were made to bring the participants to CSSTEAP/IIRS campus for carrying out the Module-3. All the participants except one from Sri Lanka were able to join the campus for the Module-3, which started from April, 2022. The participants were welcomed to campus by Director, CSSTEAP at an inaugural program held at CSSTEAP, headquarters.

25th RSGIS PG Course participants welcome to CSSTEAP campus

This module is of three months duration and basically involves execution of projects and is very critical for learning execution of project wherein the participants can exchange there idea and interact with the concerned faculty. Thereafter, the participants in consultation with their supervisor formulated on a project topic to be executed. This was followed by a seminar presentation reviewed by a committee constituted under the chairmanship of Dean, Academics, IIRS.

Post seminar presentation and suggestions made by the committee members the participants worked on their pilot project, based on the knowledge gained during the course by utilizing space inputs. The details of the topics varied from land use land cover dynamics and prediction modelling, rice crop cultural types mapping, drought characterization, agro-ecological zoning, hyperspectral data analysis for geological mapping and mineral exploration, flood hazard zonation, biomass analysis using LIDAR, soil erosion risk assessment, development of geo spatial web-based management system etc. Details of topics are given in subsequent sections.

Pilot project seminar synopsis presentation

In addition to the academic activities special efforts were also put for improving the level of competency of spoken English, understanding and writing skills in English of the participants to help the participants in to help in writing the project report and improving presentation skills. Special English language classes after office hours were conducted in campus for the two months.

Four special guest lectures were also organized during their stay for benefit of the participants. The first lecture was delivered by Dr. Shirish Ravan United Nations Office for Outer Space Affairs on “Introducing the Sustainable Development Goals (SDGs) Space applications for SDGs and role of UNOOSA” followed by Dr. Sanjay Srivastav, Chief, Disaster Risk Reduction, UNESCAP Lecture on “Earth Observation for achieving the Sendai Tagets” and “Frontier technologies for building resilience to disasters: emerging trends from mid-term review of Sendai Framework for disaster risk reduction 2015-2030” and the fourth lecture was delivered by Dr. Hamid Mehmood, Economic Affairs Officer of the Space Applications Section on the topic “Enhancing resilience to disasters in South Asia through the use of Digital Technology and Geospatial Information Systems”.

RS&GIS course participants with former Chairman ISRO, Shri A S Kiran Kumar

In addition to above the participants also had a chance to listen to former chairman ISRO Sh. Kiran Kumar views on the space activities with special reference to Indian Space Program and interact during his visit to IIRS on June 10, 2022.

During their three months stay at CSSTEAP, the participants were taken to Mussoorie on educational tour to show the Indian landscape and get acquainted with Indian tradition and culture. The students also participated in cultural program arranged by the IIRS students.

The project topics undertaken by the participants were:

- Rice crop cultural types mapping in Bangladesh using synergistic SAR and Optical data
- Drought Characterization of Bangladesh using Geospatial Technology
- Assessment of water resources of the Balkhash-Alakol basin using the VIC model
- Land use land cover dynamics and prediction modelling in “the Deforestation Arc” of the Amazonian rainforest, Brazil
- Agro-ecological Zoning for Avocado Production in Jalisco, Mexico
- Hyperspectral data analysis for geological mapping and mineral exploration in Gilbent-Uul area, Mongolia
- Spatio-temporal variability of water quality parameters in parts of Ayeyarwaddy delta region using Remote Sensing data over GEE platform
- Flood Hazard Zonation Using Remote Sensing Data: A Case Study of Myintkyina City, Myanmar
- Biomass analysis using LIDAR data [OR] Vegetation type modeling (to be decided)
- Site Suitability for Frequency Distribution from Short-Range Radio Service
- Developing OData protocol compliant Geo-spatial Dashboard using python
- Development of Geo Spatial Web-Based Management System for Electricity Breakdown of Sri Lanka
- Analysis of spatial and temporal variation of air pollution in Colombo area (Before- During-Post Covid19)
- Surface water assessment using cloud GIS (TAL: Tool for Assessment of Lake dynamics)
- Application of Regression Kriging to Air pollutants in Delhi
- Soil erosion risk assessment in a hilly watershed using RS and GIS
- LULC change assessment using GIS and RS application: a case study of Tashkent city, Tashkent Region, Uzbekistan (1990 - 2020)
- Land use and Land cover change analysis using Google Earth Engine in the Burchmulla forest basin, Uzbekistan

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

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

List of Participants

S.No.	Name	Thematic Discipline	Country	Photogarph
1.	Mst. Shetara Yesmin	Agriculture & Soils	Bangladesh 	
2.	Md. Ashraful Alam	Agriculture & Soils	Bangladesh 	
3.	Dr. Nilima Aditya Natoo	Geo Informatics	India 	
4.	Ms. Noolu Ganesh Sai Sivani	Geo Informatics	India 	
5.	Ms. Zhanerke Kemprekova	Geo Informatics	Kazakhstan 	
6.	Ms. Marina Benitez Kanter	Forest Ecosystem Assessment & Management	Mexico 	
7.	Mr. Manuel Valderrama Herrera	Agriculture & Soils	Mexico 	
8.	Ms. Boloroo Bayaraa	Satellite Image Analysis & Photogrammetry	Mongolia 	
9.	Ms. Nyo Me Tun	Geo Informatics	Myanmar 	

S.No.	Name	Thematic Discipline	Country	Photogarph
10.	Mr. Laphine Zaw Gaung	Satellite Image Analysis & Photogrammetry	Myanmar 	
11.	Mr. Binamra Thapa	Forest Ecosystem Assessment & Management	Nepal 	
12.	Ms. Lady Peñaflorida Smith	Satellite Image Analysis & Photogrammetry	Philippines 	
13.	Mr. B.H. I.I. Sirisumana	Geo Informatics	Sri Lanka 	
14.	Mr. Kukulavithanage Don Sampath	Geo Informatics	Sri Lanka 	
15.	Mr. Pinnagodage Dimuthu Udayanga	Geo Informatics	Sri Lanka 	
16.	Ms. Shahlo Amonovna Aljonova	Agriculture & Soils	Tajikistan 	
17.	Dr. Matluba Mamanazarovna Egamberdieva	Geo Informatics	Uzbekistan 	
18.	Mr. Abrorkhon Nozimov	Forest Ecosystem Assessment & Management	Uzbekistan 	

List of Faculty

Name	Topics	Photograph
Dr. Prakash Chauhan	• Remote Sensing of planetary sciences	
Dr. R.P. Singh	• EO data applications for hydrological studies	
Dr. S.K. Srivastava	• Groundwater potential zoning	
Dr. Pramod Kumar	• Urban resource planning, urban landuse planning • Urban area analysis	
Mrs. Shefali Agrawal	• Remote Sensing • Principles and applications of hyperspectral RS	
Dr. R.S Chatterjee	• SAR interferometry and its applications • Ground water geology	
Dr. Suresh Kumar	• Soil resource mapping, Digital terrain analysis • Land evaluation,Watershed Management • Soil quality assessment, soil erosion modeling	
Dr. Debashish Mitra	• Coastal Zone Management • Coastal geology and geomorphology • Coastal hazards and its mitigation • Coastal processes and modelling • Coastal pollution study through geospatial techniques • Coastal ecology and its conservation • Climate change impact on coastal zone	
Dr. N.R Patel	• Crop yield modeling, production forecasting • Drought assessment and monitoring • Land surface process, carbon cycle & climate change • Retrieval of Agrometeorological Parameters Land surface process, carbon cycle & climate change	

Name	Topics	Photograph
Dr. Anil Kumar	• Image Classification • ANN & Fuzzy, Classifier	
Dr. Hari Shanker Srivastav	• LULC analysis, Microwave RS in agriculture • Soil moisture estimation	
Dr. A.K Mishra	• Ocean colour monitor & its application • Ocean remote sensing, satellite altimetry & scatterometry for ocean	
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	• Settlement planning, Space use, ANN & CA in urban growth modelling • Urban hazard & risk assessment	
Dr. Sameer Saran	• Spatial information system, spatial data modelling infrastructure, • Spatial decision support system, MCDM • Distributed GIS, interoperability, metadata stds & cataloging	
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	
Mrs. Vandita Srivastava	• Spatial data analysis, vector & raster	

Name	Topics	Photograph
Dr. (Mrs.) Poonam S. Tiwari	• Digital Photogrammetry • Close Range Photogrammetry	
Dr. Yogesh Kant	• EO systems for climate change studies • Earth Radiation budget • Atmospheric Aerosol 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	• Image transforms and fusion • Satellite Photogrametry • Sensor modelas and product generation	
Dr. Praveen K. Thakur	• Quantification of hydrological elements: Precipitation, WL/River Flow • Snow and glacier mapping and melt modelling • DEM derivatives & application in water Resources • Site suitability of hydro-power projects • Urban hydrology: water distribution and modelling • Flood and GLOF modelling; Flood early warning system	
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	
Dr . Kshama Gupta	• Image Interpretation of Urban Areas • Base Maps and Cadastral Maps for Urban and Regional Areas • Census Operation and Population Studies • 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 • Urban Climate : Factors Affecting Urban Climate, Impact of Urban Surfaces, Diseases and Human Health	
Dr. Bhaskar R. Nikam	• Quantification of hydrological elements: Evapotranspiration • Soil erosion process and modelling • Irrigation water management, Performance evaluation, and conjunctive use planning • Drought assessment and monitoring	
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	

Name	Topics	Photograph
Dr. Vaibhav Garg	• Quantification of hydrological elements: Runoff • Water body and Snow cover mapping • Reservoir sedimentation • Urban hydrology: storm drainage networks • Modelling climate change and impact of climate change on water resources. • Integrated water resources management	
Dr. Subtrata Nandy	• Visual image interpretation for forest • Utility of VHR multi-spectral remote sensing • Growing stock, biomass/carbon estimation using optical data • LiDAR in forest inventory • Geospatial modelling, Multi-criteria decision making for forestry and ecological applications • Wildlife habitat suitability analysis • Forest ecosystem, Forest productivity estimation	
Dr. Manu Mehta	• Physics of remote sensing • Spectral signature, In-situ measurements and visual image interpretation • Radiometric and atmospheric corrections for hyperspectral and thermal data	
Mr. Vinay Kumar	• Hyperspectral Remote Sensing and data processing • Platforms & sensors • Remote sensing data errors, products • Data pre-processing • Hyperspectral remote sensing	
Dr. (Mrs.) Suchita Srivastava	• Green house gasses & their atmospheric chemistry • Retrieval of temperature, trace gases & ozone	
Dr. Shovan Lal Chattoraj	• Types of mineral deposits • RS application in engineering geology	
Mr. Ashutosh K Jha	• Agent based modelling, database connectivity, spatial variation models, dependence measures, Geo-visualization, files objects & classes, metrics & linear algebra,	
Mr. Prasun Kumar Gupta	• h/w, s/w requirements for GIS, database design using UML, attribute & positional uncertainty, basic programing concepts, web programing	
Dr. Charu Singh	• Rainfall retrieval & monsoon studies • Tropical dynamics ENSO etc	

Name	Topics	Photograph
Mr. Kamal Pandey	• Strings, tuples, dictionaries, GDAL, customizing, open source GIS s/w, server side scripting, web mapping using open layers, data quality & sources of error in GIS	
Mr. Ashish Joshi	• Principles of Microwave Remote Sensing • SAR Interferometry • Terrain Analysis. • GNSS and its Application • Statistics for Image Processing	
Dr. Shashi Kumar	• Principles of thermal and microwave remote sensing • Polarimetric SAR Remote Sensing • SAR interferometry	
Mr. Hari Shanker	• Network analysis, spatial data quality • Spatial variation models & dependence measures • SAR interferometry for land deformation	
Mrs. Richa Sharma	• Spectroscopy of minerals, hyperspectral RS mineral exploration • RS for geology, DIP	
Ms. Pooja Jindal	• Meteorological satellites & sensors • Assessment of cyclones, atmospheric humidity	
Dr. Aprit Chouksey	• Quantification of hydrological elements: interception and Soil Moisture • Water Balance studies • Integrated watershed management • Waterlogging and salinity • Trend analysis of hydro-meteorological data	
Mr. K. Shiva Reddy	• GIS data models, conceptual model of spatial information • Internet technology & WebGIS, Web GIS services	
Dr. Pratima Pandey	• Glaciology, climate tectonic relationship • Landform dynamics	
Ms. 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. Prabhakar Alok Verma	• Interpolation methods, attribute & positional uncertainty, error & uncertainty propagation, Taylor series, spatial sampling & modelling	
Mr. Justin George	• Fundamentals of soils & pedogenesis • Land evaluation • land degradation • Hyperspectral RS in degradation mapping	
Mr. Yateesh Ketholia	• Geomorphic process costal & kart • Hydrocarbon resources & mode of occurance	
Mr. Abhishek Danodia	• Fundamentals and Importance of Agrometeorology • Precision agriculture • Cropping System analysis • ICT Applications in Agriculture: Basics of DBMS, Yield gap analysis, Decision support systems, SDSS	
Mr. Pankaj Dhote	• Hydrograph analysis • Streamflow measurement • Watershed morphological analysis • Groundwater modelling • Flood hydrology, routing • Flood mapping, monitoring and damage assessment	
Dr. Taibanganba Watham	• Spectral vegetation indices • Digital image interpretation • Statistical treatment of forestry inventory data • Carbon flux monitoring using eddy flux studies • Wetland habitat monitoring and conservation planning • IPCC climate change scenarios	
Dr. Ishwari Datt Rai	• Phenology for vegetation differentiation • Biodiversity Information Systems, Global Biodiversity information facility • Forest ecosystem structural and functional analysis • Definitions and concepts of Landscape ecology • Forest ecosystem and climate linkages	
Dr. Sanjeev Kumar Singh	• Tropical Cyclone • Numerical Weather Prediction	

Name	Topics	Photograph
Mr. Surendra Kumar Sharma	• Machine Learning for urban studies	
Mr. Yateesh Ketholia	• EO data application for landslide and earthquakes	
Dr. Mamta Chauhan	• Planetary Geology	
Dr. Ashutosh Srivastava	• GNSS an its applications	
Mr. Prabhakar Alok Verma	• Geoinformatics, Geostatistics	
Ms. Supriya Sharma	• Software Design and Development	
Mr. Ravi Bhandari	• Programming for geospatial applications	
Mr. Anoop Kumar Singh	• Software Design and Development	
Mr. Dharmendra Kumar	• Database and webserver security	
Mr. Ashish Bisht	• Cloud based computing platforms, Mobile and Web Applications	

Name	Topics	Photograph
Mrs. Jappji Mehar	• Lunar geology, Microwave remote sensing	

Guest Faculty

Dr. Shirish Ravan	Introducing the Sustainable Development Goals (SDGs) Space applications for SDGs and role of UNOOSA 23-December-2021	Programme Officer (Head, UN-SPIDER Beijing Office)	
Dr. Sanjay Srivastav	Earth Observation for achieving the Sendai Tagets 23-December-2021 Frontier technologies for building resilience to disasters: emerging trends from mid-term review of Sendai Framework for disaster risk reduction 2015-2030 27-April-2022	Chief, Disaster Risk Reduction, (UNESCAP)	
Dr. Hamid Mehmood	Enhancing resilience to disasters in South Asia through the use of Digital Technology and Geospatial Information Systems 27-April-2022	Economic Affairs Officer of the Space Applications Section (UNESCAP)	

Pilot Projects of Students

Hyperspectral Data analysis for Geological Mapping and Mineral Exploration in Gilbent-Uul Area, Mongolia

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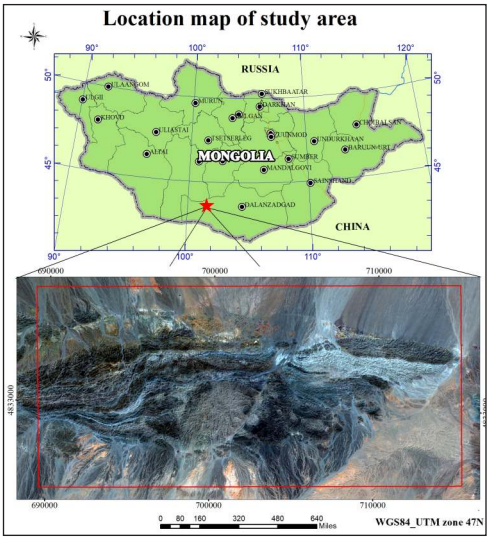
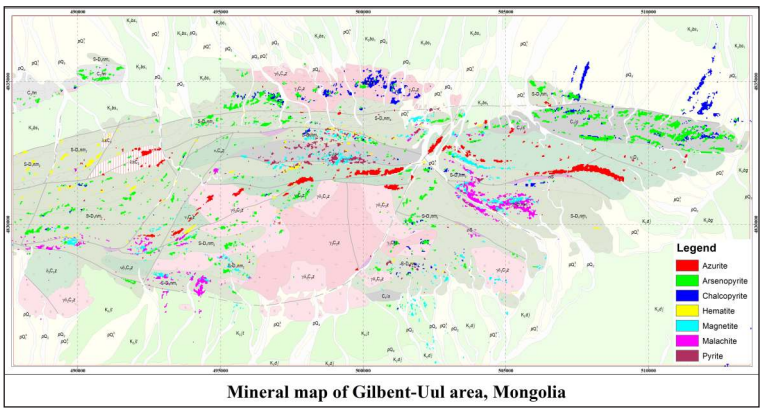
A B S T R A C T

Hyperspectral remote sensing played a significant role in geological study and mineral exploration in the last few decades. Mineral exploration and geological mapping through conventional geological techniques are tedious, expensive and time-consuming. Mapping and targeting an economic deposit through traditional techniques involves extensive fieldwork, structural mapping, study of landforms, petrography, mineralogy and geochemical analysis. These techniques need a strong laboratory database to discern slight variation in composition of ore grades Hyperspectral data helps in classification, identification and quantitative analysis of mineral resources and rock mass occurrence in earth surface. The hyperspectral sensors provide spectrally contiguous images that allow precise identification of minerals. The study area chosen for this research is the Gilbent-Uul which is situated in the part of the Mongolia. Geologically, common litho-units found here are sedimentary rock, basic volcanics, igneous rocks: granite, rhyolite porphyry, granodiorite, gabbro, andesite, sandstone, aleurolite, schist of different geological age: Paleozoic era, Mesozoic era, Cenozoic era.



In this study PRISMA (PRecursore IperSpettrale della Missione Applicativa) hyperspectral Level-2 data was used for processing. Endmembers of different rocks/mineral were extracted. Spectral analysis was done for each endmember separately. PRISMA hyperspectral image spectra/endmembers were compared with USGS library spectra for identification. Lithological classification of hyperspectral data using spectral angle mapper (SAM). In this study mineral identification was also carried out by generating different mineral indices and relative band depth images. The generated rock/mineral map was compared with the geological map and the it was observed that classified results were able to differentiate several rocks/mineral types clearly.



Mineral map of Gilbent-Uul area, Mongolia

Keywords: Hyperspectral, PRISMA, Rocks, Mineral, SAM

Development of Geo Spatial Web-Based Management System for Electricity Breakdown of Sri Lanka

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Ceylon Electricity Board (CEB) is the government-owned largest electricity supplier in Sri Lanka with the market share of nearly 100% .They control all major functions of electricity generation, transmission and distribution in Sri Lanka in two fragments, Domestic and Industries. Existing breakdown system totally operated in manually and sometimes took more time to rectify the faults and restore the system. An effective complaint management system for electricity breakdown does more than just help handle the breakdown, it also getting the feedback from customers as well.

The purpose of this system is to enable the general public to quickly report power breakdown in any part of Sri Lanka with accurate locations and provide an interface where the maintenance team can quickly direct to the right place and enable the customer to monitor the latest status of their complaint. Matara district of the southern Province has been selected as study area for the pilot project and data related to the electricity distribution, transformer locations, and administrative zonal boundaries data has been obtained from CEB.

Fig. 1: Compliant sheet

Customer can compalin through portal and Control room receives the power outage information with compain type, time, reported person info with accurate geographical location. Custemer portal sedigned using Kobotoolbox software (Fig. 1). These iformation integread to the QGIS software using Q-realtime plugging. Operator can analyse the faulty informaion with available distribution data (transformers, regional location and boundary of regional office) and assign the relevent Regional office (Fig. 2).

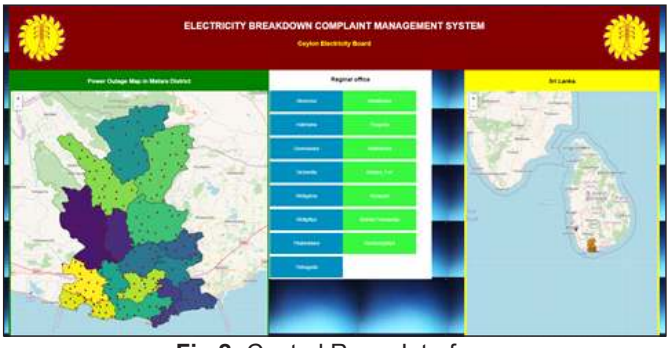

Fig 2: Control Room Interface

The relevant information about the breakdown is displayed on the dashboard of the regional office. Maintenance team can assign accordingly with the magnitude of the fault. Also these information can be passing to nearest field maintenance team through GPS technology. Maintenance team need to update the progress of the fault and customer can monitor through user interface of the latest status of the complaint.

Drought Characterization of Bangladesh using Geospatial Technology

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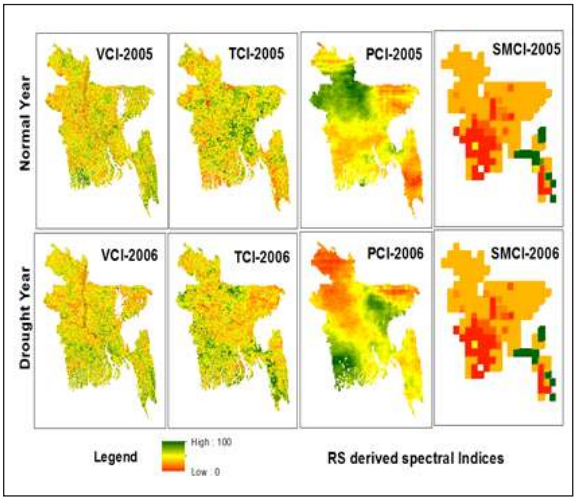
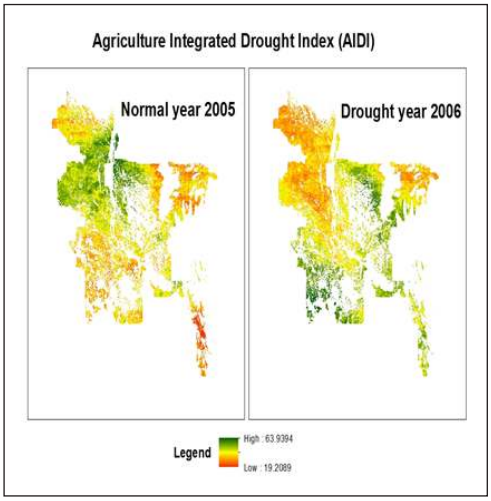
A B S T R A C T

Drought is a period of below average precipitation in a given region, resulting in shortage of water supply, whether atmospheric, surface or ground water. In the country of Bangladesh suffers with frequent drought due to deficient and uneven rainfall, poor delayed rainfall and high temperature. In this study, a novel approach defined for drought severity of Bangladesh, especially for using analytical hierarchy process established a Multi-Criteria Decision-Making approach based Integrated Drought Index (IDI). The remote sensing multi-sensor derived datasets, as long-term MODIS satellite data (NDVI & LST), rainfall from CHIRPS datasets and soil moisture from Era Interim datasets, used for quantification for the 2001–2016 period. The IDI is generated by integrated multi-spectral indices as Vegetation Condition Index, Temperature Condition Index, Precipitation Condition Index and Soil Moisture Condition Index using analytical hierarchy process derived weightage with a consistency ratio of 9.5% and consistency index of 0.009 value. The weightage or parameters priority come out to be as 19% VCI, 9% of TCI, 67% of PCI and 5% of SMCI. Observed rainfall of Bangladesh is used in generation of Standardized precipitation index (SPI) and further use in validation of IDI of agricultural region.

The study reveals that Bangladesh is having diverse drought conditions year by year. Particularly the North-West region of Bangladesh suffers more droughts due to poor and delayed monsoon and insufficient water. Northeast region of Bangladesh also has drastic effect of droughts due to abnormal rainfall. The statistical analysis illustrated a significant correlation between SPI and IDI for all states. Henceforth, a geospatial platform-based approach using historical earth observations with analytical hierarchy process integrated expert advice to finalize variables and their weighing will make this methodology more realistic, easier and quicker to apply in future at any region. Eventually, remote sensing can address the drought risk or severity for all kind of agricultural ecosystem by using cohesive approach derived from multi-sensor satellite datasets.





Site Suitability for Frequency Distribution from Short-Range Radio Service

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The National Telecommunication Commission (NTC) of the Philippines is responsible for supervising the telecommunications services throughout the country. According to Memorandum Circular No. 01-01-98 with the subject of "Licensing Guidelines and Procedure for Short-Range Radio Services (SRRS)", the allocation of frequency channels are Non-Interference Basis. In current scenario, without a geospatial database, frequency distribution from SRRS is not optimum.

The purpose of this research project was to create spatial data for site suitability of new SRRS using GIS framework. The following base maps were used to consider a location for a new base station: Land Cover, Land Use (restricted areas such as Jail, Airport, Military Headquarters, etc.), Road Network, and Digital Elevation Model. Multi-Criteria Decision-Making (MCDM) was used to compute the criteria for selecting the best option and showing alternatives for new SRRS. Analytic Hierarchy Process (AHP) pairwise comparison was used to weigh the different base maps. For collecting data KoBoToolbox was used and linked to the QGIS as a synchronized vector layer. Figure 1 showed the study area and output of MCDM.

The figure 2 showed the optimal coverage of the existing base station in accordance with the proposed coverage of the new base station. A Graphical Modeler was created in QGIS for the implementation of the view shed analysis. The Free-Space Path Loss was calculated and integrated into Viewshed Analysis for the visual representation of signal propagation in Line-of-Sight (Best Reception) and Non-Line-of-Sight (Higher Path Loss).

The MCDM result showed that 23.479% of the study area are considered highly suitable, 74.715% Average, 1.798% are least suitable and 0.009 % are not suitable.

Keywords: Suitability, MCDM, AHP, Viewshed, Path Loss

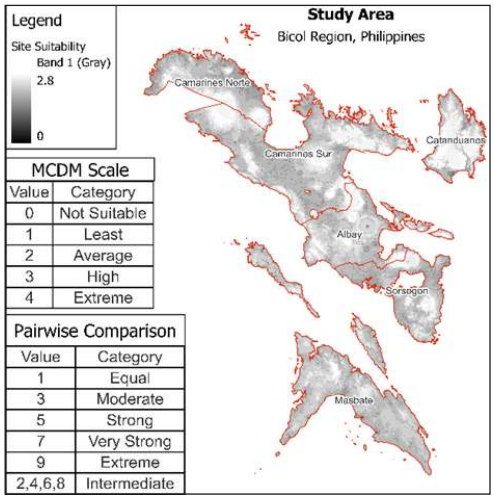

Fig. 1: Study Area with MCDM Result

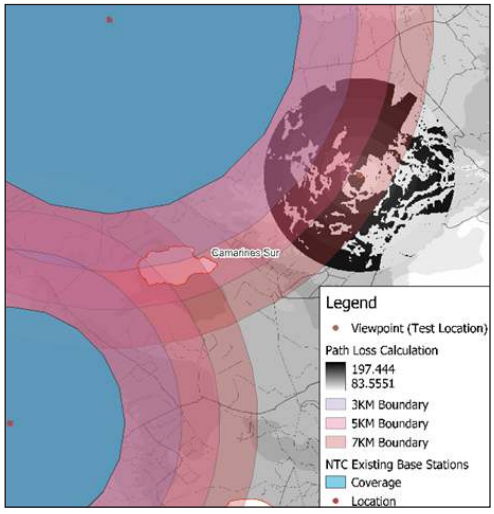

Fig. 2: Optimal Coverage with calculated Path

Flood Hazard Zonation Using Remote Sensing Data: A Case Study of Myintkyina City, Myanmar

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Co-Supervisor
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Water Resource Department, IIRS, Dehradun

Among natural hazards that affect the people, infrastructure and other aspects of community, flood is one of the most common occurring disasters over the world. It occurs during a short period of time(days) but affects severly for long period of time. The risk due to flood hazard can be reduced by hazard zonation using remote sensing data, which can further help local authorities to make a plan for preparedness and mitigation. In the present work, flood hazard zonation has been carried out in Myintkyina city, Myanmar using remote sensing data and Google Earth Engine platform. Flood inundation maps were generated using optical (Landsat-8, Sentinel-2) and SAR (Sentinel-1) data for the years from 2018 to 2020. Further, evaluation of open-source DEMs namely, ALOS PALSAR RTC HR (12.5m) and TanDEM-X (90m) was carried out to assess the characteristics of topography in flood-prone area on ward-level basis. It was found that, the wards on the eastern part of the city are most flood-prone, facing flood situation during monsoon season frequently. As per topographic evaluation using DEM and its derivatives (TRI & VRM), the area comes under relatively flat terrain providing an opportunity to temporary accumulation of the water leading to flooding. The outcomes of the study could be served as RS&GIS based product, useful to disaster management authorities.

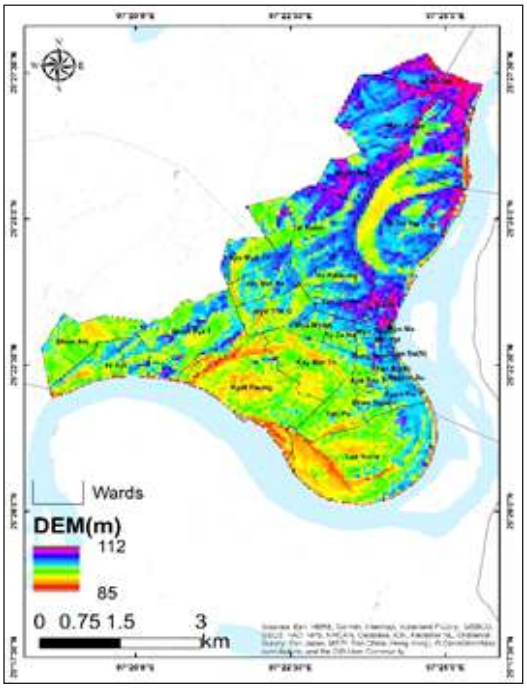

Fig. 1: Digital Elevation Model of Myintkyina City (TanDEM-X)

Fig. 2: Inundation Map of Myintkyina City

Agroecological Zoning for Avocado Production in Jalisco, Mexico

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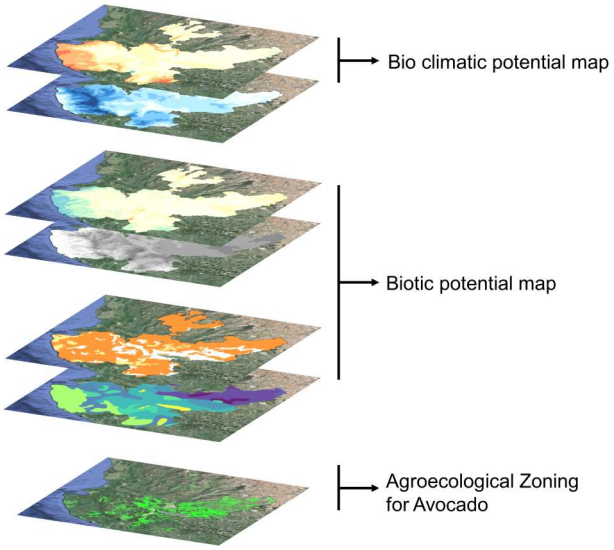
Scientist/Engineer- SG & Group Head

Mexico is the main producer of avocado in the world, according to data from the Mexican Secretary of Agriculture, its production in 2021 was more than 2.4 million tons. Due to the great world demand that exists for this fruit, it is estimated that 52% of the Mexican national avocado production is exported to various countries in the world. The opening of new International markets has brought with it a window of opportunity for Mexican producers and investors to begin expanding the production areas of this fruit.



The state of Jalisco is in western Mexico and is the second largest producer of avocado in the country. The opening has recently been opened for the avocado produced in this state to be exported to the United States of America.

The purpose of this study is to spatial database that shows the areas susceptible to the establishment of avocado orchards, and which in turn serves as a basis for the sustainable planning of agricultural areas and prioritizes the efficient use of natural resources in the state of Jalisco.

The methodology used in this project is based on the FAO Agroecological zoning framework, and for this FAO crop suitability analysis was carried out, which allows considering decision problems with multiple objectives and criteria, it was necessary to define the climatological and edaphological parameters that requires the avocado plant for its optimal development. The existing databases were organized, analyzed and managed, and put into a processed in the QGIS 3.16.15 software to automate the integration of bioclimatic inventories, soil resources and land use of the state of Jalisco.

As a result of the analysis, three outputs were generated: the first is a bio-climatological potential map, the second is a map of integrated biotic potential for avocado production, and the third is a map with the areas suitable for avocado production. As mentioned before, this GIS tool will help decision makers, investors and producers have the necessary information to be able to plan the sustainable production of avocado in the state of Jalisco and with this contribute to achieving the objectives of sustainable development.

LULC Change Assessment Using GIS and RS Application: A Case Study of Tashkent City, Tashkent Region, Uzbekistan (1990 - 2020)

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A B S T R A C T

A relevant issue in the field of GIS and RS is related to the analysis and characterization of changes in land use and land cover (LULC) in cities, which is very useful for a wide range of environmental applications and for the effective implementation of landscape planning and management policies. As the population of a given territory increases, the demand for land cover, such as an urban area, also increases, while other classes of soil cover, such as bare land, vegetation, decrease as a result of an increase in demand for an urban area. Consequently, these changes in most cases, if they are not constantly monitored, lead to certain negative consequences that can affect not only the environment, but also its inhabitants.

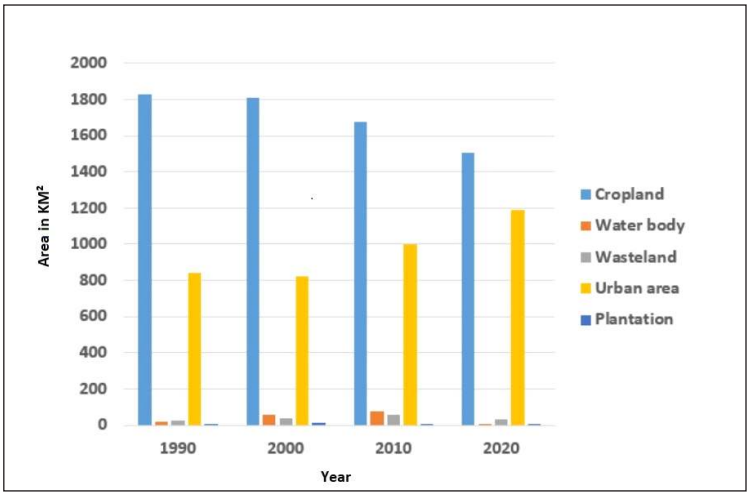

Fig.: Bar-diagram showing area of different classes

In this study an attempt is made to observe the changes in LULC features of Tashkent city, Tashkent Region, Uzbekistan. The comparison and analysis of land use/land cover based on Landsat TM satellite images in 1990, 2000, 2010 and 2020, determination of specific changes in Tashkent city in 1990-2020 and monitoring of its growth were carried out. First, Landsat images are classified for LULC mapping over a thirty-year period (1990-2020). Then, using a GIS approach, change detection and spatio-temporal analysis is integrated to characterize the dynamics of LULC with an emphasis on the gradient of the city. The results showed that urban expansion kept an even rate of increase, while substantial amount of cropland decreased and urban area use increased during the period. But there are almost no significant changes in the class of reservoirs, wastelands and plantation.

Keywords: LULC, Landsat, LULC change assessment and GIS

Analysis of Spatial and Temporal Variation of Air Pollution in Colombo Area (Before- During-Post Covid19)

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Supervisor
Mr. Prabhakar Alok Verma
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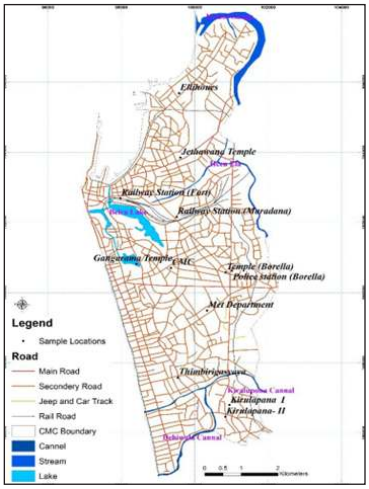
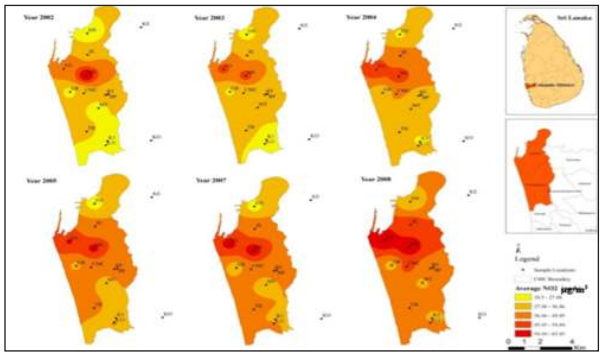
A B S T R A C T



The COVID-19 pandemic has caused many urban areas across the world to completely lock down. This has significantly reduced industrial activities which cause a considerable impact on the environment and has immensely altered human behavior, thus minimizing road traffic and air pollution. With urbanization and industrialization, Sri Lanka is also experiencing apparently high levels of air pollution. Local studies could reveal notable information on air pollution which would be crucial for future studies on air quality. The fundamental objective of this research study is to analyze spatial and temporal variation of air pollution in Colombo city area and to investigate relationship between air pollution and environmental parameters by comparing air pollution in the periods before, during and post COVID-19 scenarios. Moreover, thematic maps (interpolation techniques), moisture content / Temperature maps for before, during and post COVID-19 periods and the level of precipitation maps will be produced. Colombo, is the largest city on the west coast of the island, Sri Lanka and acts as its commercial capital city. Vehicle emissions contribute more than 60% of the ambient air pollution in Colombo, the capital of the country. Considering all these aspects, Colombo was selected as the study area for this research study. Data on air pollution parameters such as Particulate Matter (2.5 µm and 10 µm), Carbon monoxide (CO) concentration and Nitrogen dioxide (NO2) concentration before, during and post COVID-19 scenarios were obtained from National Building Research Organization (NBRO), while Meteorological Department of Sri Lanka facilitated to obtain data on meteorological parameters such as wind speed, temperature and humidity before, during and post COVID-19 periods. ArcGIS was used to identify the spatial distribution of air pollutants. Inverse Distance Weighted (IDW) technique of Spatial Analysis tool, Zonal Statistics Analysis tool were used in ArcGIS and Grid regression analysis tool in ArcMap was used for data analysis. As per the analyzed data, PM2.5 and CO reductions were most noticeable in Colombo area during COVID-19 pandemic, where vehicular traffic represents the major source of these air pollutants. The findings of this study suggest that air pollution is mainly concentrated in urban areas, mostly caused by vehicle emissions and industrial activities.



Developing OData Protocol Compliant Geo-spatial Dashboard Using Python

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A B S T R A C T

Today's world is fulfilling with data and it's created everywhere, every moment in vast amounts. This data contain 'what' instead of 'where', and the data is independent of geographic location. When this data describes any data related to or containing information about a specific location on the Earth's surface is called spatial data, or geospatial data. Just as there are many data sources, there are many possible clients: Web browsers, apps on mobile devices, business intelligence (BI) tools, and more. These varied sets of clients need commonly accepted methodologies to access these diverse data sources. The Open Data Protocol (OData) is one of the most common API software interfaces that uses RESTful protocol for accessing web services and connecting between geospatial servers and the client interfaces to provide the accessibility of information using various protocols.

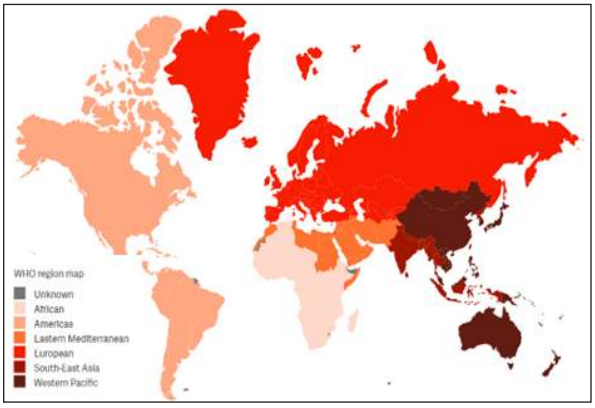

Fig. 1: WHO Member Countries

This study prove the concept that the OData ecosystem can be useful for a geospatial environment to provide real-time data synchronization in full stack development. This includes extensive literature review on the growing OData ecosystem such as Producers, Consumers, and Live Services, which can be integrated with Geospatial data, and the development of geospatial dashboards, including the integration of maps, spatial data analytics through Python programming libraries, and geographic visualization for decision support and real-time situation monitoring. Data from the health statistics database which was recently integrated with OData on World Health Organization-The Global Health Observatory was used for analysis.

Fig. 2: Dashboard

The outcome focused on present health statistics data related to road safety in a real-time updated dashboard. Visualization model developed using business intelligence application and validity of the model for decision support and real-time monitoring needs to be further researched, and recommend some future research directions.

Key words: OData, Spatial Data Analytics, Geospatial Dashboard, WHO, GHO

Surface Water Assessment using Cloud GIS (TAL: Tool for Assessment of Lake dynamics)

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About 21% of global freshwater reserves are stored in lakes or reservoirs. Based on studies by Pekel et al. (2016), the latitudinal variation between March 1984 and October 2015 shows that more than 50% of the permanently submerged earth's land surface lies in the northern hemisphere above 44°N latitude. Water resources planning and distribution for different sectors viz. irrigation, fisheries, domestic, industrial, recreational and other miscellaneous activities, is driven by the dynamics of inland freshwater. At the same time, increasing population, urbanization, climate variability and change, land use, and other watershed activities influencing surface runoff and groundwater pose a challenge in sustainably managing these open and most exploited surface water reserves. Freshwater scarcity (linked to UN-SDG 6) is one of the significant emerging/intensifying crisis of the 21st century and requires both quantitative and qualitative estimation of surface water dynamics. This study aims at realistic and accurate estimation of temporal dynamics of water stored in surface reservoirs using modern geospatial techniques (Tehri and Ramganga reservoirs are taken as case study).

Geospatial technology has long been used for various fields including mapping of water extent as well as estimation of water level. Traditional methods of water body monitoring are limited, mainly due to challenges in processing of large volume of remote sensing datasets to extract the temporal behavior of the water body. So, the tool is developed on Google Earth Engine platform. The freely available remote sensing data of optical and active microwave missions Sentinel-2, Landsat 8 & 9, Sentinel-1 is used. In case of optical data only cloudless imageries from 2017 to 2022 were chosen for processing.

The tool allows user to compute (a) traditional water extraction indices (NDWI and MNDWI), (b) manually select threshold from MNDWI based histogram, and (c) automatic extraction using three different methods. The extracted water surface area and daily water level (field recorded) data is computed to obtain the volumetric dynamics. This Tool for Assessment of Lake dynamics (TAL) would further be augmented by adding more flexibility to users by adding more automatic mapping algorithms, include water level data from altimetry, expanding it to other Indian states facing acute freshwater scarcity and for assessment of reservoir sedimentation analysis.

Keywords: surface water storage dynamics, automatic water extraction, GEE, MNDWI, UN-SDG 6

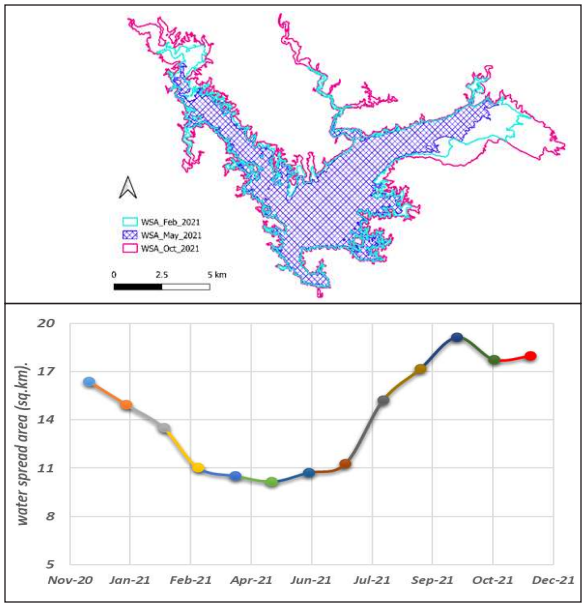

Fig.1: (a) Spatial and (b) temporal variation of surface water spread (12/2020 – 12/2021) for Ramganga reservoir

A B S T R A C T

Land Use and Land Cover Change Analysis Using Google Earth Engine in the Burchmulla Forest Basin, Uzbekistan

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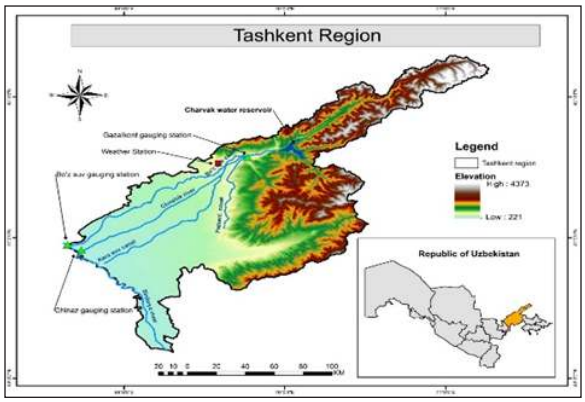
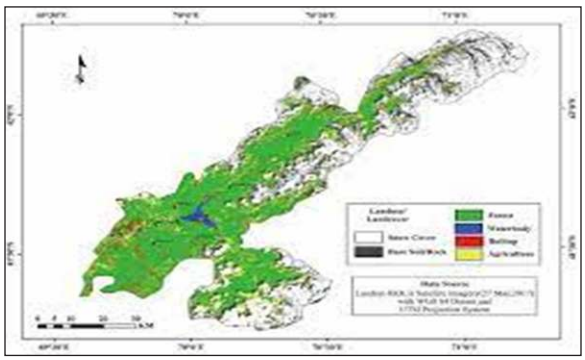
A B S T R A C T

Land use and land cover change analysis is a process aimed at identifying differences over time in land cover. Basically, multi temporal datasets are used to quantify changes in land cover. The main condition is that the land cover changes the radiation values and can therefore be detected remotely by optical sensors. Preparation of decadal (1990-2022) LULC maps for the Burchmulla forest basin in Tashkent region using GEE. Land use patterns and land cover are analyzed.

The proposed study is conducted on the GEE cloud platform using a supervised classification technique with Landsat data for the period 1990-2022. Research is conducted in May to September during the less rainy and less cloudy seasons. As a result, it is necessary to determine how much the area of the forest has increased or decreased over 30 years, and to determine the status of reduction or expansion of agriculture, settlements, water resources, pastures.

Prepare statistical data as a result of the analysis and develop measures to prevent deforestation.Basically using Landsat 8, Level 2, Collection 2, Tier 1, using GEE cloud platform for this research, Extraction of study area, and Supervised Classification using Machine Learning algorithm, Accuracy Assessment, LULC Maps, LULC Change analysis.





Keywords: Landsat, and Supervised Classification, Accuracy Assessment, LULC Maps, LULC Change analysis.

Spatio-temporal Variability of Water Quality Parameters in Parts of Ayeyarwaddy Delta Region Using Remote Sensing Data Over GEE Platform

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Inland and coastal water bodies are an essential part of the ecosystem and play a major role in its sustenance. A superior quality of water is vital to the economic, health, and social well-being of the people. Unfortunately, the increased anthropogenic activities have been degrading the quality of water. Furthermore, degraded water quality has negative impacts on aquatic ecosystems. Therefore, monitoring of water quality is undertaken for a range of reasons including protecting public health as well as aquatic ecosystems.

Fig. 1: Ground data collection for various location points

In recent decades, inland water quality mapping is being carried out using remote sensing based satellite data. The strength of using remote sensing for water quality analysis is its ability to capture synoptic data of a whole study area to produce continuous surface data often showing detail spatial and temporal variables in water quality.

Water quality indicators like chlorophyll (Chl-a), total suspended matter, turbidity and colored dissolved organic matter (CDOM) can be measured using remote sensing techniques. In the present attempt has been made to compute and map water quality parameters for Pathein River, which is a western branch of the Ayeyarwaddy River and also located parts of Ayeyarwaddy Delta region. In this project, we concentrated on two water quality parameters: turbidity and chlorophyll (Chl-a) and consequently highlighted the variation in river's water quality parameters in terms of spatio-temporal by using Surface Reflectance data from Sentinel-2 series over Google Earth Engine platform which is a comprehensive web portal that makes it easy to access both multi-temporal remote sensing big data and high-performance computing resources for processing these datasets. To analyze changes in water quality parameters, three different normalized indices such as Normalized difference water index (NDWI), Normalized difference turbidity Index (NDTI), and Normalized difference chlorophyll index (NDCI) were used. The validation process is carried out using the ground data of ten locations along the river.

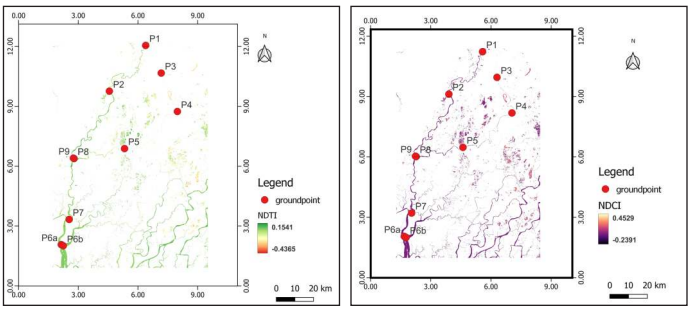

Fig. 2: Changes in water quality indices at various location points

Keywords: Water quality, Turbidity, Sentinel-2, NDWI, NDTI, NDCI

Application of Regression Kriging to Air pollutants in Delhi

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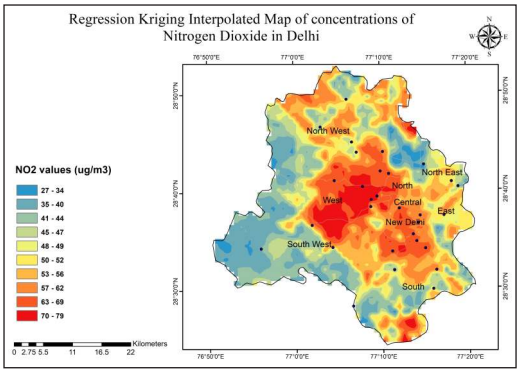
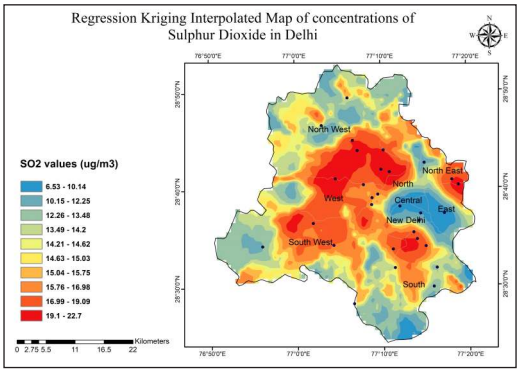
A B S T R A C T

Air pollution is one of the serious issues in present time. Air is getting contaminated by numerous economic and industrial activities which has adverse effects on environment, human health, and other living organisms. The situation is getting worse in developing countries. Because of large population and rapid development Delhi is also facing serious problems of air pollution. Organisations such as Central Pollution Control Board (CPCB), Delhi Pollution Control Committee have undertaken measures for monitoring pollution in Delhi.





Air quality studies are done with monitoring and modeling techniques. Air pollution measurements are taken at specific locations by the ground monitoring stations. There is also a need for pollutant information at other locations. This can be achieved by spatial interpolation techniques with which we can predict the concentrations at unsampled locations using observations from neighbouring sampling stations.

In this study, Regression kriging (RK) interpolation technique, a hybrid method that involves residuals of the multiple linear regression model with ordinary kriging is employed for the spatial distribution of regionalized variables nitrogen dioxide (NO2) and sulphur dioxide (SO2) concentrations in Delhi for October 2018. This ground truth data is collected from CPCB. For selecting the auxiliary variables various parameters such as relative humidity, air temperature, precipitation, wind, population density and distance from roads raster data sets of resolution <1km are considered and their correlation with auxiliary variables is studied using linear regression analysis. But because of very less availability of sampling points and their high spatial variability only wind speed and wind direction are integrated in this study. This technique is also compared with other deterministic and geostatistical techniques such as Inverse Distance Weighting (IDW), Local Polynomial Interpolation (LPI) and Ordinary Kriging (OK). All the results are compared, and accuracy is assessed using the cross-validation method and Root-Mean-Square-Error (RMSE). The RMSE results of SO2 show that regression kriging is better than other techniques and for NO2 though the RMSE value is higher than LPI, the spatial distribution of interpolated points is better in regression kriging.

Keywords: Regression Kriging, Geostatistical analysis, Inverse Distance Weighting, Local polynomial Interpolation, Ordinary Kriging.

Soil Erosion Risk Assessment in a Hilly Watershed using RS&GIS

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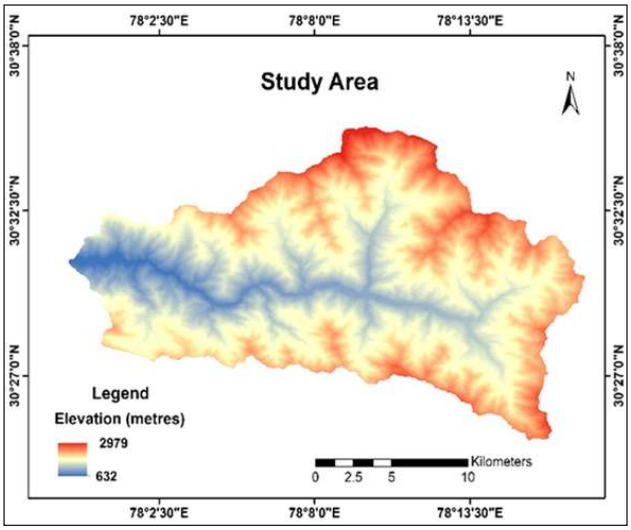
Soil erosion is a global environmental crisis in the world today that threatens natural environment and agriculture. Accelerated soil erosion has adverse economic and environmental impacts. Quantification of erosion under various land use /land cover helps to prioritize the watershed for soil conservation planning, in order to encourage effective natural resource conservation and sustainable development. This study is aimed at use of remote sensing and GIS for soil erosion risk assessment in a hilly watershed located in Tehri Garhwal District, Uttarakhand employing spatially distributed Revised Universal soil loss equation (RUSLE) model.



Spatial distribution of soil erosion risk was estimated by integrating various RUSLE factors (R, K, LS, C, P) in raster based GIS environment. Sentinel 2 Multispectral remote seining data along with SOI toposheet and field collected information was used for generation for land use/land cover map of the area. CartoDEM with 10m resolution has been used for preparation of topographic factor (slope). Physiographic soil map was prepared using the interpretation of land use/land cover, topographic information and field collected soil information. The various factor maps will be integrated in a GIS platform to predict the spatial distribution of soil erosion risk. The soil erosion map thus generated, can be used as tool for planning and implementation of various management and conservation practices

Keywords: Soil erosion, RUSLE model, Remote Sensing, GIS.

Rice Crop Cultural Types Mapping in Bangladesh using Synergistic SAR and Optical Data

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Bangladesh is an agro based country and more than 80% of rice is contribute to the country's economy. A timely record of agricultural areas and crop types is an essential requirement for ensuring global food security and allowing early crop monitoring practices through the use of remote sensing technology. This pilot project is aimed at use of multi date Sentinel-1 SAR (Synthetic Aperture Radar) and optical data for proposing an effective method of mapping during Kharif season in 2019 at Dacope upazilla, Khulna district which is coastal region of Bangladesh. Here, Sentinel-1 (SAR) time series was used that are strong for cloud cover, supplemented by Sentinel-2 optical images which capture the pigment based properties. SAR data cover large area in light and illumination as well as monitoring the lowland rice environment due to its sensitivity to crop geometry and flooded condition and. First, the temporal behavior of the Sentinel-1 SAR back scattering coeffients (σ◦) over agricultural plots was studied to determine the best metrics that identify and discriminate the rice plots.

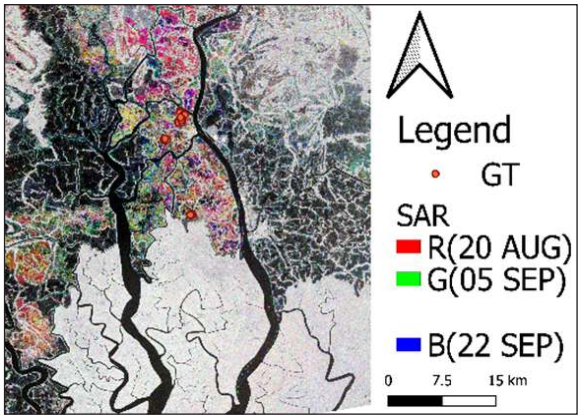

Fig. 1: Three dates composite of SAR Image (VV and VH polarization)

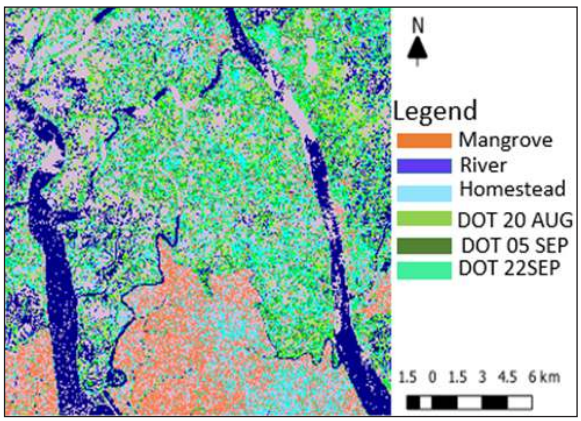

Fig. 2: Accuracy assessment of supervised classification

Five dates at about 15 days interval Sentinel-1 SAR data were download from Alaska Satellite Facility (ASF) for Kharif season from 12 July 2019 to 22 September, 2019. After preprocessing (Apply orbit file, Radiometric calibration, Speckle filtering, Terrain correction, Co-registration, Convert data to decibel (dB)) by SNAP software, generating temporal profile for the rice verses rice and other features were extructed with the help of QGIS LULC mapping. Attempt was made to discriminate rice fields by using the SAR data and a knowledge based decision tree classification by ENVI software. Mangrove, homestead rive, water log accuracy was more than 90% and all rice types' accuracy was more than 80%. But the overall accuracy was obtained 76.3%. After that vegetation indices (NDVI, RENDVI and LSWI) were generated from Sentinel 2 image with the help of google earth engine. These profile were compared with sentinel 1 profile as well as generation of rice cultural type signature.

Most high yielding variety was transplanted between 20th July to 20th August. Some local and Basmati rice transplanting date exceed up to end of September.

Assessment of Water Resources of the Ile River Basin Using the VIC Model

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The Ile River originates in the Central Tien-Shan on the territory of the People's Republic of China. Only 20-30% of the river basin lies in the territory of Kazakhstan. The Ile River is fed by rains, seasonal snow and glaciers melt, along with little groundwater contribution. The major part of the flow of the Ile River passes mainly in the spring-summer period (April-August). In a typical year, the month of July has an annual maximum flow in the Ile River. At present, the natural flow of the distribution of the Ile River is a result of economic activities in the region of the PRC.

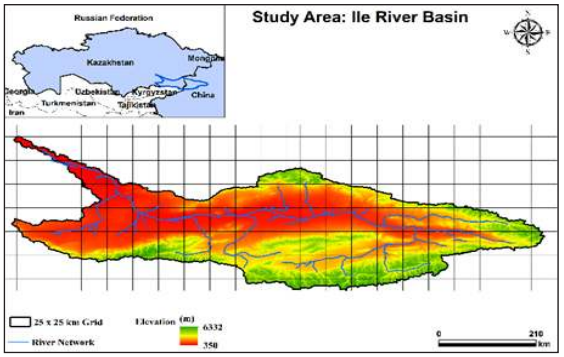

Fig. 1: Location of Study Area

A change in the flow of the Ile River due to water intake and regulation in the territory of the PRC has been noticed already in the 90s of the 20th century. During the same period, the glaciers of the region started melting at higher rate, the associated discharge in the river increased. The intensification of economic activity in the PRC and its impact on the natural flow of the Ile River became obvious. It caused water withdrawals and the intra-annual redistribution of the flow of the Ile River. The winter water discharges have become higher, and in summer, flow was 2-3 times lower than the norm. The summer decrease in the water content of the Ile River is especially significant in years of low water availability, such as 2008, 2012, and 2014. Due to the anthropogenic load on the water resources of the basin, a decrease in runoff during the growing season is observed, and in the winter months, it slightly increases. Therefore, in the present study, an attempt has been made to assess the water resources availability in the Ile River basin using the physically based semi-distributed hydrological model, i.e., Variable Infiltration Capacity Model. The model was setup using the following datasets: MERIT DEM, Copernicus Global Land Cover data, FAO HWSD, and ERA5 meteorological datasets. The entire river basin was discretized in 25 x 25 km grid for the modeling. The model was run for the period from 1980 – 2021 at daily time scale. The model outputs were calibrated with observed discharge at 04 gauging stations: port Dobyn, 164 km upstream from Kapshagai HPS, Kapshagai tract, 1 km below the branch of the Zhideli. The study may be very critical to understand the changes in hydrological behavior of the basin with time. The results of the study would be useful for the water resources planners of the region.

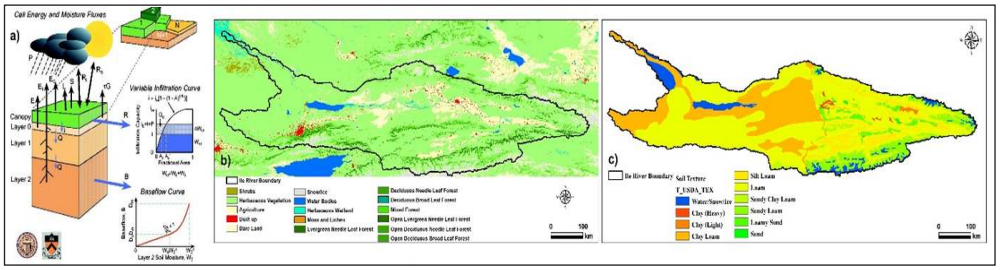

Fig. 2: a): Schematie of VIC Hydrological Model; b) LULC of the Ile River Basin (Source: Copernicus); e) Soil Texture of the Ile River Basin (Source : FAO)

Land Use Land Cover Dynamics and Prediction Modelling in "The Deforestation Arc" of the Amazonian rainforest, Brazil

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A B S T R A C T

Deforestation is the second major cause of CO_2 emissions contributing to approx. 12% of CO_2 emissions annually (IPCC, 2022). The Amazonian rainforest, the most extended forest worldwide, is one of the regions that are being massively affected by largescale deforestation. In this study, the forest cover depletion of the 'Arc of Deforestation' in the Amazon Rainforest was monitored over an area of 160199 km^2 in the state of Pará, Brazil. For this, temporal Landsat satellite images were collected (1990, 1996, 2000, 2005, 2011, 2015, and 2020), and the land use land cover of different periods were classified using random forest classifier in the Google Earth Engine platform. Post classification change detection method was used to analyse the land use land cover changes that occurred during the study period (1990-2020). It was followed by the prediction modelling. Subsequently, landscape fragmentation analysis was carried out using the 'Landscape Fragmentation Tool' in ArcMap. Different types of forest fragmentation categories were mapped for different time periods and the area statistics were generated.

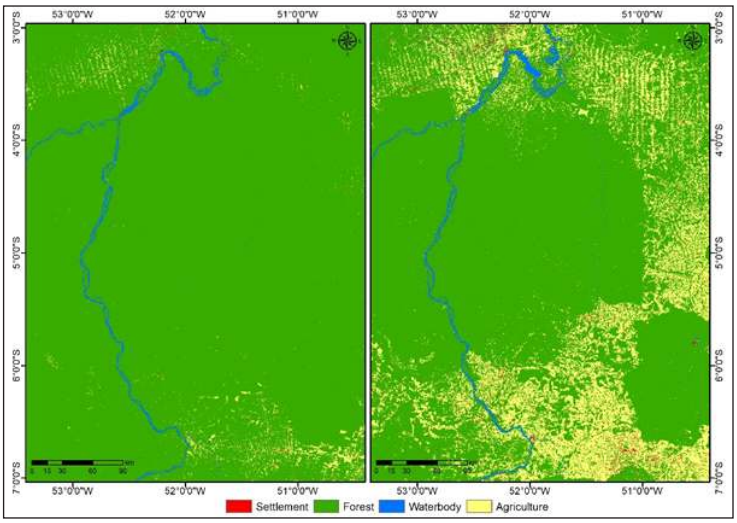

Fig. 1: Land Use and Land Cover Change between 1990 and 2020.

There was a continuous loss of forest cover during the study period from 156275.69 km^2 in 1990 to 129062.12 km^2 in 2020 which amount to approximately 17% loss of the forest areas. Land classes that expanded between 1990 and 2020 were pastures and urban areas at 17.5% and 0.5% respectively (Figure 1). The prominent forest fragmentation was the increase of perforated areas affecting mostly CORE-III areas, which are forested regions larger than 500 acres. If a similar trend continues, there will be a reduction of core areas of rainforest which could decrease the supply of goods and ecosystem services like the provision of water, fuel, wood, the capture and storage of carbon, and food for many people. This type of analysis could guide decision-makers to implement more sustainable strategies, policies, and actions that promote productive and development practices that could enhance the conservation of the natural resources in the region.

Keywords: Amazon Rainforest, Deforestation, Landscape fragmentation, Land use land cover change, random forest, Google Earth Engine

Assessing Phenological Dynamics of Grassland Ecosystem in Terai Arc Landscape (TAL), Nepal using RS and GIS

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Grassland constitutes one of the largest biomes of the earth. These ecosystems are primary source of the food for large groups of herbivores and further the food chain on it. Phenology of these grassland ecosystem is important to understand the functioning of the ecosystems and also the seasonal patterns of resource utilization by wildlife and linkages with impacts of environmental changes on these processes. With improved spatial, spectral and temporal resolutions the advanced RS satellites enables better understanding of these phenomenon in spatially explicit manner. Terai Arc Landscape (TAL) is selected for the study as it is important wildlife habitat and corridor across the Himalayan foothills. The high spatial resolution Sentinel-2 satellite data used for retrieval of land surface phenology (LSP) using vegetation indices and machine learning. Worldclim climatic data are used to understand the relation of climatic variables with phenological patterns across the landscape. Google Earth Engine (GEE) was used to generate phenological metrix in terms of the Start of the Season (SOS), Length of the Season (LoS) and End of the Season (EOS) for the year to 2021. Smoothing and threshold method in different vegetation indices like NDVI, EVI, NDPI, GCC on GEE. The result obtained contains the spatial phenological pattern of ecosystem and its relation with major environmental factors. The study revealed the spatial patterns of phenological metrix across the TAL landscape which will be useful in understanding the linkages of phenological events and further, for management of the landscape in context of seasonality of resource utilization by wildlife to minimize human-wildlife interaction.

Fig. 1: Extent of Study Area, Nepal (Source: Google

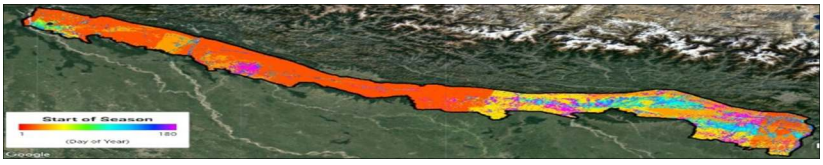


Fig. 2: Spatial Pattern of Start of the Season (SOS)

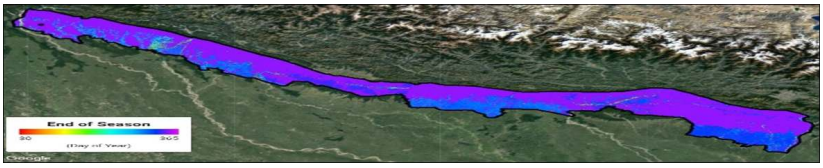
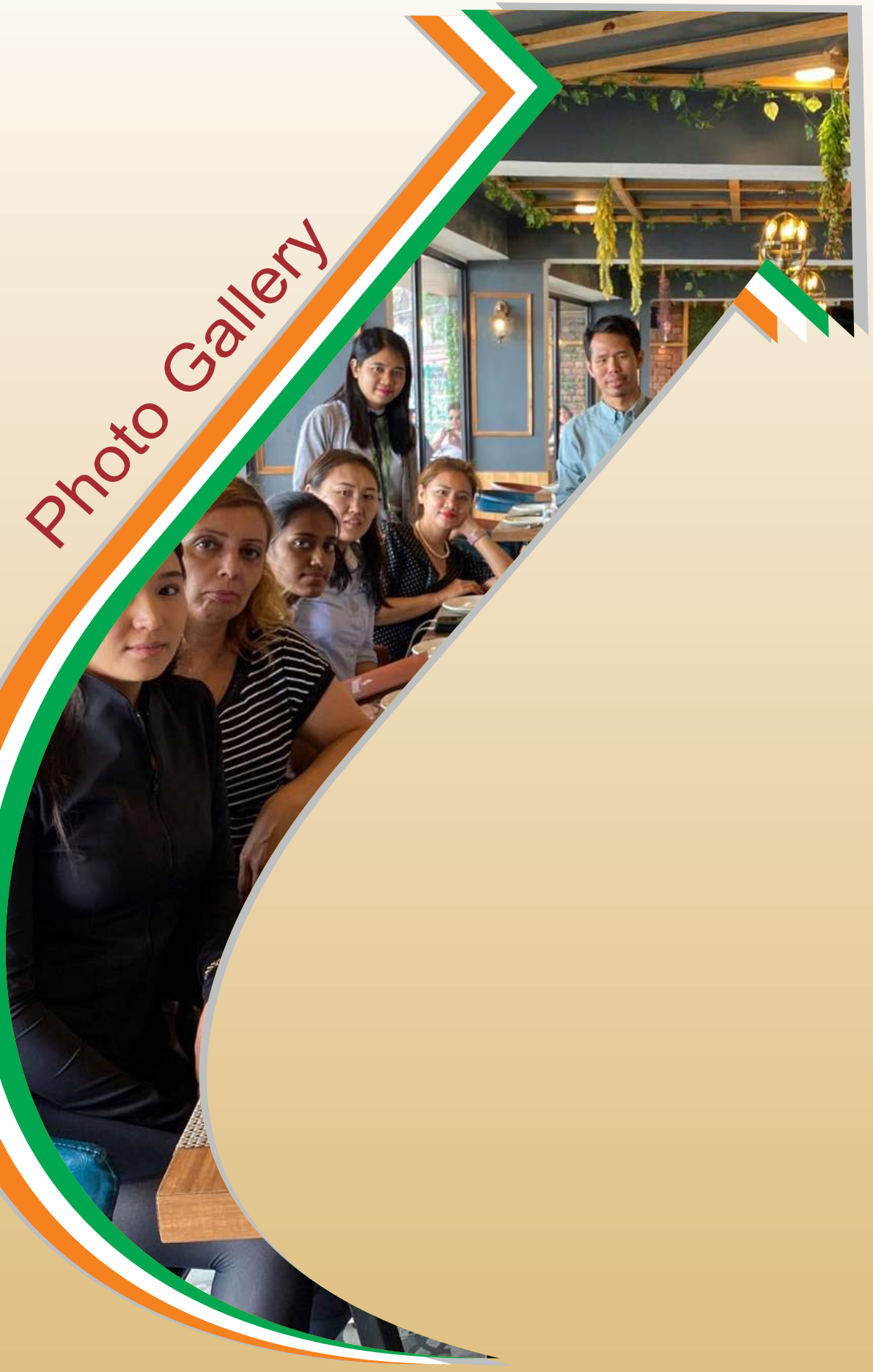


Fig. 3: Spatial patterns of End of the Season (EOS)

Keywords: Google Earth Engine; land surface phenology; Phenology; Sentinel-2; Vegetation Indices; Worldclim

Photo Gallery



1 - Participants at IIRS campus
2 - Participants visiting Robbers Cave
3 - Participants at Company Garden, Mussoorie
4&5 - Participants at IIRS campus

Clockwise from Top

6 – Participating in International Yoga Day Celebrations
7- Participants at IIRS Campus
8 - Participants at Library Chowk, Mussoorie
9 - Participants visit to Dalai Hills

Clockwise from Top

11 - Participants at CSSTEAP hostel
12 - Participants playing snooker
13 - Participants at FRI Campus
14 - Participants with English teacher
15 - Participants on way to Mussoorie
16 - Participants at IIRS Campus

Impressions of Participants

In Remembrance

Participants from 11 different countries went through deliberations and nominations to be a part of the prestigious 25th PG Diploma Course in RS & GIS, a program organized by CSSTEAP to train aspiring students in promoting social and economic development with the use of space-based data in geospatial information.

Asia and the Pacific region participants were trained and educated intensively to build a capability in the field of RS & GIS, and were introduced in other disciplines. As our batch had to undergo “online” classes because of the pandemic, it was a difficult adjustment yet made possible with the efforts made by the faculty, the staff, and the members of IIRS-ISRO.

Notable improvements were developed among the participants as they partake this course. From the technical to the social aspect. Being able to adjust in a class with multinational delegates with different field of expertise was an exciting and interesting experience.

Days went by, the pandemic subside and boarders opened. This allowed us to pursue our third and final module in India. The anticipation and the hope to explore the facility and the equipment in person were noticed among the participants. As we flew to India, one by one, after a quarantine period we finally had a chance to bond and know each other.

Encouragements and guidance from teachers, co-participants, advisors, friends, family, and lots of hard work made the 3-month Module Pilot Project a success. Going around the campus to every day in the sweltering heat was a challenge. Numerous trials, failed approach, and unexpected output drove us to work harder. Motivation to succeed built a determination among us to finish what we started.

Moments no matter how small, are memories that will be treasured forever. Our special night English class, which was a breath of fresh air, was our only time when we can be free from worrying about our projects. Weekend travels to a nearby tourist destination, allowed us to explore the culture and tradition of India. Late night study session in our hostel, with some snooker game once in a while. Knocks at our hostel room was always welcomed because usually standing outside would be our co-participants with delicious dish from their country. We consider ourselves brothers and sisters not by blood but by our passions.

Indeed victory comes from finding opportunities in problems. This course was postponed for a year because of the pandemic, nevertheless this batch was victorious in completing it in the midst of uncertainty.

Closing this journey was never easy, but we have to go back to our countries and share what was imparted to us. We would like to acknowledge the CSSTEAP IIRS-ISRO for their unwavering support all throughout our course, our respective departments and agencies for believing and allowing us to grow our career by nominating us. On behalf of the 25th RS&GIS Batch, Thank you!

Engr. Lady P. Smith

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