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

(AFFILIATED TO THE UNITED NATIONS)

MEMOIRS

Twenty Sixth Post Graduate Course in Remote Sensing & Geographic Information System 2022 - 2023

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 SIXTH POST GRADUATE COURSE IN REMOTE SENSING &
GEOGRAPHIC INFORMATION SYSTEM
SEPTEMBER 15, 2022 TO JUNE 15, 2023

Conducted at

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

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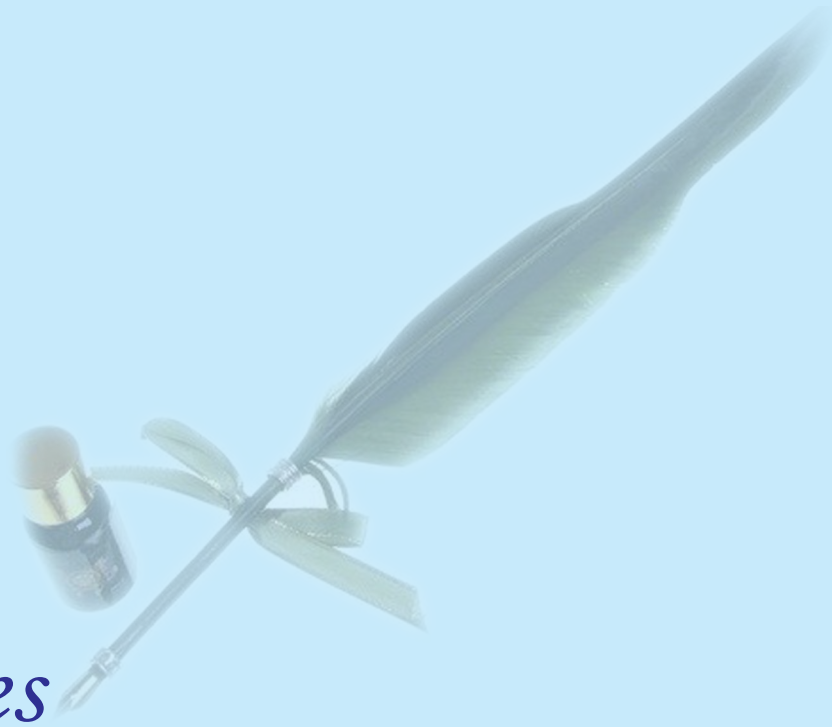

Messages

Governing Board Members and Special Invitees during 27th Governing Board Meeting
held on December 14, 2022

UNITED NATIONS
Office for Outer Space Affairs

Message

The United Nations Office for Outer Space Affairs (UNOOSA) warmly and sincerely congratulates all participants for completing the 26th Post-Graduate Course on Remote Sensing and Geographic Information System and the 13th SATCOM and Global Navigation Satellite Systems Courses.

The Office highly values the effort of the Centre for Space Science and Technology Education (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 UNOOSA.

I hope these post-graduate courses have provided you with the necessary knowledge and skills for the future steps ahead in your lives, and I encourage you to utilize the experiences from these training programmes in developing your pathway and contributing to the sustainable development efforts of your countries and regions.

Allow me to also extend my dearest gratitude to the CSSTEAP Leadership, course coordinators and the faculties of the Centre for making these programmes successful. I close this message by thanking the Chairman of the Indian Space Research Organisation (ISRO) for his continuous support of CSSTEAP.

Niklas Hedman
Acting Director
United Nations Office for Outer Space Affairs

Bringing the benefits of space to humanity

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Message

I am delighted to announce that the 26' Course on Remote Sensing and Geographic Information System (RS & GIS) organized by the United Nations Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) at the Indian Institute of Remote Sensing (IIRS) in Dehradun, India, has successfully concluded. I would like to extend my warmest congratulations to CSSTEAP, Dehradun for the successful completion of this course. Furthermore, I am extremely pleased to congratulate all the participants on their successful completion of the program. I firmly believe that the 15 participants representing seven different countries have greatly benefitted from this course.They will now be able to apply their enhanced knowledge of RS & GIS in their respective countries, particularly through undertaking projects tailored to address the specific needs of their nations.

I would also like to express my sincere gratitude to the Government of India and the Department of Space/Indian Space Research Organization for providing this valuable opportunity to participants from the Asia Pacific Region. I hope that the participants will also be able to utilize their acquired knowledge through this course to implement several activities for their countries and enhance the application of earth observation of technologies and geo-information science. I sincerely hope that the Government of India along with other pertinent organizations will continue their efforts to make similar valuable contributions in the future.

I wish the participants for all the success in their future endeavors, and look forward to seeing how they utilize their newly acquired knowledge and skills for the betterment of their countries. Finally, best wishes for the participants, Director, Resource persons, Scientists and Staff of IIRS, Dehradun, India.

15.5.23

Md. Azizur Rahman
Director

MONGOLIAN ACADEMY OF SCIENCE

Message

Dear Colleagues at CSSTEAP

I am happy to know that the IIRS, Dehradun is completing its 26th Batch of PG Course In Remote Sensing and Geographic Information System on 15th June, 2023 with a total of 15 participants from 7 countries, 13th SATCOM Course being conducted at SAC, Ahmedabad total of 14 participants from 5 countries, and 4th GNSS Course being conducted at SAC, Ahmedabad with total of 15 participants pursuing this course from 7 countries.

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

I hope that this post-graduate courses have provided the necessary knowledge and skills for the graduates and helped them to achieve their future careers and goals.

I would like to send my regards to the graduates that programs encouraged their research capability to utilize the experiences and knowledge's in developing their networks and contributes to the sustainable development efforts of their countries and wishing all success.

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

Sincerely yours,

B. Avid
Secretary General,
Mongolian academy of Sciences

भारत सरकार GOVERNMENT OF INDIA
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एन एम देसाई / N M Desai
विशिष्ट वैज्ञानिक / Distinguished Scientiest
निदेशक / Director

Message

I am happy to know that the 26th Post Graduate Course in Remote Sensing and Geographic Information System (GIS), conducted by the Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), during September 15, 2022 to June 15, 2023 at Indian Institute of Remote Sensing (IIRS), Dehradun has been completed successfully. It is interesting to note that participants from 7 countries, including Bangladesh, Kazakhstan, Mongolia, Myanmar, Nepal, Sri Lanka and India from the Asia Pacific region have been successfully trained under this unique initiative of ISRO. Since the inception of CSSTEAP, Space Applications Centre (SAC) has been the major knowledge partner, responsible for conducting various courses on SATMET, SATCOM and GNSS and has successfully imparted the relevant knowledge and practical exposure to the participants in the areas of space science, technologies and associated applications to more than 530 participants from various countries.

Space technologies have been advancing exponentially to gather geo-spatial data more accurately and affordably for Decision support. This is well supported by the data policy released recently by the Government of India to promote research. ISRO's recently launched Remote Sensing satellite, Oceansat-3, with payloads such as Ocean Colour Monitor (OCM-3) and Scatterometer, realized by SAC, is providing operational support to various National projects. The Geospatial tools and techniques developed by SAC such as Solar Calculator, Potential Fishing Zone (PFZ), Safe beach and upcoming Krishi-DSS are being disseminated through MOSDAC and VEDAS, the satellite data and products dissemination portals.

I congratulate all the participants for successfully completing the program. I am confident that the knowledge gained by the participants will benefit in their future assignments and will greatly contribute towards creating new and advanced applications and technologies in the areas of Remote Sensing & GIS for community at large.

I heartily congratulate the Faculties and the supporting staff who sincerely and diligently ensured the successful completion of the Course.

28/05/2023

एन एम देसाई / (N M Desai)
निदेशक / Director

भौतिक अनुसंधान प्रयोगशाला
(भारत सरकार, अन्तरिक्ष विभाग की यूनिट)
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डॉ. अनिल भारद्वाज, एफएनए, एफएएससी, एफएनएएससी
Dr. Anil Bhardwaj, FNA, FASc, FNASc
जे. सी. बोस नेशनल फेलो / J. C. Bose National Fello
विशिष्ट प्राध्यापक / Distinguished Professor
निदेशक / Director

Message

I am happy to note that the 26th PG Course on Remote Sensing (RS) and Geographic Information System (GIS) being conducted from September 15, 2022, at IIRS, Dehradun is scheduled to conclude on June 15, 2023, with the participation of 15 students from 7 countries.

The tools and techniques of Remote Sensing & Geographical Information System are increasingly being used in emerging countries for sustainable management of natural resources and for environmental protection. I hope that the participants will be able to contribute in the socio-economic development of their home countries by applying the knowledge and experience gained from this course.

I congratulate the faculty and staff of IIRS and CSSTEAP for the successful organization of this course and extend my warm wishes to all the participants in their future endeavours.

Date : May 22, 2023

ABhardwaj 22/5/2023

डॉ. अनिल भारद्वाज
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निदेशक / Director

E-mail: abhardwaj@prl.res.in / bhardwaj_SPL@yahoo.com Phone: +91-79-26314855/53 Fax: +91-79-26300374

CSSTEAP: A Brief

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

Dr. Prakash Chauhan
Director, CSSTEAP

Post Covid Pandemic CSSTEAP resumed its nine month Post Graduate (PG) on campus training programs from 2022 onwards. The Covid period was a learning experience for CSSTEAP to adapt its capacity building activities towards newer platforms and modes of communication to continue learning respecting social distancing. CSSTEAP undertook several initiatives to bridge the gap in capacity building by launching various new online short courses including the Massive Open Online Courses (MOOC). The long term courses were also successfully conducted in hybrid mode where the theory classes were delivered through online mode and as conditions improved the participants were brought to campus for the three months project work. The application of digital platform for enhancing outreach activities post pandemic has become more matured and has seen a significant rise in demand for online short courses. During 2022 about five short online course were conducted in which about 200 participants have got benefitted from 16 countries.

The year 2023 will mark an important milestone in the journey of CSSTEAP wherein one more centre of ISRO i.e. National Remote Sensing Centre (NRSC), Hyderabad will be joining the other ISRO centers towards imparting capacity building to CSSTEAP participants. National Remote Sensing Centre (NRSC), ISRO, is a centre of eminence providing remote sensing data acquisition, data processing and geospatial application services to meet the national goals and objectives. It has the mandate for establishment of ground stations for receiving satellite data, generation of data products, dissemination to the users, and development of techniques for remote sensing applications including disaster management support, geospatial services for good governance and capacity building for professionals, faculty and students. NRSC is in the forefront of using geospatial information technologies and is collaborating with its stakeholders for building a thriving innovation ecosystem in the Geospatial Technology arena. NRSC in the beginning will be offering two short courses in the field of data acquisition and data processing and with time depending on the demand and feedback from the participants may evolve into regular PG programs in future. These courses have been approved in the 27th Governing Board meeting held during 2022. The first two short courses on 'Remote Sensing Data Acquisition' will be conducted during August 21- September 01, 2023 whereas the short Course on 'Remote Sensing Data Processing' during October 09-20, 2023.

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, Global Navigation Satellite Systems (GNSS), Navigation and Satellite Positioning System and Small Satellite Missions using modern infrastructure, technology and training tools and practices. The Centre has announced two new short courses from 2023 on remote sensing data acquisition and processing which will be hosted by National Remote Sensing Centre, Hyderabad.

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 and National Remote Sensing Centre (NRSC), Hyderabad short courses on data acquisition and data processing. 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 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

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

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 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 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 192 participants from 17 countries have been awarded M. Tech. Degree in the 5 disciplines (85 participants in RS & GIS; 53 in SATCOM; 22 in SATMET; 27 participants in SAS and 05 in GNSS).

The Centre has taken initiative to facilitate its alumni to do higher studies leading to Ph.D degree and M. Sc. and Centre provides support in terms of expert faculty to guide the student for analyses and logistics (accommodation, research lab, library access, etc.).

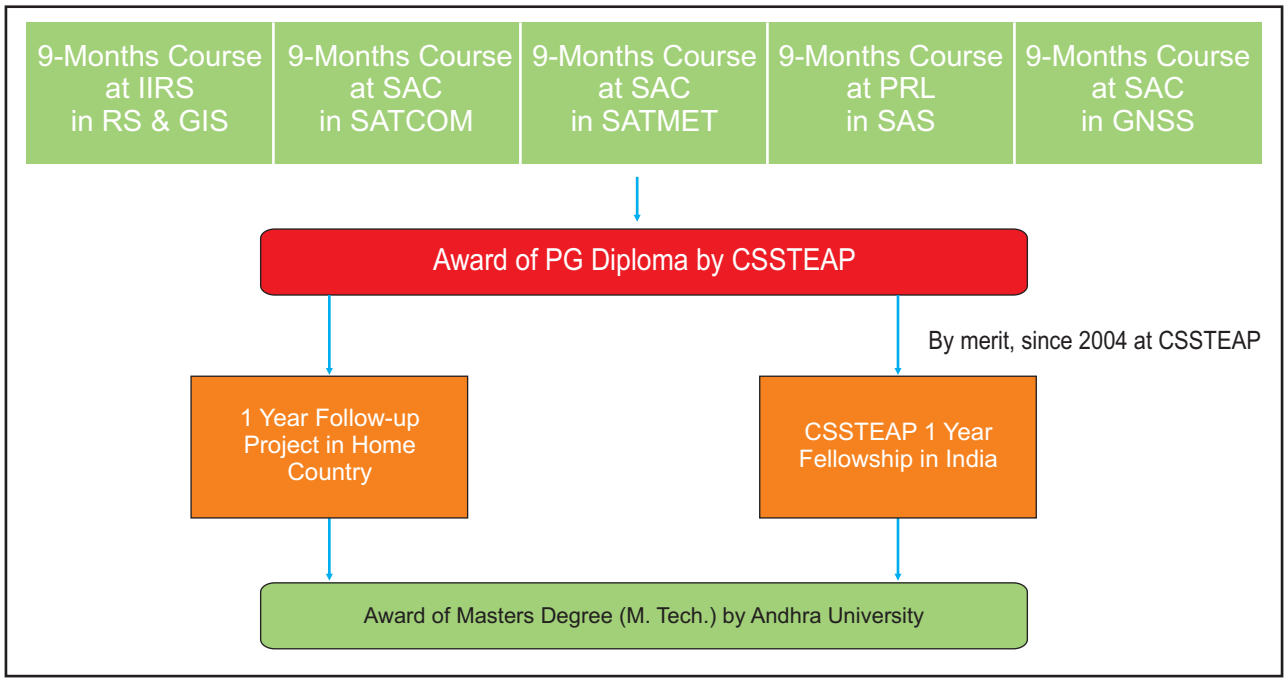


Fig. 1: Structure of PG diploma educational programmes at CSSTEAP

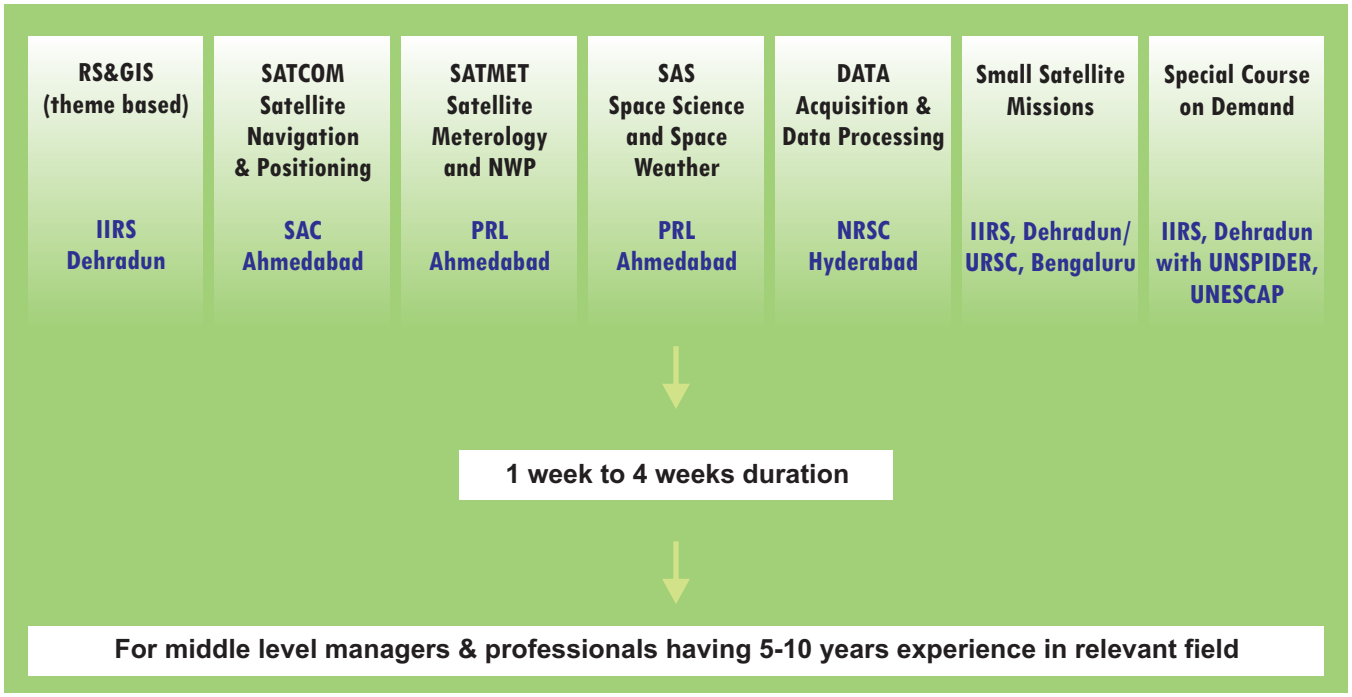


Fig. 2: Short-term training programmes at CSSTEAP

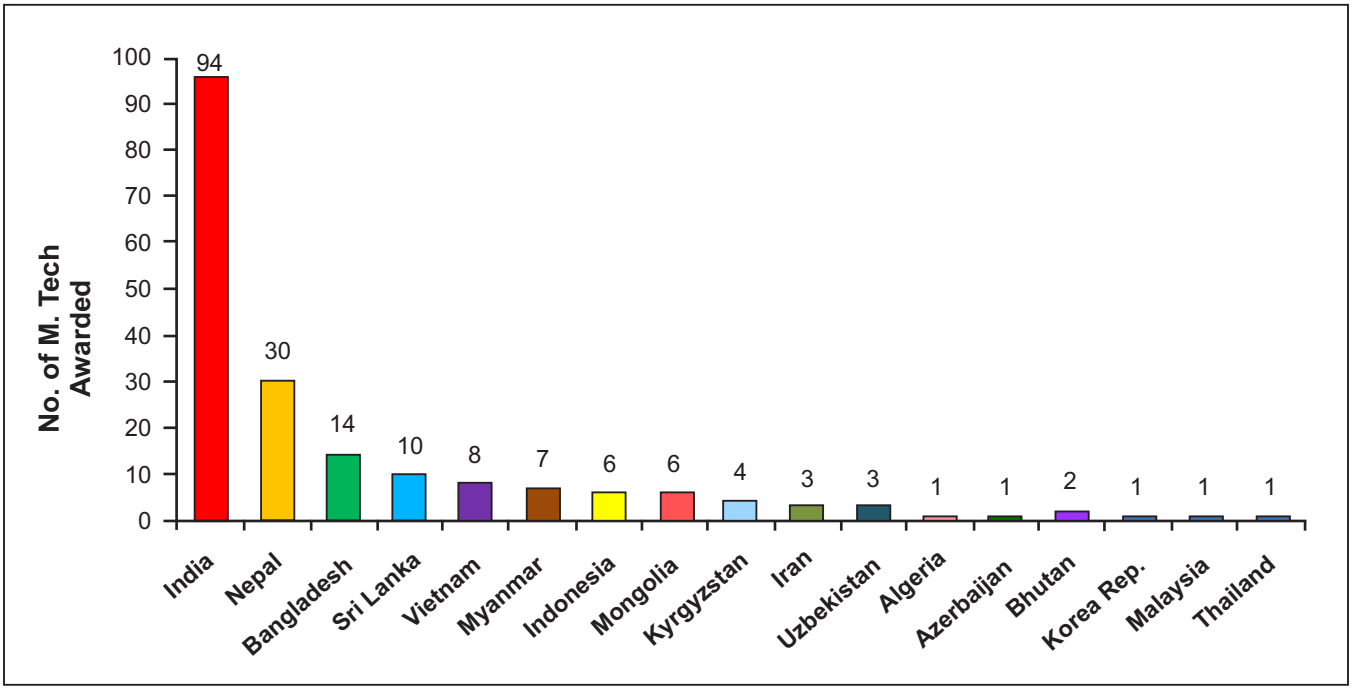
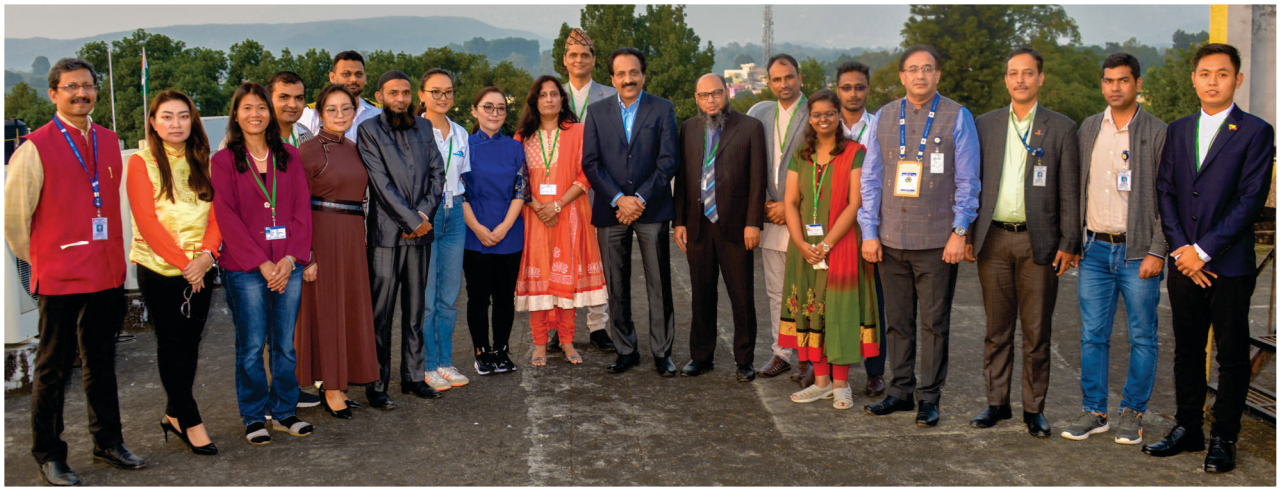


Fig. 3. Status of M. Tech. degree awarded

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 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. From the year 2022 the revised syllabus approved by the 12th Board of Studies (BOS) meeting of PG course in Remote Sensing & GIS of CSSTEAP was implemented for the present batch of 25th RS&GIS participants undergoing the course. During 12th BOS a new discipline i.e Natural hazards and Disaster Risk Management (NHDRM) was added from the year 2022.

The Post Graduate course is divided into two semesters (semester-I of four months and semester-II of five months which also includes three months pilot project work). Semester-I covers principles of remote sensing, photogrammetry, image interpretation and analysis, Geoinformatics, natural resource & environmental management. During Semester-II the course participants have to study two compulsory papers which advanced remote sensing and Geoinformatics focusing on topics like hyperspectral & microwave remote sensing principles and processing techniques, spatial database design, storage and retrieval, basics of programming language and data structures, Web GIS and open platforms for geoprocessing, AI/ML and Spatial Sampling and Variogram Modeling. In this semester apart from two compulsory papers the participants also have to opt for two elective papers based on his/her academic qualification, professional experience and requirement of his/her parent organization. The thematic optional streams in Elective-I cover (i) Agricultural & Soil Resource Management (ii) Forest Resource & Ecosystem Analysis, (iii) Urban & Regional Studies, (iv) Advances in Image Analysis & Geoinformatics for Elective-II covers (v) Satellite Hydrology & Water Resource Management (vi) Geological Remote Sensing, (vii) Marine and Atmospheric Remote Sensing and (viii) Natural hazards and Disaster Risk Management. At the end participants are required to work on a pilot project based on the learning and understanding acquired during the previous modules. After successful completion of PG Diploma participants fulfilling eligibility criteria of MTech set by Andhra University carry out a pilot project which to be carried out in their home country of the course participant.



RS&GIS course participants with Chairman, ISRO and Director CSSTEAP

Participants of 25th RS&GIS Course receiving PG Diploma

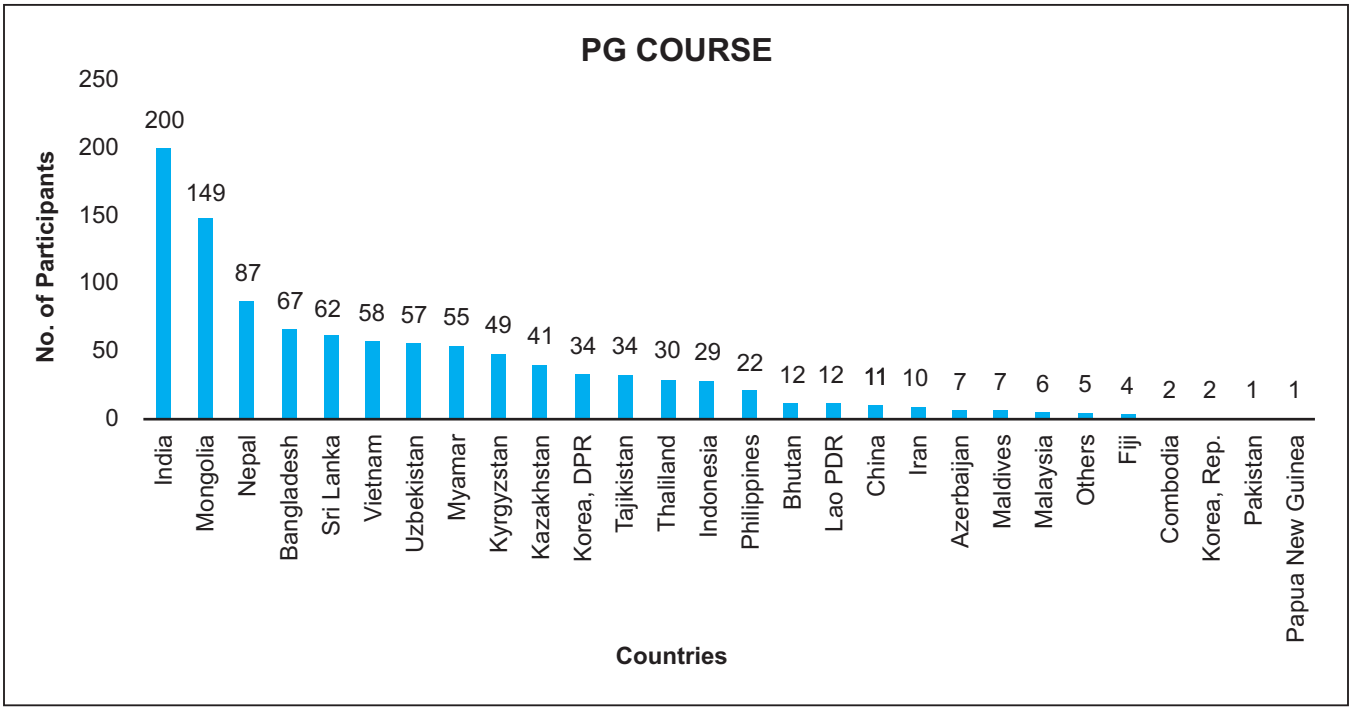
Achievements

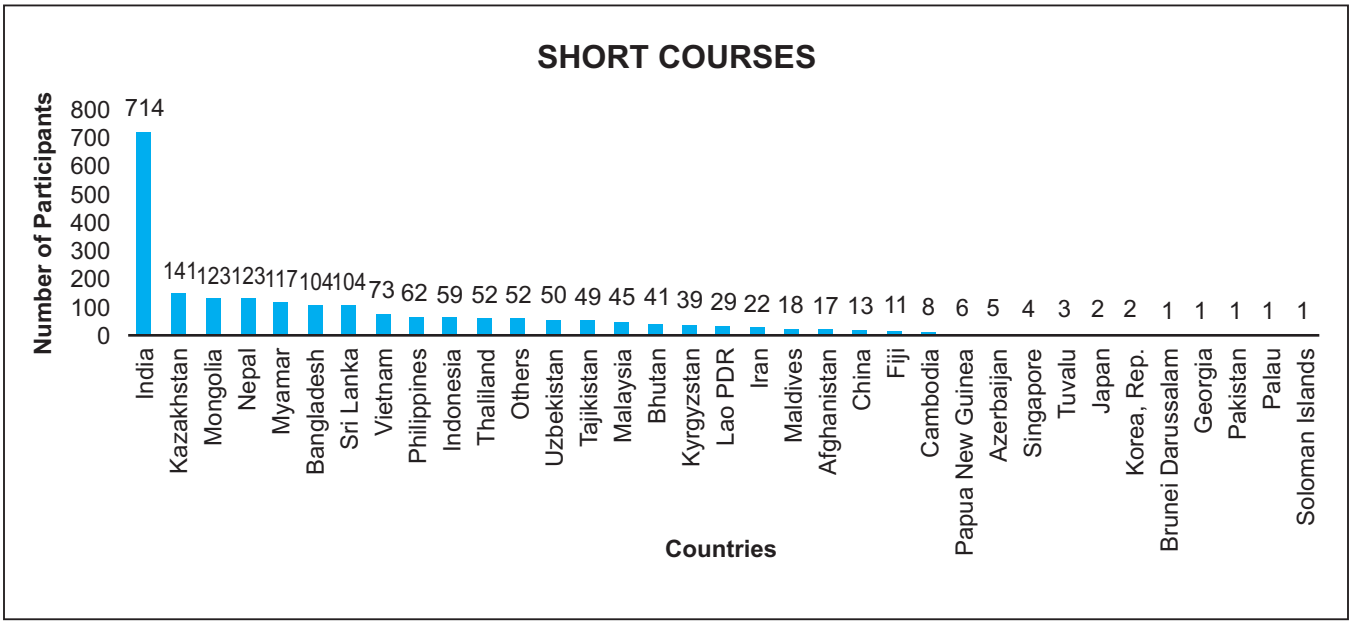
CSSTEAP has been actively conducting Post Graduate and Short Courses in various disciplines for the last 27 years. Till date the Centre has conducted 64 PG courses 25 in RS & GIS, 12 in SATCOM, 12 in SATMET, 12 in SAS and 03 in GNSS. The Centre has also conducted several short courses and workshops in past 27 years. These programmes have benefitted around 3149 participants from a total of 37 countries in the Asia-Pacific region. In addition to this, 57 participants from 24 countries outside Asia-Pacific regions have also been benefitted. PG Courses have benefitted 1054 participants while Short Courses have benefitted 2095 participants. During year 2022, the center has conducted 03 post graduate diploma courses, 05 online short courses, 04 offline short curses and 01 special course. The details of the courses conducted are mentioned below:

Online Short Courses -2022

- Online Short Training course on “Open Source GIS Technology & Geoweb service “during April 25 -May 26, 2022. (53 Participants from 8 countries)

- Online Short Training course on “Hyperspectral Remote Sensing and its Applications “during May 16 to June 03, 2022. (43 Participants from 09 countries)
- Online Short Training Course on “Techniques and Application of Synthetic Aperture Radar (SAR) Remote Sensing” during October 10-21, 2022. (36 participants from 16 countries).
- Online short course on Advances in Remote Sensing Data Analysis Techniques for Geological Applications with emphasis on Asia-Pacific Region to be organized during December 12-16, 2022.





Number of participants of PG and Short Courses conducted by CSSTEAP

- Online Short Course on "Space based innovative solutions to improve water resources management in Asia-Pacific region to be organized during December 12- 16, 2022.

Offline Short Courses -2022

- Short Training course on 11th Small Satellite Mission during November 07 - 18, 2022. (25 Participants selected from 12 countries)
- Short course on “Weather Forecasting using Numerical Weather Prediction models” during November 14 - 25, 2022. (24 participants from 09 countries)
- Short Training course on “Application of Space Technology for Disaster Risk Management with Emphasis on Floods and Landslides for Asia Pacific Region” during November 21 – December 02, 2022. (16 Participants selected from 10 countries)
- Short Training course on “Space Weather” during December 01-15, 2022. (21 Participants selected from 11 countries).

Special Courses

- Post Symposium Tutorial on “Space-based Data for Climate Monitoring and Climate Change Impact” as part of UN/Austria Symposium 2022 - Space for Climate Action Training on 19th September 2022 conducted with UNOOSA (73 participants from 18 countries)

MoU between CSSTEAP and GISTDA

An MoU between CSSTEAP and GISTDA, Thailand was signed during the virtual signing ceremony on August 03 2022 to enhance cooperation between the two institutes. A draft MoU between CSSTEAP and GISTDA was framed and subsequent to kind concurrence of CSSTEAP GB members, the MoU was formally signed during the virtual signing ceremony. Dr. Prakash Chauhan, Director, CSSTEAP and Dr. Pakorn Apaphant, Executive Director, GISTDA signed the MoU after the duly concurrence by the honourable GB members of CSSTEAP.

Officials Visits to CSSTEAP

- Mr. Burenbayar D. Chanrav, Minister Counsellor, Embassy of Mongolia at New Delhi visited CSSTEAP and IIRS on January 17, 2023 in connection with capacity building collaboration between CSSTEAP and Mongolia.
- Netherland Embassy Officials visited CSSTEAP on February 24, 2022 to explore common areas of interest that can be pursued in the field of research and capacity building.
- A delegation from Saudi Space Commission (national space agency of Saudi Arabia) visited CSSTEAP on March 07, 2023.

Alumni Meet in Philippines

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. An alumni meet was organized on 29th September 2022 at Manila which was attended by 13 Alumni along with DG PhilSA and Dy DG, PhilSA as special invited guest along with the Programme Coordinator, CSSTEAP. Director, CSSTEAP joined the meet through Video Conference.

Alumni meet Philippines

Participation in Technical Advisory Mission (TAM)

Preceding the Alumni on 29th September 2022, UNOOSA and PhilSA as part of TAM organized a one-day workshop on DRR and all the alumni were invited to the workshop where the advances of technology in disaster management and risk reduction were deliberated. CSSTEAP also showcased the activities of the center and the capacity building opportunities available for the Asia and the Pacific region

Participants in Technical Advisory Mission (TAM) by CSSTEAP

Youth Forum on the Innovative Use of Geospatial Information

CSSTEAP participated in the UNESCAP organized Youth Forum on the Innovative Use of Geospatial Information from 31 January – 1 February 2023 in Royal Park Rajapruek, Chiang Mai, Thailand. Four CSSTEAP participants participated in the youth forum and presented their research work which gave them chance to to report their innovative applications of geospatial information for urban, environment and climate, disaster, agriculture and air pollution monitoring.

CSSTEAP actively promotes international cooperation and regional networking in the Asia-Pacific region. It facilitates the exchange of scientific and technical information, organizes conferences and symposiums, and promotes collaborative research projects among member countries. These initiatives contribute to the development of a regional network of space professionals, strengthening cooperation and fostering a conducive environment for the peaceful use of space technologies.

Overall, CSSTEAP plays a vital role in fostering space science and technology education, capacity building, and regional cooperation in the Asia-Pacific region. Its activities and programs contribute to the sustainable development and peaceful use of space, promoting the application of space technologies for the benefit of society.

Capacity Building and Learning Opportunities at IIRS

Capacity Building and Learning Opportunities at IIRS

Dr. Raghavendra 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 endeavor 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 3198 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 characterization, 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.

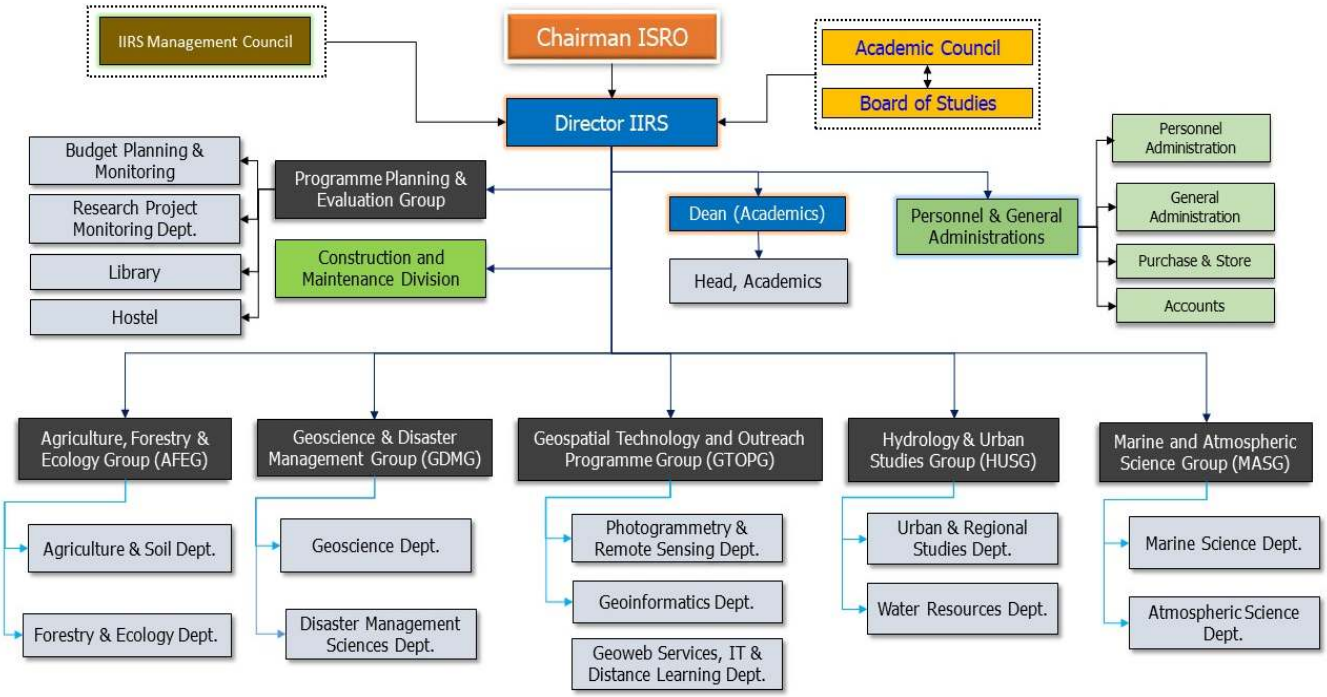
Objectives

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 dedicated scientists at IIRS contribute to delivering the course contents. Guest faculties from reputed organizations/ institutes in the country and abroad are regularly invited to share their knowledge and experience with the course participants. The training and education programmes conducted by the Institute include:

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

The institute also conducts various other courses, namely i) Certificate programmes (including NNRMS-ISRO sponsored programme for University faculty), ii) Awareness programmes, and iii) Special on-demand/tailor-made courses. The Institute has so far trained 14,039 till April 2023, professionals including 1410 from abroad representing 106 countries from the Asia, Africa and South America.

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

The 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 3149 participants from a total of 38 countries in the Asia-Pacific region. In addition to this, 61 participants from 24 countries* outside Asia-Pacific regions have also been benefitted. PG Courses have benefitted 1054 participants while Short Courses have benefitted 2095 participants.

Participant of Short Course on Application of Space Technology for Disaster Risk Management with Emphasis on Floods and Landslides for Asia Pacific Region with Director, IIRS

Participant of Small Satellite Mission (SSM) receiving certificate from Director, IIRS

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, behavioral 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 Organization (ISRO), is an initiative for training students and professionals from academia and user departments in the field of geospatial technology & Earth Observation. IIRS DLP started in the year 2007 with 312 participants from twelve universities in India. Till December 2022, IIRS has successfully conducted 130 outreach programmes through live and interactive classroom mode (also known as EDUSAT programme) benefitted more than 5.73 lakh participants from 3198 network Institutions distributed across the country. During last fourteen years, IIRS has successfully established a network of academic and professional Institutions in the country under this programme. The content of IIRS Distance Learning Program (DLP) focuses on teaching Basics topics along with technological advancement in the field of Remote Sensing, GIS, GNSS and its applications. The online sessions delivered under this programme are interactive and majority of such sessions/lectures of these courses are delivered by Subject Matter Experts (SME) from IIRS and also guest faculty from other ISRO centers. All the courses of IIRS DLP are made available through in-house developed Electronic Collaborative Learning and Knowledge Sharing System (E-CLASS) platform which enables various innovative learning tools to the participants such as attend the live sessions, post queries, download study material, attend offline sessions, appear for online examinations and download course certificate etc.

To enhance the outreach of geo-spatial science and technology, IIRS has also developed e-learning contents and Learning Management Systems (LMS) for different certificate courses in Remote Sensing and geo-spatial technology and its applications (http://elearning.iirs.gov.in). The e-learning courses are self-paced and learner centric courses. The syllabus of the courses 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 is conducting International Distance learning programme under “ISRO-IIRS Space Application Training (ISAT)” programme since 2020. A dedicated portal, Learning Management System (LMS) and E-CLASS International platform was developed and deployed for International users in the month of October 2020. A dedicated portal, Learning Management System (LMS) and E-CLASS International platform was developed and deployed for International users. A total of three courses were conducted through MOOC for International participants. The MOOC became very popular among the participants across the globe. Total 84000 participants from 115 countries have registered for this course in year 2022.

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 2022, around 21,000 participants were registered for the course through SWAYAM portal. The examination was conducted by National Testing Agency and the successful participants 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.	**MTech. in Remote Sensing & GIS (Affiliated with Andhra University)** Specializations in - Agriculture & Soils; Forest Resources & Ecosystem Analysis; Geosciences; Natural Hazards and Disaster Risk Management, Urban & Regional Studies; Marine & Atmospheric Sciences; Satellite Image Analysis & Photogrammetry; Water Resources; Geoinformatics	24 months	60
2.	**M.Sc. in Geo-Information Science & Earth Observation (Affiliated with ITC, University of Twente, The Netherlands)** Specialization in - Geoinformatics	22 months	10
3.	**Post-Graduate Diploma in Remote Sensing and GIS** 9 Specializations - Agriculture & Soils; Forest Resources & Ecosystem Analysis; Geosciences; Natural Hazards and Disaster Risk Management; Urban & Regional Studies; Marine and Atmospheric Sciences; Satellite Image Analysis & Photogrammetry; Water Resources and Spatial Data Science.	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 analyze the effectiveness of teaching methods, conduct of examinations and students' feedback of the courses.

IIRS Academia Meet (IAM) 2023

Course Report

26th Post Graduate Course on Remote Sensing & Geographic Information System (RS & GIS)

Inaugural of the course

The 26th PG Diploma RS&GIS batch was the first batch to start formally on campus after the Covid-19 pandemic. The previous 25th RS&GIS batch was conducted in a hybrid mode. Due to international travel restrictions the 26th RS & GIS formally started on September 15, 2022. The 26th RS&GIS batch had participation of fifteen participants from seven countries of Asia-Pacific Region (one participant from Sri Lanka and Kazakhstan, two participants each from Bangladesh, Myanmar, three each from Mongolia, Nepal and India). 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 was inaugurated in the presence of Director CSSTEAP, Dr. Prakash Chauhan, Director IIRS, Dr R.P. Singh, Dean (Academics) Dr. Pramod Kumar, Program Coordinator, CSSTEAP Dr. Ariit Roy along with the Group Heads, Heads, Course Director, Course Coordinator, faculty members and course participants.

RS&GIS course participants at classroom and lab

Semester 1: The course started with an induction programme giving and overview of the course, briefing about the CSSTEAP campus and various other facilities. From the 26th RS&GIS batch the syllabus was revised as per the recommendations of the 12th Board of Studies (BOS). Induction and orientation program was followed with commencement of Semester-I consisting of principles of remote sensing, photogrammetry, image interpretation and analysis, Geoinformatics, natural resource & environmental management. The first Semester-I laid emphasis on building the fundamentals. During Semester-II the course participants had to study two compulsory papers which included advanced remote sensing and Geoinformatics focusing on topics like hyperspectral & microwave remote sensing principles and processing techniques, spatial database design, storage and retrieval, basics of programming language and data structures, Web GIS and open platforms for geoprocessing, AI/ML and Spatial Sampling and Variogram Modeling.

Semester 2: In this Semester apart from two compulsory papers the participants also had to opt for two elective papers based on his/her academic qualification, professional experience and requirement of his/her parent organization. The thematic optional streams in Elective-I cover (i) Agricultural & Soil Resource Management (ii) Forest Resource & Ecosystem Analysis, (iii) Urban & Regional Studies, (iv) Advances in Image Analysis & Geoinformatics for Elective-II covers (v) Satellite Hydrology & Water Resource Management (vi) Geological Remote Sensing, (vii) Marine and Atmospheric Remote Sensing and (viii) Natural hazards and Disaster Risk Management. In the present batch for Elective-I, 9 participants opted for Advances in Image Analysis & Geoinformatics, 2 for Agricultural & Soil Resource Management and 3 for Forest Resource & Ecosystem

List of Participants

S.No.	Name	Elective-I	Elective-II	Country	Photograph
1.	Md. Rashedul Islam	Advances in Image Analysis & Geo Informatics	Natural hazards and Disaster Risk Management	Bangladesh 	
2.	Sahidull Hassan	Agricultural & Soil Resource Management	Natural hazards and Disaster Risk Management	Bangladesh 	
3.	Ms. Buddha Prayodhi Sree Sahiti	Advances in Image Analysis & Geo Informatics	Marine and Atmospheric Sciences	India 	
4.	Dr Priyanka	Forest Resource & Ecosystem Analysis	Natural hazards and Disaster Risk Management	India 	
5.	Cdr Saurabh	Advances in Image Analysis & Geo Informatics	Marine and Atmospheric Sciences	India 	
6.	Aigrem Sultbanabekova	Advances in Image Analysis & Geo Informatics	Water Resources	Kazakhstan 	
7.	Mendbayar Bataa	Natural hazards and Disaster Risk Management	Agriculture & Soil Science	Mongolia 	
8.	Delgertsetseg Renchinmyadag	Natural hazards and Disaster Risk Management	Agriculture & Soil Science	Mongolia 	
9.	Saranchimeg Batsukh	Advances in Image Analysis & Geo Informatics	Water Resource Management	Mongolia 	

S.No.	Name	Elective-I	Elective-II	Country	Photograph
10.	Aung Min Hein	Advances in Image Analysis & Geo Informatics	Water Resources	Myanmar 	
11.	Dr EI EI KHIN	Advanced Image Analysis and Geo Informatics	Natural Hazard and Disaster Risk Management	Myanmar 	
12.	Rajesh Sigdel	Geo Informatics	Water Resources	Nepal 	
13.	Sanjeeb Bhattarai	Forest Resources and Ecosystem Assessment	Natural Hazards and Disaster Risk Reduction	Nepal 	
14.	Shankar Tripathi	Forest Resource & Ecosystem Analysis	Natural hazards and Disaster Risk Management	Nepal 	
15.	Amila Madushan Manamperi	Geo Informatics	NHDRM	Sri Lanka 	

Analysis whereas in Elective-II, 9 participants opted for Natural hazards and Disaster Risk Management, 4 for Satellite Hydrology & Water Resource Management and 2 for Marine & Atmospheric Science. The participants were assessed through internal assessment followed by semester end assessment and practical examinations. The core components of course syllabus were covered by the faculty of IIRS and additional lectures by guest faculty on specialized topics were also arranged for the academic benefit of the course participants. The participants had several field excursions for ground truth collection and for interpretation and analysis of remote sensing satellite data. The participants were assessed through internal assessment followed by semester end assessment and practical examinations.

Pilot Project

Participants worked on a pilot project work approved by a panel of committee during pilot project synopsis presentation under the supervision of their supervisors. The topics varied from agricultural drought, desertification, soil carbon stock, modelling of litter mass, flood hazard, soil erosion, irrigation water requirement, ship detection, web GIS application, coastal landforms, characterization of forest structure and fuzzy machine learning.

RS&GIS Syllabus Overview

Semester-I (Module-1): Compulsory

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

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

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

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

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

Study Tour

Field Visits

Semester End Examination

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

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

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

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

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

Study Tour

Field Visits

Semester End Examination

Semester-II Module-3

Pilot Project Study & Seminar Presentation

The project topics undertaken by the participants were:

- Road Network and Accessibility Analysis of Lalmonirhat District of Bangladesh
- Agricultural drought monitoring by integrating remote sensing and meteorological indices over Bangladesh
- Monitoring and Mapping of Coastal Landforms using Pixel and Object based Techniques
- Characterization of seasonal changes in forest structure of dry and moist deciduous forests of Siwalik range, Uttarakhand, India using Multi-Sensor approach
- Ship Detection using SAR data in Arabian Sea
- Irrigation Water Management Using Remote Sensing Inputs in the Karaturuk region of the Big Almaty Canal, Kazakhstan
- Quantitative analysis of desertification using Remote Sensing and GIS: a case study of Mongolia
- Soil quality & Soil carbon stock estimation & mapping using Geospatial modelling approach - A case study of Mongolia
- Hydrological study of Kherlen river basin, Mongolian using geospatial inputs
- Flood Hazard Assessment using Multi-temporal Satellite Data: A Case Study on Chindwin River, Myanmar
- Study of fuzzy machine learning model for sugarcane ratoon crop harvesting mapping
- Estimation of runoff and sediment yield in Gandaki river basin, Nepal
- Spatio-temporal dynamics of ecosystem Services from coffee agroforestry ecosystems in Llano Bonito watershed, Costa Rica
- Modelling of litter mass of Barkot forest using satellite data
- Development of Web Based Geospatial Application using FOSS4G for Matara District of Sri Lanka

Educational Tour

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

RS&GIS course participants participating in ISRS-ISG Pre-Symposium Tutorials

were conducted in campus for the three months.

As part of the course curricula the participants were taken for study tour to Hyderabad and Vishakhapatnam during November 10-18, 2022. During first lap of the visit, the participants travelled to Hyderabad and visited National Remote Sensing Centre (NRSC) where the participants had an opportunity to see Integrated Multi-mission Ground Segment for Earth Observation Satellites (IMGEOS) facility and also witnessed real time acquisition of EO data at Shadnagar, Hyderabad. The participants were also shown State-of-art CalVal (Calibration/Validation) site at Shadnagar campus of NRSC. The participants were also shown the virtual reality facility and National Database for Emergency Management (NDEM) facility at NRSC, Shadnagar Campus. They also got a chance to do live Video Conferencing with the Scientists at Antarctica. At Hyderabad the participants also got an opportunity to attend the ISRS pre-Symposium Tutorial and attend the National Symposium on “Geospatial Technology: Journey from Data to Intelligence”. The pre-symposium tutorials covered contemporary technologies with hands-on lab sessions and demos during November 12-13, 2022 at NRSC Outreach Facility, Jeedimetla, on the topics, (i) Machine Learning and Deep Learning for Remote Sensing Applications, (ii) Microwave Remote Sensing: SAR applications with EOS-04 & (iii) Recent trends in UAVs for Remote Sensing Applications. During the second leg of visit the course participants were taken to Andhra University where they had an opportunity to meet and interact with Vice Chancellor of Andhra University. Screening of participants eligibility interested for doing MTech was also done by a committee of members form Andhra University. The participants during their travel also had an opportunity to visit cultural & natural landscape in Visakhapatnam, and Hyderabad and have an understanding of Indian culture, heritage and

RS&GIS course participants at NDEM Block Shadnagar, Hyderabad

Interaction with Distinguished Speakers

In addition to above the participants also had an opportunity to listen and interact with several renowned academicians and researchers. Prominent among them are Padma Vibhushan Dr. Kasturirangan, Hon. Distinguished Advisor, ISRO, Dr. George Joseph, Former Director, SAC (ISRO), Dr. S Somanath, Secretary Department of Space, Chairman ISRO, Dr. Prasad Srinivasa Thenkabail, Senior Scientist, USGS, Dr. P.S. Roy, Senior Fellow, Sustainable Landscapes and Restoration, WRI India and Former Director, IIRS and Dr. Andrew Joseph Kruczkiewicz, Senior Researcher, Columbia University, USA. The participants also had an opportunity to meet and interact with the Saudi Space Agency delegation during their visit to IIRS, Campus.

List of talks delivered by distinguished speakers to CSSTEAP partcipants

Speaker Name	Lecture Title	Photograph
Dr. K. Kasturirangan (Padma Vibhushan) Hon. Distinguished Advisor, ISRO	Evolution of Space Program in India	
Dr. George Joseph Former Director SAC (ISRO) and Director, CSSTEAP	Science and Technology of Earth Observation Camera	
Dr. Prasad Srinivasa Thenkabail Senior Scientist, USGS	A Paradigm-shift in Planet-Scale Global Agricultural Cropland Mapping using Big-Data Analytics, Machine Learning, and Cloud-Computing	
Dr. P.S. Roy Senior Fellow, Sustainable Landscapes and Restoration, WRI India and Former Director, IIRS & Director, CSSTEAP	Why we need to study vegetation phenology - science and research perspectives?	
Dr. Andrew Joseph Kruczkiewicz Senior Researcher, Columbia University, USA	Integrating Earth Observations for Humanitarian and Disaster Management and Decision Making	

RS&GIS course participants with former Director, IIRS and Director CSSTEAP Dr. P.S.Roy

Participants during their stay had access to the state of art library to access journals, books and other literature related to their subjects and interest. They were also provided accommodation in international hostel having kitchenette and wifi access in their rooms. For recreation participants had indoor sporting facilities like gymnasium, TT table and snooker board apart from outdoor sporting. During their stay at campus and educational tour participants got to learn, understand and celebrate Indian traditions, customs and dishes.

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

RS&GIS course participants at International Hostel

List of Faculty

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

Name	Topics	Photograph
Mrs. Minakshi Kumar	• Digital Image Analysis • Image Preprocessing and Enhancement techniques • Texture analysis • Image segmentation • Object Based Image Analysis	
Dr. Arijit Roy	• Sampling techniques in forest inventory • Predictive modeling • Decision support systems • Climate change impacts on forests and biodiversity • Forest fire monitoring and early warning	
Dr. Sandeep Maithani	• Urban planning, Machine learning & CA in urban growth modelling • Urban hazard & risk assessment • Urban land surface temperature studies	
Dr. 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	
Dr. Praveen K. Thakur	• Quantification of hydrological elements: Precipitation, WL/River Flow • Snow and glacier mapping and melt modelling • Flood and GLOF modelling; Flood early warning system	
Dr. Yogesh Kant	• EO systems for climate change studies • RS application for air quality monitoring • Satellite based aerosol studies	
Dr. Vandita Srivastav	• Geoinformatics • Image processing and Analysis • Information Extraction • Geoinformation Management	

Name	Topics	Photograph
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. (Mrs.) Poonam S. Tiwari	• Digital and close range photogrammetry • Lidar Remote Sensing • Image Processing, Machine Learning, Deep Learning • Geospatial technologies for Archeological studies	
Dr. Ashutosh Bhardwaj	• Stereo photographs and its geometry • Stereo photogrammetry • Introduction to digital surface generation • Advances techniques in SAR interferometry	
Dr. (Mrs.) Hina Pande	• Lidar Remote Sensing & Application • Photogrammetry & Application • Image processing application in automated feature extraction • Heritage documentation with geospatial methods	
Dr. Kshama Gupta	• Image Interpretation of Urban Areas • 3D Modeling Techniques for urban Surface profiling • DEM/DSM Generation for Urban Areas, Modeling and Visualization • Geospatial Technologies for Urban Heritage and Conservation • Urban Open Spaces and Green Spaces, Blue-green infrastructure • Urban Climate : Factors Affecting Urban Climate, Impact of Urban Surfaces, Diseases and Human Health • Urban Climate modeling, Urban canopy parameters, Heat wave	
Dr. (Mrs) Dipanwita Haldar	• Land use / Land cover (LULC) Analysis • Crop Inventory and mapping/discrimination • Optical and Microwave Remote Sensing • Physico-chemical factors of soil and pedogenic factors	
Dr. Bhaskar R. Nikam	• Quantification of hydrological elements: Evapotranspiration • 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	
Dr. Subtrata Nandy	• High resolution remote sensing for vegetation mapping • Growing stock, biomass estimation using optical data • LiDAR applications is forest inventory • Multi-criteria decision making for ecological applications • Wildlife habitat suitability analysis and protected areas	

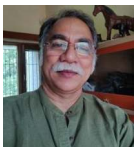
Name	Topics	Photograph
Dr. Vaibhav Garg	• Hydrological modeling using GWS portal inputs • Water body and water quality mapping • Reservoir sedimentation • Urban hydrology: storm drainage networks	
Dr. (Mrs.) Shuchita Srivastava	• Retrieval of temperature, trace gases & ozone • Gaseous air pollutants - chemistry, transport & monitoring • Green house gases & their implication	
Dr. Shovan Lal Chattoraj	• Spectroscopy of rocks and minerals • RS applications in Engineering Geology and Landslides	
Mr. Dharmendra Kumar	• Database and webserver handling for Geo Applications • Cyber security Analysis of Network systems • Aerial data Analysis.	
Mr. Ashutosh K Jha	• Agent based modelling, database connectivity, spatial variation models, dependence measures, Geo-visualization, LULU Modeling HPC computation	
Dr. Charu Singh	• Rainfall retrieval, monsoon studies, Extreme events • Tropical dynamics ENSO etc • Regional & Climate Modeling, Climate dynamics	
Dr. Shashi Kumar	• Principles of thermal and microwave remote sensing • Polarimetric SAR Remote Sensing • SAR interferometry	
Dr. Manu Mehta	• Physics of remote sensing • Spectral signature, In-situ measurements and visual image interpretation • Radiometric and atmospheric corrections for Remote Sensing data	
Mr. Ravi Bhandari	• Programming for geospatial applications	

Name	Topics	Photograph
Mr. Prasun Kumar Gupta	• h/w, s/w requirements for GIS, database design using UML, attribute & positional uncertainty, basic programing concepts, web programing	
Mr. Vinay Kumar	• Hyperspectral Remote Sensing and data processing • Platforms & sensors, Resolution • Satellite mission & their characteristics	
Mr. Ashish Joshi	• Principles of Microwave Remote Sensing • SAR Interferometry • Terrain Analysis. • Statistics for Image Processing	
Dr. Ashutosh Srivastava	• GNSS and its applications	
Mr. Kamal Pandey	• Strings, tuples, dictionaries, GDAL, open source GIS s/w, server side scripting, web mapping using open layers	
Mr. Hari Shankar	• Network analysis, spatial data quality • Spatial variation models & dependence measures • SAR interferometry for land deformation	
Dr. Arpit Chouksey	• Quantification of hydrological elements: interception and Soil Moisture • Water Balance studies • Integrated watershed management • Waterlogging and Soil Salinity • Trend analysis of hydro-meteorological data	
Mr. K. Shiva Reddy	• GIS data models, conceptual model of spatial information • Internet technology & WebGIS, Web GIS services	
Dr. Pratima Pandey	• Glaciology, climate change impact on cryorphve • Landform dynamics • Permafrost	

Name	Topics	Photograph
Mrs. Richa Sharma	• Spectroscopy of minerals, hyperspectral RS mineral exploration • RS for geology, DIP	
Ms. Pooja Jindal	• Meteorological satellites & sensors • Atmospheric sounding • Retrieval of winds • Fog detection using satellite data	
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	
Mr. Pankaj R. Dhote	• Hydrograph analysis • Streamflow measurement • Watershed morphological analysis • Groundwater modelling • Basics of flood hydrology flood peak estimation and routing • Flood mapping, monitoring and modeling	
Dr. Suresh Kannuajiya	• Geodynamics and Seismicity of Himalaya • Active fault imaging in the Foothills of Himalaya • Basics of GNSS satellite and Advanced GPS data processing • Basics GRACE/GRACE-FO satellites and applications in hydrology and other applications • Geophysical Prospecting: • High-Resolution EO data study in the various geological applications	
Mr. Justin George	• Land degradation and watershed management • Fundamentals of soils & pedogenesis • Hyperspectral RS in degradation mapping / Soil spectral / Characteristics	
Dr. Sanjeev Kumar Singh	• Numerical modelling of tropical cyclone • Numerical Weather Prediction • Satellite data assimilation in NWP model	
Mr. Prabhakar Alok Verma	• Geoinformatics • Geostatistics	

Name	Topics	Photograph
Dr. Ishwari Datt Rai	• Phenology for vegetation differentiation • Biodiversity characterisation & conservation priontization • Forest ecosystem structural and functional analysis • Definitions and concepts of Landscape ecology • Forest ecosystem and climate linkages	
Dr. Taibanganba Watham	• Forest inventory concept & Scope • Statistical treatment of forestry inventory data • Wetland habitat monitoring and conservation planning • Forest fire risk zonation and danger rating • Forest productivity estimation and carbon flux monitoring • Fire ecology, Eo-based active fire detection and monitoring , burnt area mapping and recovery assessment	
Mr. Abhishek Danodia	• Agriculture Informatics, • Remote sensing for Agricultural Drought & Water management • Fundamentals & importance to agrometerology • ICT applications in agriculture, Basic of DBMS, SDSS	
Dr. Mamta Chauhan	• Physical and dynamical oceanography • Numerical ocean modeling • Ocean biogeochemistry	
Mr. Yateesh Ketholia	• Geomorphology & geomorphic processes • Hydrocarbon resources & mode of occurrences • Landslides & earthquakes	
Dr. Surendra Kumar Sharma	• Machine Learning for urban studies	
Mr. Ashish Bisht	• Cloud based computing platforms, Mobile and Web Applications	
Mrs. Jappji Mehar	• Lunar geology, Microwave remote sensing	

Guest Faculty

Dr. Ruchi Badola	Assessment and valuation of ecosystem services-global best practices	Scientist - G & Registrar Wildlife Institute of India	
Prof Qaman Qureshi	Biodiversity assessment at the landscape and species level and studying habitat use patterns using RS and GIS	Wildlife Institute of India	
Dr. A.K. Mishra	Remote Sensing for Coastal Bathymetry, Ocean Dynamics	Ex. Scientist IIRS	
Dr. H. Shiva Kumar	Tsunami Early Warning Services & Operational Tsunami Forecast	Project Scientist – II INCOIS, MoES	
Dr. Siva Srinivas	Numeric Modelling of Tsunami	Project Scientist – II INCOIS, MoES	

Students at INS Kursura Submarine Museum at R K Beach, Visakhapatnam

Pilot Projects of Students

Road Network and Accessibility Analysis of Lalmonirhat District of Bangladesh

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Co-supervisor
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A B S T R A C T

Survey of Bangladesh is the national map-making organization under the Ministry of Defense. Established in 1767, it is the only authority for making maps for defense activities. It also supplies DEM, contours, guide maps, and other maps as per customer requests.

In this pilot project, road data of 1:125,000 scale of survey of Bangladesh for Lalmonirhat district is downscaled to 1:50,000 scale. Downscaling process involved correcting existing road lines as well as adding new lines in the database. Digitization is done using QGIS and google imagery in the background with help of Quickmapservices plugin. Roads are categorized in highway and other way categories. Road connectivity analysis using Euclidean Distance is a way of measuring the proximity of two points on a map. Euclidean distance measures the straight-line distance between two points, and is the most commonly used metric when analyzing road connectivity. Euclidean Distance is useful to measure the disconnection of two points due to physical, economic, or demographic factors such as barriers to access. Euclidean distance of highways (figure 2) and non-highways (figure 1) is calculated from Government offices as well as villages. Min, max& average distance of villages from other roads is found as 0.86 m, 162 m, 1101 m however these distances from highways are found as 43 m, 12017 m, 3586 m respectively. Min, max& average distance of various govt. offices from other roads is found as 0.09 m, 319 m, 139 however these distances from highways are found as 157 m, 29519 m, 12908 m. It can be concluded that some of the villages as well as offices are not well connected to the road and highways. There are 56, 40, 40 government offices in the distance range of meter 0-10000, 10001-20000, > 20001 respectively from highway,33, 77, 26 government offices in the distance range of meter 0-100, 101-200, > 201 respectively from other way, 39, 30, 85villages in the distance range of meter 0-1000, 1001-2000, > 2001 respectively from highway, 65, 49, 40 villages in the distance range of meter 0-100, 101-200, > 201 respectively from other way.

Keywords: Network Analysis, GIS, Bangladesh, Euclidean distance

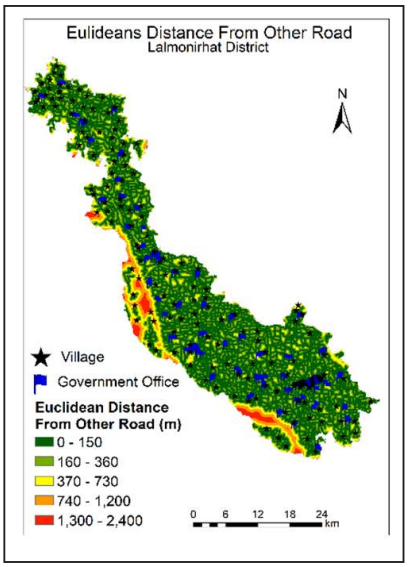

Fig 1: Distance from other roads

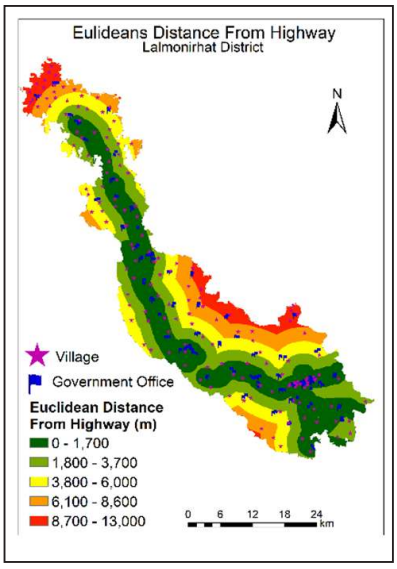

Fig 2: Distance from highway

Agricultural drought monitoring by integrating remote sensing and meteorological indices over Bangladesh

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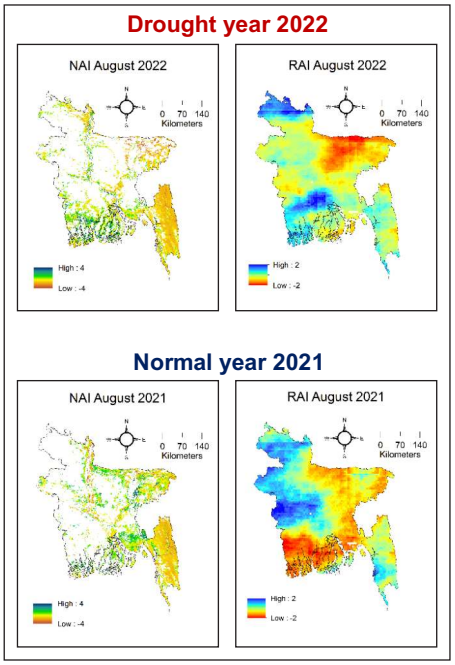
Drought is a prolonged dry period in the natural climate cycle in Bangladesh. It is a slow-onset disaster allows time to observe lack of precipitation resulting in a water shortage. Changes in precipitation nature, temperature and the overall status of surface water. Drought is an intricate atmospheric phenomenon with the greatest impacts are significant and widespread, affecting on food security, agriculture, economies and the environment at any one time. Drought may severely reduce crop yields. The hazard footprints of areas affected by droughts are typically larger than other hazards. Timely information about the onset of drought duration and impacts can limit drought related losses. Meteorological drought is classified as rainfall deficiency in that area is ≥25% of its long term normal. Moderate and severe drought depending upon whether the deficiency is between ≥25 to 50% and more than 50%, respectively.

In this study, an attempt has been made to apply google earth engine (GEE), remote sensing and GIS techniques for drought detection of Bangladesh, especially in the North-west region which is the most drought prone area of Bangladesh. Agricultural drought risk areas were identified based on NDVI anomaly index (NAI) using MODIS Normalized Difference Vegetation Index (NDVI) of 16-day Global dataset for June to October of 2000-2022 and Rainfall anomaly index (RAI) CHIRPSglobal rainfall daily data set for same period. Anomaly of the NDVI and rainfall calculated from the mean values and standard deviation. Meteorological drought was determined based on Standardized Precipitation Index (SPI) calculated from observed rainfall by rain gauge of 34 weather stations in Bangladesh meteorological department (BMD). Seasonal Vegetation Anomaly Index (SVAI) and Seasonal Rainfall Anomaly Index (SRAI) are calculated from Monthly NAI and RAI. Integrated Agricultural drought maps were prepared by integrating the SVAI and SRAI maps. SPI will further correlate with rainfall anomaly index. Then apply agriculture mask by MODIS land coverdatasets after integrated drought index. 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.



Keywords: BMD, NDVI, NAI, RAI, SVAI, SRAI, SPI, MODIS, CHIRPS, GIS, GEE, Drought, IDI, AIDI.

ABSTRACT

Monitoring and Mapping of Coastal Landforms using Pixel and Object based Techniques

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Co Supervisor
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A B S T R A C T

There has been a constant change in earth featuresbecause of anthropogenic forces and natural events through time. Thus, there is a necessity for continuously monitoring the region to keep a check on its varying features. The changes within the patterns of the region over a monitored time act as a primary source for understanding the human interaction with the environment and as decision support for sustainable development of the region etc.

This study is done for an Estuarine ecosystem, whichare home to thousands of species providing various services to the mankind. This led to the regions under extreme pressure for exploiting its resources due to the development activities performed in or around that region. Thus, there is a need for monitoring these ecosystems for sustainable use of its resources. The region of study of this project is the East Godavari River Estuarine Ecosystem (EGREE) in Andhra Pradesh, India. It is well known for Coringa Mangroves that are affected due to the increased maritime activities in the Kakinada port and aquaculture over years. Therefore, the main purpose of this study is concerned with monitoring the coastal and land features of East Godavari River Estuarine Ecosystem over a period of 15 years (2006-2021) for which the features are mapped using the conventional andobject-based classification techniques. Object based classification has the advantage of classifying features in a more accurate manner where there is spectral similarity among the classes.

Three datasets (2006, 2015, 2021) of Landsat series of EGREE region is used for mapping. This region is initially classified using a conventional classification technique (supervised classification) and then using Object-based Classification.This study helps us to compare the accuracy of classified maps of these techniques for coarser resolution images (i.e., 30m) and assessing the changes of the region over 15 yearsdue to anthropogenic and natural activities. This will help the planners to take decision judiciously towards coastal zone management activities in the study region.

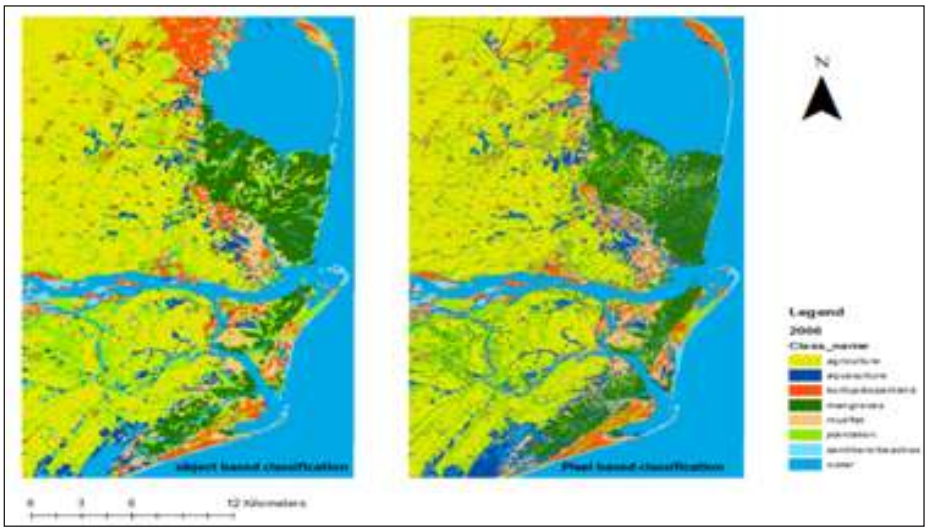

Fig 1: Object based, and Pixel based Classification of study area for 2006.

Keywords: Pixel and Object-based Classification, Accuracy Assessment, Change detection.

Characterization of seasonal changes in forest structure of dry and moist deciduous forests of Siwalik range, Uttarakhand, India using Multi-Sensor approach

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Supervisor
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Forestry and Ecology Department, IIRS, Dehradun

Mapping of forest structures of different forest types is important for ecological and climatic studies. Structural diversity parameters were found to be better predictors of key ecosystem functions, such as productivity, energy, and nutrient dynamics. Remote sensing plays a key role in the mapping and monitoring of forests. In this study, dry and moist deciduous forests, located in part of the Siwalik range of Himalaya, spread across Uttarakhand and Uttar Pradesh states of India, was selected as the study area. The study area has high variability in climatic and topographic conditions. There is high variation in environmental conditions e.g., radiation, soil moisture, and temperature with respect to slope and aspect in this region, which in turn resulted in microclimatic (e.g., light, temperature, humidity) gradients. These climatic gradients modify biological processes which further affects the structure of the forest. In this study, spatial modelling of forest structural components, viz., Plant Area Index (PAI) and Foliage Height Diversity (FHD) was done to understand the seasonal variations (dry (April-May) and wet (October-November) in moist and dry deciduous forests of the study area. Multi-sensor EO data (Sentinel-2 and the Global Ecosystem Dynamics Investigation (GEDI) and Random Forest Regression (RFR) were used for spatial modelling of forest structural components, e.g. PAI (Fig.1) and FHD. GEDI Level 2B products - PAI and FHD, 10 spectral band reflectance and 21 spectral indices, generated from Sentinel-2, were used in RFR to identify the best predictor variables and develop prediction models for PAI and FHD. For the dry season SWIR1, SWIR2, RedEdge-2 band, IRECI, NDMI, NBR, and MCARI were found as the top variables in PAI modeling. For the wet season, SWIR2, SWIR1, RedEdge-1 band, NBR, IRECI, NDMI, GNDVI, ARVI, and MCARI were found to be the best variables in PAI modeling.

Keywords: Forest Structure, Plant Area Index, Foliage Height Diversity, GEDI, Sentinel 2, Random Forest

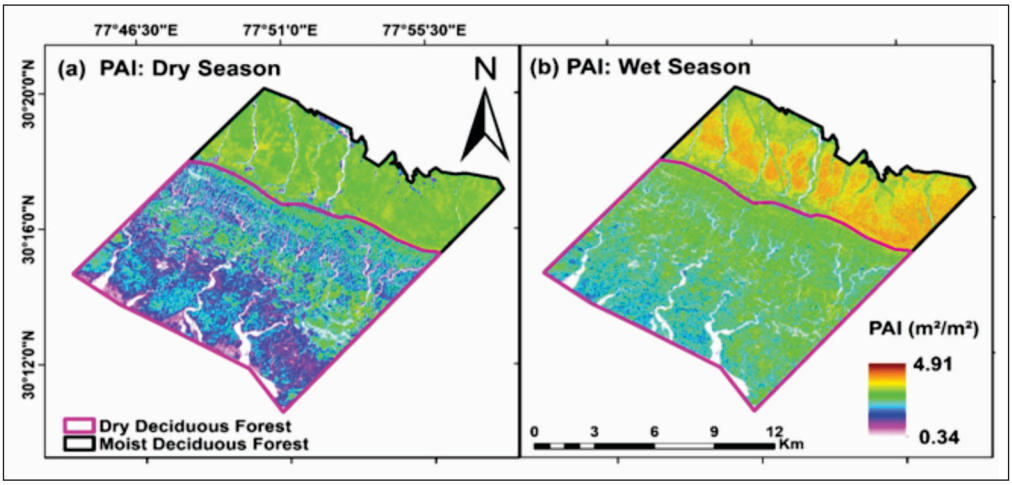

Fig 1: Spatial distribution of plant area index (PAI)in moist and dry deciduous forests.

Ship Detection using SAR data in Arabian Sea

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Photogrammetry and Remote Sensing Department,
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A B S T R A C T

This project is aimed at usage of SAR data for ship detection; to also use the datasets of EOS-04(RISAT-1A) which was launched on 14 Feb 2022. The analysis of C-Band of EOS-04 and Sentinel-1 data for the ship detection was carried out in this project.

The Ship Detection can be possible using Yolo algorithm, SUMO approach, Machine Learning and SVM. There is a tool of Object Detection in SNAP software which can be used for Object Detection. The various factors like maximum size, minimum size, CFAR rate can be set and then the Software can detect the Objects. ArcGIS Pro also has a ship detection module which makes the ship detection.

Synthetic Aperture Radar (SAR) being all weather, 24 x 7 satellite can help in detection of sea objects at much higher accuracy compared to optical data. The ability of SAR to penetrate cloud cover and operate at night provides valuable tool for ship detection.

Automatic Identification System (AIS) data was used from open source websites Marine Traffic, Vessel Finder and Fleetmon. EOS-04 datasets were made available from NRSC, Hyderabad by the Supervisor. The Supervisor suggested that the data be of GeoTiff format and hence the same was used. The other sources for datasets were from Sentinel- SLC and GRD format.

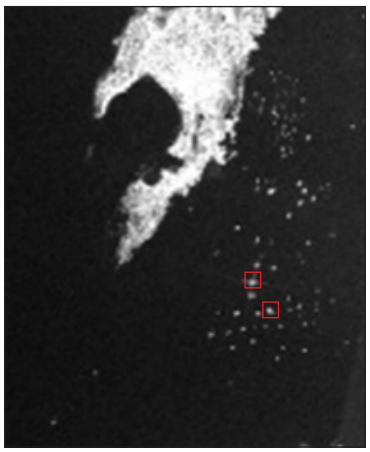

Fig 1: Ship detection using SNAP

Fig 2: Grab of Fleetmon (AIS Software)

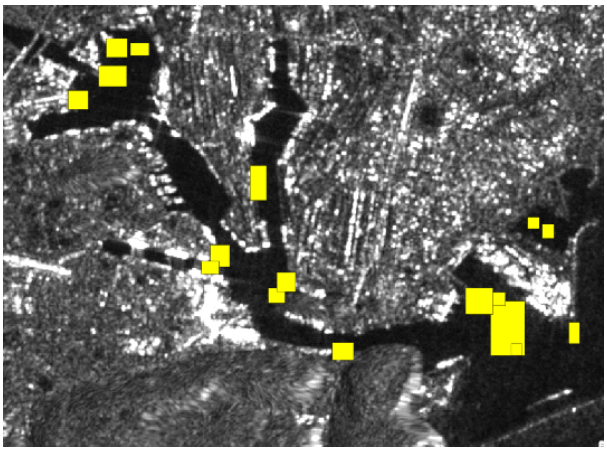

Fig 3: Ship Detection using ArcGIS Pro

Keywords: SAR, Ship Detection, EOS-04, Python, Machine Learning, ARC GIS Pro, SNAP

Irrigation Water Management Using Remote Sensing Inputs in the Karaturuk region of the Big Almaty Canal, Kazakhstan

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National Space Agency of Kazakhstan
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Water Resource Department, IIRS, Dehradun

Co-supervisor
Dr. Shashi Kumar,Scientist/Engineer– 'SF'
Photogrammetry and Remote Sensing Department,
IIRS, Dehradun

This project aims to enhance irrigation water management in the Karaturuk region of the Big Almaty Canal, located in the Almaty Region, by utilizing remote sensing inputs. The Big Almaty Canal was originally constructed to irrigate croplands spanning 174.6 thousand hectares, but due to various socio-economic and climatic factors, the current irrigated area has reduced to approximately 80 thousand hectares. The existing water management practices face challenges in terms of deficit supply or underutilization of the irrigation potential.

To address these challenges, this project focuses on exploring the potential of remote sensing techniques to improve water management within the irrigated command area of the Big Almaty Canal project. The specific objectives include estimating crop acreage using remote sensing data, estimating crop water requirements and irrigation water requirements using remote sensing inputs, and evaluating the performance of the existing irrigation system.

The study area shown in Figure 1 encompasses 6,000 hectares in the Karaturuk region, and the expected outcomes of this project are twofold. Firstly, it aims to demonstrate the benefits of incorporating remote sensing techniques in improving water management practices in irrigation projects. Secondly, the project seeks to develop methodologies for accurately estimating crop acreage and crop water requirements/irrigation water requirements using remote sensing data. Additionally, evaluating the performance of the Big Almaty Canal project will shed light on the specific challenges faced by the irrigation system.

Initial results of crop classification shown in Figure 2 identified Alfalfa (35%), Maize (33%), and Orchards/Apple gardens (25%) as the dominant crops grown in the area during summer season (March-September) of year 2022 using optical (Sentinel-2) and SAR (Sentinel-1) dataset. Thermal bands of Landsat 8 and 9 were utilized to derive crop evapotranspiration (ETa) for water demand supply analysis and performance evaluation.

By integrating remote sensing data, field observations, and historical data related to water availability, crop production, and irrigation practices, this project will provide valuable insights into water management practices in the study area. The results, presented through maps, graphs, and tables, will facilitate informed decision-making for the water department of the Big Almaty Canal, leading to improved water management practices and bridging the gap between the potential irrigation capacity and actual water utilization.

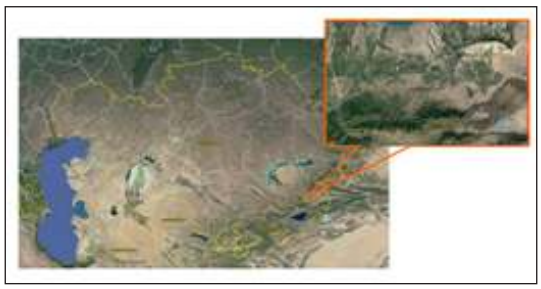

Fig 1: Study area Karaturuk

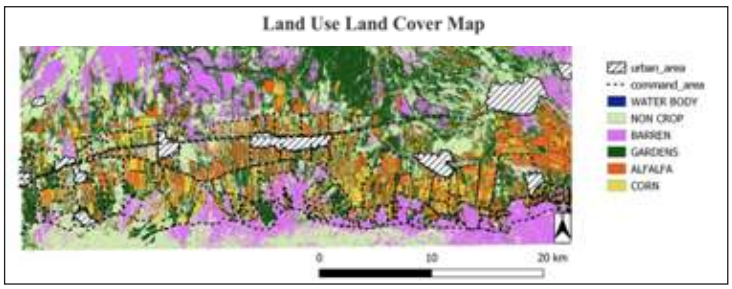

Fig 2: Classified LULC map

Keywords: Irrigation water management, evapotranspiration, crop acreage, performance evaluation.

Quantitative Analysis of Desertification using Remote Sensing and GIS: A Case Study of Mongolia

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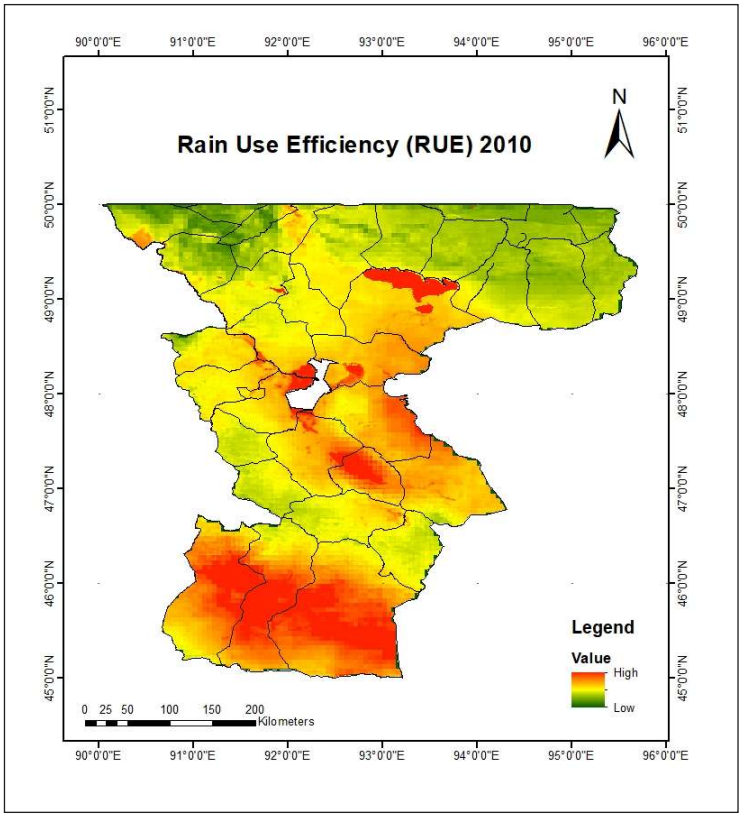
Mongolia is a globally crucial region that has been suffering from land desertification owing to its arid, semi-arid and desert characteristics. However, current understanding on Mongolia's desertification is limited, constraining the desertification control and sustainable development in Mongolia and even other parts of the world. The study was aimed to quantitatively analyze desertification in north-western part of Mongolia using Remote Sensing and GIS. The study comprised of inter-annual rainfall use efficiency analysis of selected provinces in Mongolia as well as mapping of the vegetation-rainfall relationship in the area using long term remote sensing and rainfall data.



MODIS NDVI monthly composite data and CHIRPS rainfall data during cropping season of 22 years (2001-2022) were processed for the computation of integrated NDVI and seasonal rainfall at pixel level. Integrated NDVI and seasonal rainfall were utilized for computation of rain Use efficiency (RUE) during individual years for the entire study. A correlation analysis was carried between Integrated NDVI and Rainfall using the individual year's data to assess the nature of the relationship. Further a correlation and regression analysis was carried out by considering yearly RUE as dependent variable and time (years) as independent variable. Regression modelling was carried out using long-term (10 years) pasture biomass observations from the area and long-term NDVI values of different months during the growing season to identify their relationship. The validated regression models were used for the spatial mapping of biomass in the area for individual years.

Keywords: Desertification, NDVI, Rain use efficiency, pasture biomass, Mongolia.

Soil Quality/Soil Carbon Stock Estimation by Rs And GIS A Case study of Mongolia Province

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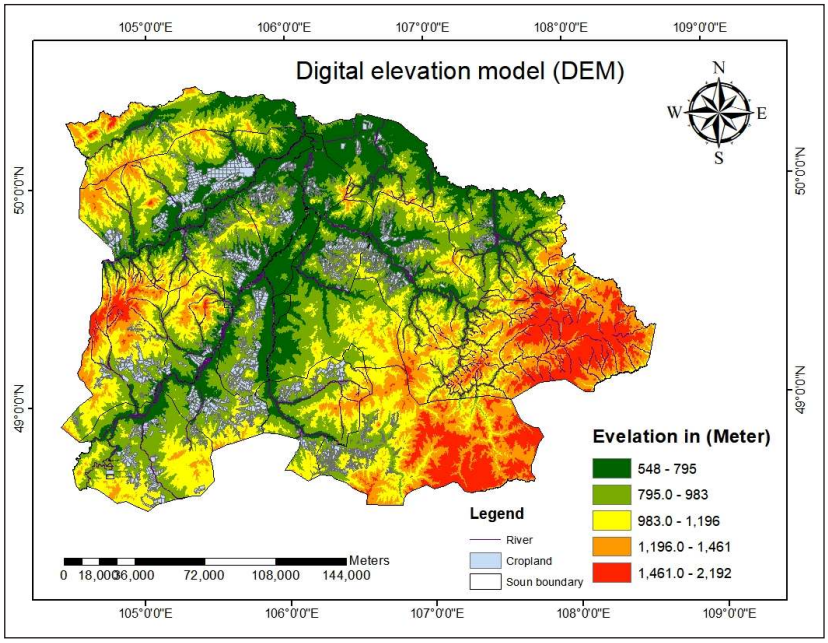
The Mongolia is Central Asian country with extra-continental nature climate conditions and domination of dry steppe and Gobi-desert nature. Ecosystems of the Mongolia have developed under highly variable climates, and are sensitive to grazing management and to changes in rainfall and temperature. Soil degradation and pollution becoming very serious problem in Mongolia, recently. Now, up to 60 % of soil cover affected by soil erosion and soil fertility declining. Soil organic carbon (SOC) is an important soil parameter of cultivated soils that needs to be monitored and mapped regularly to enhance soil health and productivity. The study was aimed at computation of soil organic carbon density (SOCD) and soil Quality index (SQI) in Mongolian forest steppe area and their mapping using remote sensing inputs employing machine leaning techniques. Soil sample analysis database from Mongolian forest steppe area was used for the computation of SOCD making use of different pedotransfer function. Principal component analysis (PCA) was conducted to identify the most contributing parameters for soil quality and their weights were determined using factor analysis (FA). Organic carbon (%), Calcium content (kg/ha), Magnesium content (kg/ha), Sand (%), Clay (%) and Potassium (kg/ha) were identified as the minimum dataset and were scored using linear scoring functions. SQI was computed from the integration fo these scores and their corresponding weights. The SOCD and SQI computed for each sampling locations were further used for mapping their spatial distribution employing random forest regression technique. Various environmental variables such as LULC, long term RS data derived vegetation indices, DEM based terrain parameters, Geological information, spectral indices, and bioclimatic parameters were integrated via RF modeling for spatial mapping of SOCD and SQI.



Keywords: Soil organic carbon, Soil Quality, PCA, Random forest regression, Machine Learning

ABSTRACT

Hydrological study of Kherlen river basin, Mongolian using geospatial inputs

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A B S T R A C T

Due to global warming and human activities, the water regime of the Kherlen River has changed. Water resource management in the Kherlen river basin is becoming increasinglycomplex, due to multiple interests competing for limited water supplies, and the necessary balancing of land and water development strategies. Henceforth, our research work involves the use of SWAT model to study the hydrological balance of the Kherlen River Basin, Mongolia. To achieve this, the complete study area of Kherlen River Basin having an area of 95652.74 km2 was simulated using Soil and Water Assessment Tool (SWAT), for a period of 21 years, i.e, 2000-2020. SWAT simulates the water budget components of the given study area by dividing the complete watershed into smaller sub-basins, thus providing us with crucial outputs such as stream discharge at the output of each subbasin, in accordance to the topographical and meteorological parameters defined by the user.

MERIT (Multi Error Removed Improved Terrain) DEM having the spatial resolution of 90 m was used to delineate thebasin, leading to the division of the complete basin into 76 sub-basins. Next, Copernicus Global Land Cover Layers: CGLS-LC 100 Collection 3 was used to define the Land Use Land Cover of the delineated watershed. Further, the Soil data provided by FAO (Food and Agriculture Organisation) was used to define the soil characteristics of the study area. Superimposition of LULC, Soil Data and the Slope classes lead to the formation of 162 Hydrological Response Units (HRUs), possessing unique landuse/management/soil attributes. The MERRA-2 meteorological data namely, Precipitation, Solar Irradiance, Wind Speed, Relative Humidity and Temperature, provided by NASA-POWER-LARC was used to force the hydrological model.

Finally, SWAT simulation was run for 21 years, with the warm-up period of 5 years. The model was run at a daily time step, thus producing surface as well as sub-surface components such as streamflow, baseflow, etc., occurring daily at the outlet of each sub-basin for the given time period. The simulation resulted in the surface runoff equal to 25.09 mm, and the groundwater contribution to the stream being 7.93 mm. The calibration and validation of this SWAT model will be done further using the observed discharged values at Kherlen-Choibalsan with the discharged values simulated by SWAT at the outlet of Sub-basin No. 18, taking into account the orographic precipitation, groundwater variables as well as other parameters to fine-tune our SWAT model, leading to its enhanced accuracy and hence accurate hydrological analysis of our study area.

Keywords: Hydrological study, Kherlen river basin, Mongolian, SWAT, Streamflow, Baseflow

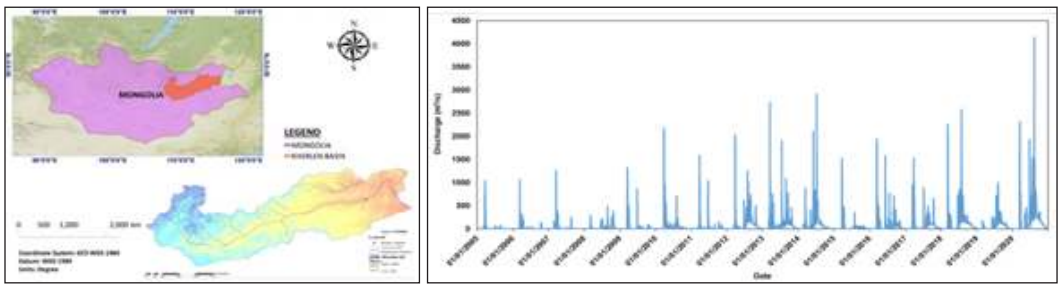

Fig: a) Study Area; **b)** Simulated discharge at Kherlen-ChoibalsanGauging Station

Flood Hazard Assessment Using Multi-Temporal Satellite Data: A case study of Chindwin River

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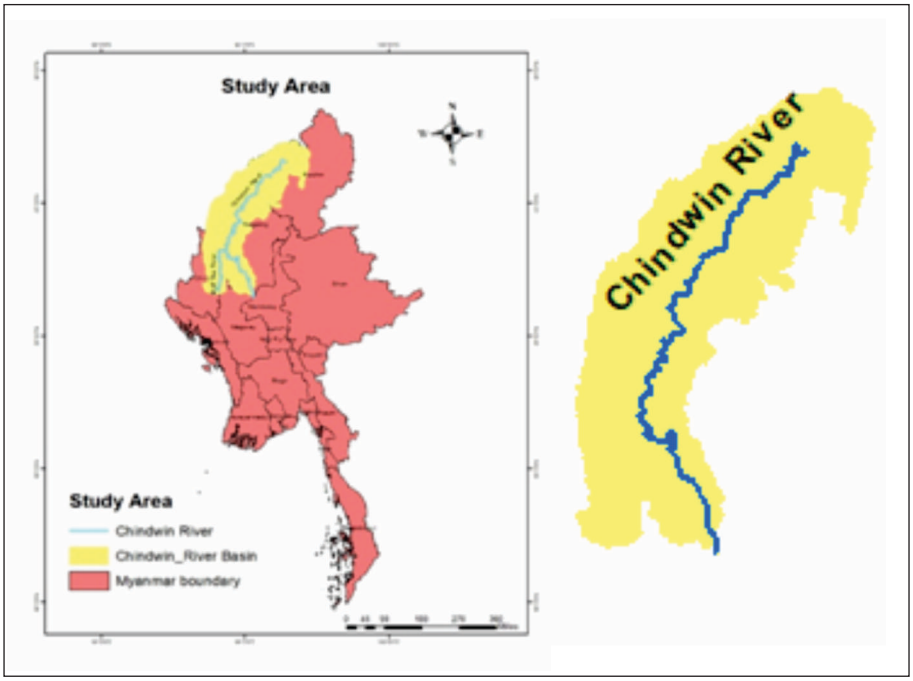

Among natural hazards that affect the people, infrastructure and other aspects of community, flood is one of the most common occurring disasters over the world. It occurs during a short period of time (days) but affects severely for long period of time. Flood hazard assessment is crucial for understanding and mitigating the impacts of flooding events on human settlements and infrastructure. This study focuses on the Chindwin River, a major watercourse in Myanmar prone to frequent flooding. The objective of this research is to evaluate flood hazards by leveraging multi-temporal satellite data. To achieve this, the study utilizes the Google Earth Engine cloud-platform for processing satellite data. Flood inundation maps were generated using optical (Landsat-series, Sentinel-2) and SAR (Sentinel-1) data for the years from2002to2021.The generated flood maps time-series was used to assess the frequency of flood at each pixel in Chindwin River basin. Further, flood hazard map was generated and integrated with the administrative boundaries. The multi-temporal satellite data analysis reveals spatial and temporal patterns of flooding, enabling the identification of high-hazardprone areas and the estimation of flood recurrence intervals. The flood hazard maps provide essential information for decision-makers and emergency responders to prioritize resources and develop effective flood mitigation strategies. The application of multi-temporal satellite data for flood hazard assessment in the Chindwin River case study demonstrates the potential of remote sensing and geospatial analysis techniques in flood hazard management.

Keywords: Flood, Flood hazard, Remote Sensing Chindwin River Basin

ABSTRACT

Study of Fuzzy Machine Learning Model for Sugarcane Ratoon Crop Harvesting Mapping

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A B S T R A C T

Classification of crop can be done accurately by using the growth pattern of that crop and try to discriminate between various agriculture crops and varieties. While mapping a specific crop using remote sensing techniques, the information of other crops presents in that area or nearby is also important. So, mixed pixels became a problem in preparing accurate crop map. For accurate mapping of the crop, contribution due to the fractional part of the pixel as well as full crop pixel need to be included. The proportional contribution or un-mixing of classes can be handled using techniques like linear mixture model (LMM), fuzzy classification, neural network, etc. As a result, the precise area estimation of a land cover can easily be found for both low and high spatial resolution imageries. Optimal crop mapping and monitoring the growth pattern can be done by using temporal remote sensing images with fuzzy classification approach, which handle spectral overlaps with other crops. The germination processes of plant and ratoon in sugarcane fields vary gradually and so machine learning algorithms based on statistical principles cannot effectively handle the vast amount of variability. Therefore, a Possibilistic c-means fuzzy based classifier (PCM) which is capable of extracting single class in an image while mapping the differently cultivated sugarcane crops (Ratoon and Plant) in a region of Meerut, India, using a novel individual sample as mean training approach has been tested in this research.Since many different crops were grown in the vicinity of each other, there existed an issue of spectral overlap that is overcome by adopting the temporal approach which helped in distinguishing between the different crops present. Temporal images from Planetscope DOVE sensors were used for the testing of Modified Soil and Vegetation Index (MSAVI2). The utility of this vegetation index in reducing the data dimensionality was applied and the temporal data set was optimized in such a way that the unique growth phenology of sugarcane plant and ratoon had been captured. The optimized combinations of temporal dates were obtained through the separability analysis to maximize the separation between target and non-target classes. The fuzzy PCM was used to map the target classes while testing the Individual Sample as Mean (ISM), training approach. A novel approach ISM based PCM in handling of heterogeneity within class has been proposed in this study. Accuracy assessment of the results was done using the Mean Membership Difference (MMD) and Variance parameters, which are parameters of indirect assessment of results and handled level of heterogeneity within the class respectively. It was observed that output of PCM performed the best classification results for the considered target class (Ratoon-January). Each target class was mapped the best, i.e., with minimal heterogeneity and minimal spectral overlap, with particular temporal indices database. An attempt was made in this study to monitor the harvesting of the sugarcane Ratoon-January and Plant-February using the proposed PCM model.This study can eliminate the need of extensive manual survey and contribute in the mapping of varieties of sugarcane (Plant and Ratoon) sown at different times of the year. Harvesting stage of sugarcane plant/ratoon can also be monitored with good precision using the mentioned approach.

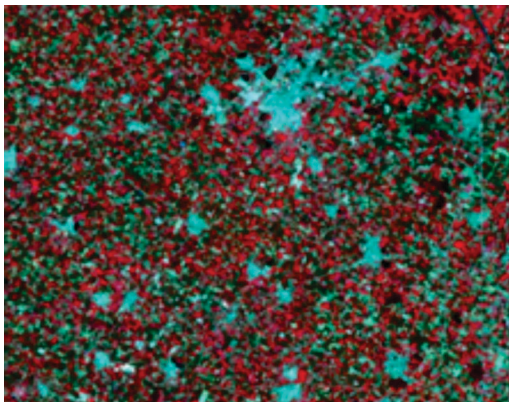

Fig. 1: Sample of Planetscope Satellite Data for the Study Area

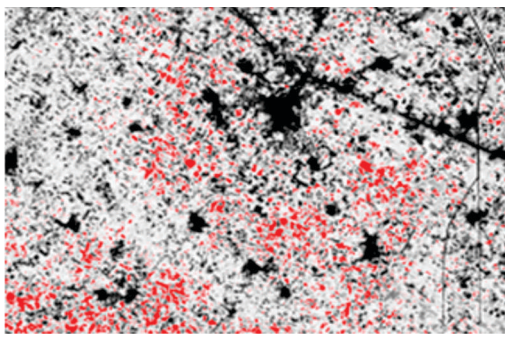

Fig. 2: Harvested Sugarcane Ratoon-January Fields (in red) Mapped using Temporal Index MSAVI_2

Keywords: Machine Learning Model, Sugarcane, Ratoon, Crop Harvesting Mapping, Fuzzy based classifier, Possibilistic c-means

Estimation of Runoff and sediment yield in Gandaki River Basin, Nepal

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The Soil Water Assessment Tool (SWAT model) is a semi-distributed hydrological model operating on a daily, monthly, and yearly time scale. The Gandaki River basin is divided into a number of sub-basins. In each sub-basin, Hydrologic Response Units (HRUs) are created, which are unique combinations of soil, land use, and slope characteristics.

The main purpose of this study is to estimate runoff and sediment yield by applying SWAT model in a heterogeneous and complex type of topography and climatically diversified basin. The Gandaki is the left-bank tributary of River Ganga; a transboundary river basin that originates from Tibetan plateau of People's Republic of China and drains through central part of Nepal (Fig. 1) and India up to Bay of Bengal. Annual rainfall recorded at more than 15 rain gauge stations gives 1500 mm per year. whereas observed flow (1984-2010) at Devghat shows 1527 m3/s per year. March 3rd month of year has a lean flow i.e., 279 m3/s and August observed highest flow i.e., 4670 m3/s. Fig. 2 shows daily Hydrograph from 2007 to 2010.

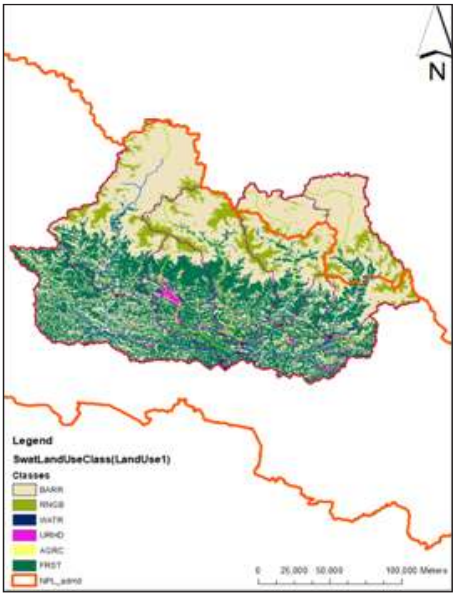

Fig 1: Gandaki River Basinat Devghat

During this work, basinis divided into 7major sub-basins and five slope classes (0–30, 30–45, 45–60, and >60 percent). 123 Dominant HRU's are created using the land use and land cover, soil and slope classes. Further, to account for orographic effects, 1000 m range elevation bandsare generated in each sub basin. The SWAT model is calibrated and validated manually for a simulation period of 37 years (1984–2010). Where 3 years are kept as a warm-up period. The sensitive parameters are selected for calibration. It isobserved that two different sets of parameters directly influence the surface runoff (CN2 and OV_N) and lateral flow (LAT_TIME and SURLAG) whereas five parameters (ALPHA_BF, GWDELAY, GWQMIN, SOL_AWC and SOL_Z) impact the base flow from the basin. There are six snow related parameters (snowfall temperature (SFTMP), snowmelt temperature (SMTMP), snow cover (SNOCOVMX), degree-day factors (SMFMX, SMFMN) and temperature lapse rate (TLAPS)) which are used to calculate the snow component of the total flow.

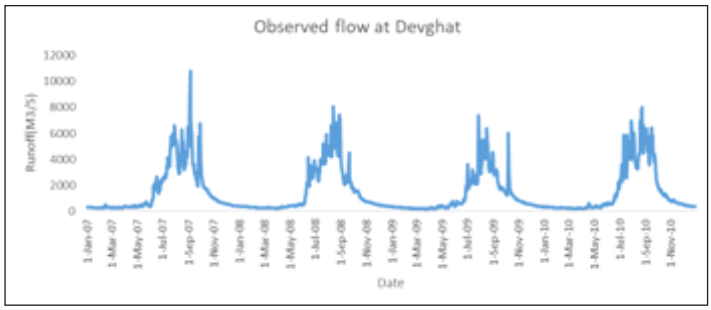

Fig 2: Hydrograph at Devghat

Keywords: Swat, Gandaki, HRUs, Calibration, Validation

Spatio-Temporal Dynamics of Ecosystem Services from Coffee Agroforestry Ecosystem in Llano Bonito Watershed, Costa Rica

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A B S T R A C T

Agroecosystems are sources for various ecosystem services (ESs) and the flow of the ESs depend principally on how the agroecosystems are managed. The farmers in coffee agroecosystem dominated landscape of Llano Bonito Watershed in Costa Rica manage farms in diverse ways. The farmers' field practices vary in such a way that there are variations of combinations resulting inspectrum of intensities between low and high input practices.

With the objective of assessing spatio-temporal dynamics in yield, and pest and diseases; the study established a system of sampling, measurement, and monitoring of coffee yield (provisioning ES), and pests and disease (regulating ES), and their key drivers (e.g., leaf area index - LAI, plot characteristics, management operations, weather parameters etc.) in plots representing diversity of coffee practices in the study area.

The analysis involved production of spatially and temporally explicit maps of LAI and ESs employing machine learning Random Forest algorithm in Google Earth Engine and R-Statistics with various indices derived from satellite images as proxies in a two-stage analytical process (Fig. 1). At first, LAI was extrapolated from plot to landscape scale using different indices such as normalized difference vegetation index (NDVI) derived from RapidEye (5m) and Landsat (30m) images.

In the second stage, the measured ecosystem services (yield, pest and diseases) were correlated with management variables, production situation, climatic parameters and LAI progression to assess plausible drivers.

Satellite data and emerging geospatial technology found to be useful in studying and predicting spatio-temporal dynamic of ESs at landscape scale with reasonably high accuracy.

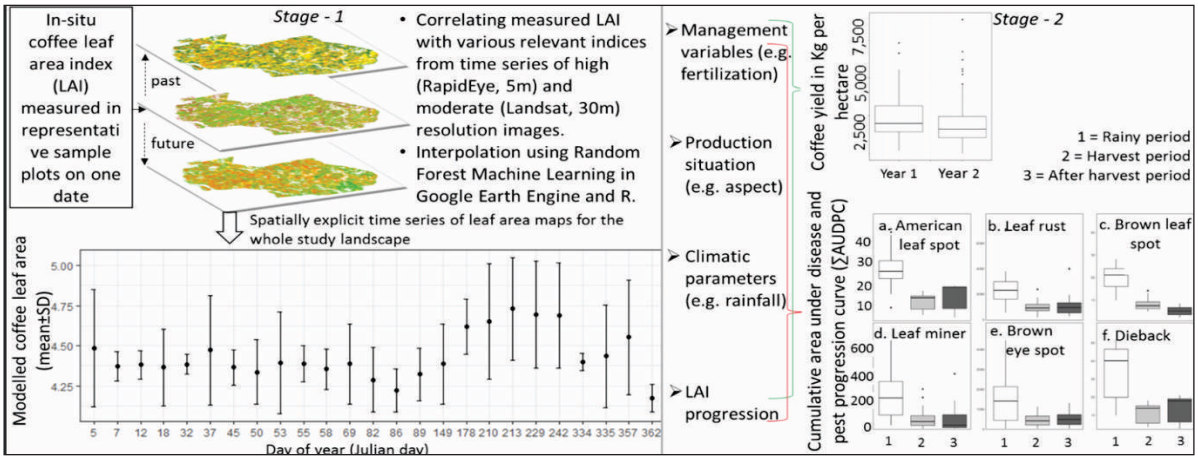

Fig. 1: Correlating indices with LAI to generate LAI progression maps (Stage-1), and correlating ESs with Management variables, Production situation, Climatic parameters and LAI progression for generating spatio-temporal ESs dynamics (Stage-2).

Keywords: leaf area index (LAI), coffee yield, coffee pest and diseases, geospatial, machine learning

Modelling of litter mass of Barkot forest using satellite data

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Figure: strata (top left) based on forest type (top right), EVI (bottom left) and SOS (bottom right). Forest Litter is loose non-living organic debris consisting of freshly fallen or slightly decomposed plant parts on the surface layer of the forest floor which has an important role in soil formation, nutrient enrichment, food and shelter for small animals, soil temperature, and moisture conservation as well as an elevated risk of forest fire in the dry summer seasons. Therefore, understanding the distribution and dynamics of forest litter using remote sensing data is crucial for sustainable forest management. The study was focused on modeling the forest litter mass using satellite data on the Barkot Forest of Uttarakhand, India. Sentinel 2 optical image data was obtained, and relevant indices, were calculated. NDVI-based phonological parameters i.e., SOS, POS, EOS, and LOS were calculated using sentinel image collection of year (2022/2023) through Google Earth Engine. Composite images were prepared using all bands, indices, and phonological parameters. Litter mass was collected using stratified random sampling. Strata were prepared based on the forest type, SOS and EVI. A total of 75 plots of 30m *30m size were prepared and within each plot five sub-plot of size 1m were laid out and litter mass of fresh and oven dry conditions (75°C, 24hr) were measured from every subplot. A Random Forest regression model was implemented and cross-validation was carried out to validate the model. The result of this study will be helpful to fuel estimation during fire prone season and further estimation of carbon from the litter mass.

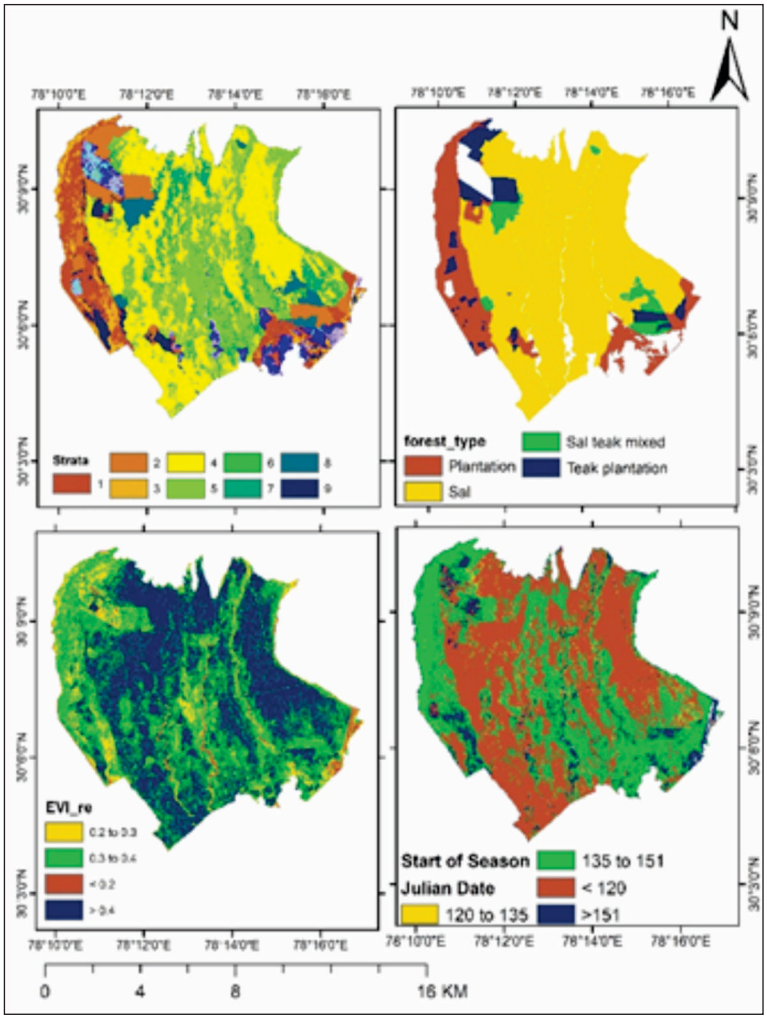

Fig. 1: Strata (top left) based on forest type (top right), EVI (bottom left) and SOS (bottom right).

Keywords: Litter Mass, Indices, Modelling

Development of Web Based Geospatial Application Using FOSS4G for Matara District of Sri Lanka

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A B S T R A C T

There is a growing need for web-based geospatial application for fast and easy dissemination, sharing, visualizing and analysis of spatial information. Such applications are the need of hour and are useful in various domains e.g. natural resource management, disaster management, tourism, governance etc. Free and Open Source Software for Geospatial (FOSS4G) provides a mature alternative for developing such web enabled geospatial applications compared to the commercial software's without the restrictions and cost implications associated with the same.

The objective of this project is to develop a web based geospatial application for the Matara district of Sri Lanka (Fig. 1) using FOSS4G which provides users functionality of accessing and analysing the geospatial data over the Web without requirement of GIS software at their end. The application consists of two main modules accessible through an intuitive homepage (Fig. 2) namely:-

I. Geospatial Viewer- for accessing the geospatial datasets published using OGC compliant Web Map Service Standard (WMS) on various themes like land use, transportation, hydrological features, building structures, administrative boundaries, forested areas, and public spaces. Non-spatial data such as population figures, voter demographics, gender ratios and land use statistics are also available (Fig. 3). It also allows users to selectively view specific layers, generate printed maps, GIS tools like zooming, panning, identify, measure distances and calculate areas along with executing online attribute based queries on stored data and.

II. Geospatial Dashboard- Interactive geospatial application displaying various information and analytics using interactive charts, tables, maps and widgets for the decision makers (Fig. 4). It provides functionality of online data exploration using the multiple-linked views capability of slicing and dicing the dataset. This enables users to filter and arrive at the desired information by interacting with the connected charts and widgets only.

The application follows three-tier architecture and utilizes Open source Apache Tomcat and GeoServer as the Web and GIS server respectively with geospatial data residing in the PostgreSQL/PostGIS backend database. For the development of the application open source MapStore framework is used.

Keywords: Web Based Geospatial, FOSS4G, Geospatial Viewer, Geospatial Dashboard, Matara district (Sri Lanka)

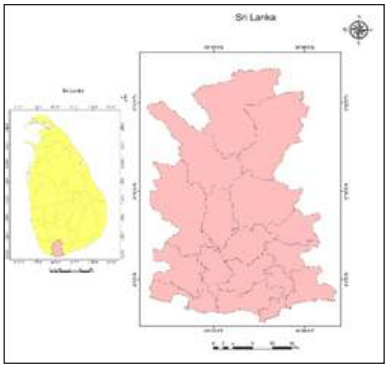

Fig. 1: Study Area

Fig. 2: Home Page

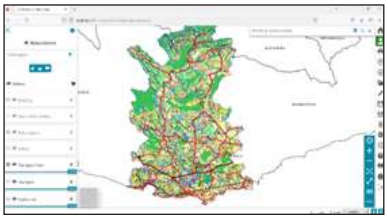

Fig. 3: Geospatial Viewer

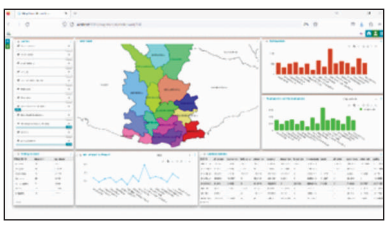

Fig.4: Geospatial Dashboard

Photo Gallery

1 - Participants at Rishikonda Beach, Visakhapatnam A.P.
2 - At CSSTEAP Hostel
3 - GYM, IIRS
4 - Salarjung Museum, Hyderabad
5 - Field Visit

Clockwise from Top

6 – Salarjung Museum, Hyderabad
7- CSSTEAP Hostel
8 - With Chairman, ISRO & Director, CSSTEAP
9 - Kempty Fall, Mussoorie

Clockwise from Top

11 - Exhibition Visit
12 - Field Visit at Hydraulics Research Station
13 - At Shadnagar Earth Station, NRSC, Hyderabad
14 - Field visit Barkot Forest Range
15 - Playing Snooker
16 - ISRS pre-symposium UAV tutorial

Impressions of Participants

In Remembrance

We came from 07 different countries to be a part of the prestigious 26th PG Diploma Course in RS & GIS, a program organised 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. We were lucky in sense that our batch got a chance to go regular classes after the COVID-19 pandemic.

While some of us played badminton, billiards, trekking, some were actively involved in yoga and Bhangra dancing.

The module 1 was a foundation phase were in we learnt and honed our skills, as we went towards the end, we were experts in ArcGIS, QGIS, Google Earth Engine, Python, GIS tools like PostGRES and SQL. From structured to unstructured data, from numbers to images we worked our way and climbed the ladders.

We saw rains, cold winters, spring and then summers- the circle of life was seen and felt by us at IIRS, Dehradun.

While all of us explored Hyderabad & Visakhapatnam, the visit to the beach was the first for many of us. Some of us also explored New Delhi & saw Tajmahal at Agra. Weekend travels to a nearby tourist destination, allowed us to explore the culture and tradition of India. Late night study sessions in our hostel, Football World Cup 2023, barbeque parties every month was great fun and allowed us to bond well. The midnight birthday celebrations were an additional fun to which we looked forward to.

The projects that we have chosen in our respective fields speak of our knowledge and confidence that we have gained over the last nine months to tackle any problem that is thrown at us.

We were victorious in the Sports field as well winning - Football, Volleyball and Table Tennis; we also gave a tough fight in Cricket and other games.

Goodbyes are 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 26th RS & GIS Batch, Thank you! Jai Hind!!

Commander Saurabh
Indian Navy

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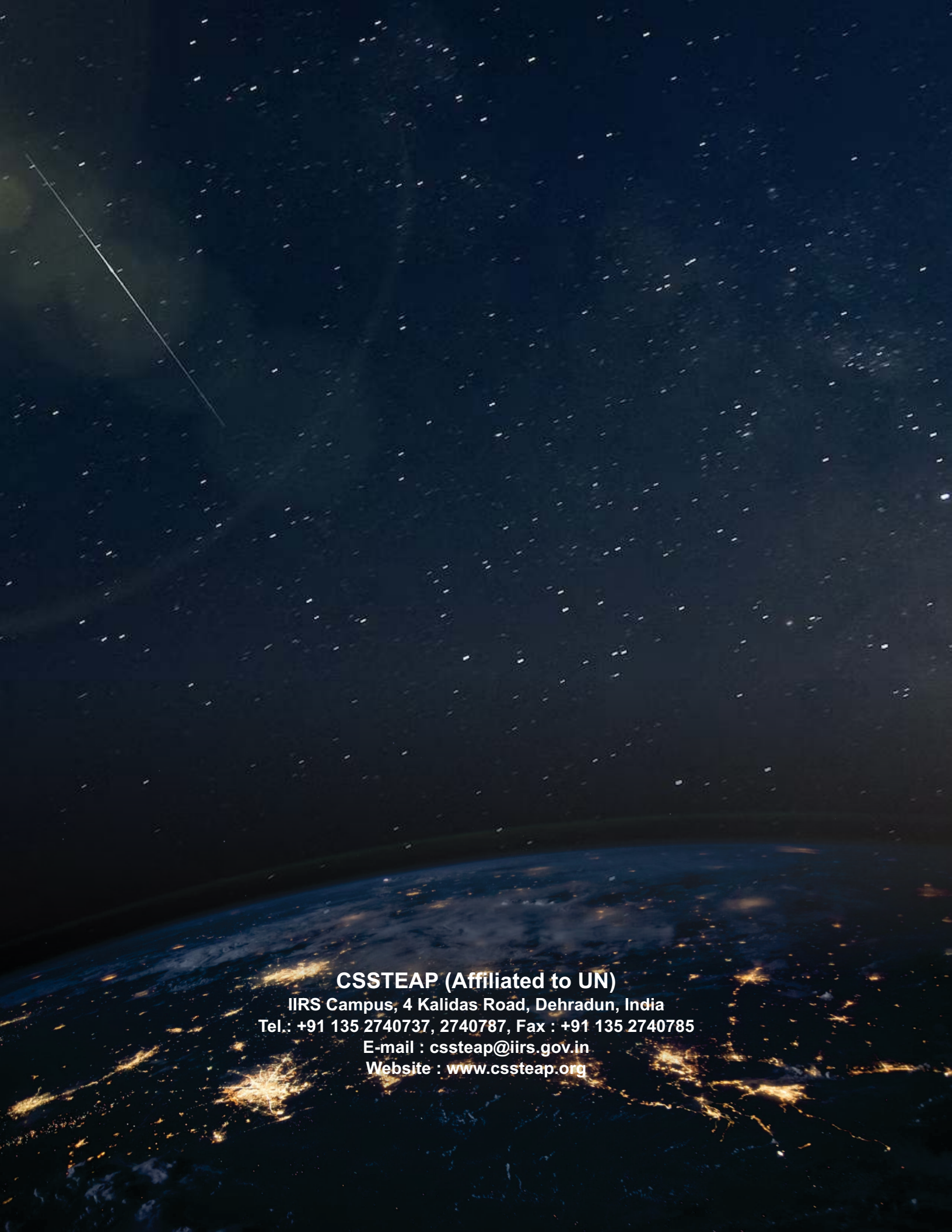

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