National Seminar
on
Recent Advances in Geospatial Technology & Applications
(for Post-graduate Students and Research Scholars)

March 2, 2020
Dehradun

Abstract Proceedings

Jointly organised by
Indian Institute of Remote Sensing
&
Indian Society of Remote Sensing
(Dehradun Chapter)

Hosted by
Indian Institute of Remote Sensing
Indian Space Research Organisation
Department of Space, Govt. of India
Dehradun
www.iirs.gov.in
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Dr. Prakash Chauhan
DIRECTOR, IIRS

FOREWORD

It is with deep satisfaction that I am writing this foreword to the Abstract Proceedings of the National Seminar on "Recent Advances in Geospatial Technology & Applications" jointly organised by Indian Institute of Remote Sensing (IIRS) and Indian Society of Remote Sensing- Dehradun Chapter (ISRS-DC) on March 2, 2020. It is the unique initiative where the Institute (IIRS) and the Society (ISRS-DC) have come together to facilitate the young researchers to share, learn and gain experience.

The National Seminar on "Recent Advances in Geospatial Technology & Applications" is particularly organised for the Post Graduate students and Research Scholars to share their research with the peers and furthermore to gain knowledge through interaction with experts in their discipline. It shall provide a forum to comprehend the data gaps and opportunities in Geospatial technologies & applications in the light of new challenges brought about by rapid urbanisation, depleting natural resources, climate change and so on and to bring resilience in the community.

I am sure that the Seminar will provide opportunity to better understand the Earth and its environment and to devise suitable solutions using Geospatial Technologies. It will also highlight the application potential of newer remote sensing data products.

We thank all authors and participants for their contributions.

Dated: February 27, 2020

(Prakash Chauhan)
Dr. S. K. Srivastav
Chairman, ISRS-DC

PREFACE

Indian Society of Remote Sensing - Dehradun Chapter (ISRS-DC) and Indian Institute of Remote Sensing (IIRS) are jointly organising the National Seminar on “Recent Advances in Geospatial Technology & Applications” on March 2, 2020 for the postgraduate students and research scholars. It is the unique activity undertaken by the ISRS-DC with IIRS, Dehradun to provide an opportunity for young students and research scholars working in the field of Geospatial technology and applications to present their research findings in front of their peers.

Today, humans are consuming the resources much faster than ecosystems can regenerate. The increasing frequency of natural disasters, particularly in Asian continent, along with changing climate pose further challenges to manage our natural resources. It is, therefore, necessary that the emerging Geospatial technologies, tools and resources are effectively used for the quantification, monitoring, conservation planning and management of natural resources for sustenance and survival of the humankind.

I am extremely happy to note that there was a very good response from the student community to the announcement of this seminar. The papers being presented during the seminar are addressing various issues relevant to Earth systems and society through advanced research being carried out at several academic and research institutes, universities and colleges in the country. I am sure that the students will use this platform for enhancing their knowledge through scientific deliberations and interactions with their peers and experts.

I, on behalf of executive council and members of ISRS-DC and on my own behalf, wish the Seminar a grand success and also convey my best wishes to the Organising Team.

Dated: February 28, 2020

(S. K. Srivastav)
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Poster Presentations
TREND OF MACRO AND MICRO-URBANIZATION: A CASE STUDY OF BHUBANESWAR-CUTTACK TWIN CITY

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ABSTRACT: The eleventh sustainable development goal envisions creating an environmentally safe, economically strong and ecologically rich strengthened network of urban-peri urban-rural pockets with high resiliency. It demands special attention to the critical planning of sustainable cities at the regional level. In developing countries like India, the urban-related policies and schemes are biased for the megacities like Delhi, Mumbai and Kolkata, in which the growth rate has been dropped drastically in the last few years. On the contrary, small and medium-sized cities are growing exponentially with a burgeoning population and limited resources. Such kind of urban expansion affects the landscape at the macro as well as micro-level. The current study aims to evaluate the level of macro-urbanization in terms of the overall growth of the urban area in the temporal dimension and quantifying the urban morphological characteristics for assessing the micro-urbanization. Bhubaneswar-Cuttack urban complex is considered for the case study, which spread across 745 Km² area in between 20°12’ to 20°23’N latitude and 85°44’ to 85°54’E longitudes on the eastern coastal plains of India. The BHUVAN land use and land cover data sets of the year 2005, 2010 and 2015 are used for the analysis and reclassified to 5 major classes i.e., built-up, waterbody, vegetation, agriculture and barren land. For a thorough understanding of spatial urban development, a multi-ring buffer technique is adopted and concentric rings of 5 km interval have been taken up for the study. The result shows that the Bhubaneswar-Cuttack urban complex experienced an increase of ~5% in built-up area cover since 2005. Arable land is found to be gradually converted to residential, industrial and commercial establishments. Shannon’s entropy is found maximum in core city within 5 km buffer area and subsequently, the value declines up to 15 km followed by a parabolic rise within 30 km concentric circle. Dynamics at macro-level influences the pattern of micro-urbanization substantially and the rate of randomness is critically interrelated with the patch density. Micro-level dynamics are evaluated using spatial metrics and it depicts the size, edginess and fractality of the built-up patches in the urban complex. Although the city core is experiencing compact development due to infill growth, and re-urbanization, the peri-urban area suffers largely due to highly dispersed patch development. Therefore, a comprehensive analysis of rapidly growing cities like Bhubaneswar-Cuttack can provide valuable information regarding the growth pattern and urban dynamics, which will help the planners and policymakers for sustainable designing of the city.

KEY WORDS: Sustainable Development, Urban Morphology, Spatial Metrics, Entropy, Urban Expansion

REMOTE SENSING STUDY OF GLACIER MONITORING OF GORICHAINE MOUNTAIN IN EASTERN HIMALAYA

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ABSTRACT: The Himalayan glacier has its own significance in order to influence regionally as well as globally. Glacier’s vulnerability due to various climate aspects encourage to research scholars and scientists for cryosphere studies. Since, cryosphere studies are being prime concern to reduce the influence of it. The Himalayan glaciers are mother of numerous perennial rivers in Asian continent and profoundly crucial for socio-economic point of views. The continuous monitoring of Himalayan landscape is important to accomplish the goal of conservation of natural resource and achieve
sustainable development. However, from conservation aspect the Himalayan cryosphere is the most sensitive and critical part of Indian Himalayas. In this study, extracting Snow Cover Area (SCA) and topography mapping of Khangri (Patliputra) glacier in Tawang valley near Gorichain mountain of Eastern Himalayan Region (EHR). The variation in Snow Cover Area (SCA) of the region since from last 3 years via 2017, 2018 and 2019 with 15 datasets have tried to be estimate using Sentinel-2b satellite data which have 10 m resolution and visualize the changes that occurred. We have also evaluated the change detection of topographic elevation and slope. The outcome has shown that SCA is 170 km$^2$ maximum covered in Dec 2018 and 24.37 km$^2$ is minimum glaciated area in this region.

**KEY WORDS:** SCA, Landscape, Cryosphere, Remote Sensing, GIS

**INVENTORY OF GLACIAL LAKES & DETECTION OF POTENTIALLY DANGEROUS LAKES FOR GLOF USING REMOTE SENSING & GIS IN PITHORAGARH DISTRICT OF UTTRAKHAND, INDIA**

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**ABSTRACT:** Global warming & changing temperature causing faster melting of glacial ice, resulting in formation of large number of glacial lakes. Glacial lake is a water mass existing in a sufficient amount and extending with a free surface in, under, beside or in front of a glacier and originating from glacier activities and/or retreating processes of a glacier. Glacial lake outburst floods (GLOFs) are sudden, fast flowing release of glacial lake water that move downslope as a result of lake Dam failures. Some studies reported no glacial lakes in Uttarakhand are potentially dangerous, but on 17th June 2013, Kedarnath GLOF event has created a need to update the analysis of glacial lakes & GLOF risk assessment. The present research using Remote Sensing & GIS techniques has been carried out in Pithoragarh district of Uttarakhand, India. This study includes inventory of glacial lakes using Sentinel 2 satellite data of 31 October 2018 to study characteristics of glacial lakes in district Pithoragarh. Lakes mapping has been carried out by semimanual digitization on the basis of visual interpretation along with NDWI and slope information. Potentially dangerous are detected with the help of their area, volume & slope information. In this study, 4 potentially dangerous lakes were detected. Potentially dangerous lakes are linked with their down streams & their flood risk zones are mapped. The result of the study can help in carrying out downstream flood risk assessment, betterment in spatial planning and better preparedness for future GLOF hazards.

**KEYWORDS:** Global warming, Glacial lakes, GLOF, Spatial planning, Remote Sensing & GIS

**GEOINFORMATICS APPLICATION FOR EVALUATION AND ANALYSIS OF WATER BODIES: A CASE STUDY OF SHRINKING LAKE- CHAD, AFRICA**

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**ABSTRACT:** Lake Chad is a vitally crucial wetland in the semi-arid Sahel region of Africa provides the basis of many millions of livelihood which depends on its water and seasonal fluctuation to renew irrigation, fish stocks, and farmland. This research is examining lake shrinking and livelihood changes in the context of multiple stressors through a case study of “lake Chad of” with the help of remote sensing data, in the continent of Africa, research on Livelihoods about regions shows declined in water body fluctuations has largely focused on the wellbeing and security of people on the lake shore. The
demonstrates that limited opportunities outside agriculture, the influx of mixed ethnic migrants, boko haram of northern Nigeria which is terror group occupy lake part of Nigeria that lead people of the area migrate as refugee to other state and city of Maiduguri and the increasing spate of violence all enhance livelihood changes. Livelihood opportunities centre on the renewal effects of seasonal floods pulses on lake waters and learning opportunities triggered by past droughts. Although the reverse of the water body has brought new adaptive changes to the shore of basin behaviors on seasonality, traditional prognostic factors and availability of assets, responses have remained largely reactive. The research is focus on the factors responsible for the changes in socioeconomic activities of the people who are reside on the lake shore, and suggests that awareness of the particularities of the mechanisms that connect lake drying to livelihoods can offer insights into the ways local people might be assisted by governments and other donor agencies.

**IMPORTANCE OF GEOGRAPHIC INFORMATION SYSTEM (GIS) TO EVALUATE SEISMIC DAMAGE STATE AND DAMAGE PROBABILITY OF RC BUILDING STRUCTURE**

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**ABSTRACT:** The past study shown that since last few decades natural disaster intensity and frequency increased. As a result, worldwide every year loss of life and loss of assets rate also increasing. This study discussed importance of geographic information system (GIS) to identifying and quantifying seismic damage and damage probability of reinforced concrete building structure. To ensure lifeline and damage stage of any structural modal structural engineer using number of data and geological information, those are collected from different database website, such as PEER database. Using new technology like Geographic information system (GIS), Remote-sensing (RS), Geographic information System (GIS) and Global Navigation Satellite System (GNSS) all database website updating their database system and represent in such a way that people can understand easily. In current study considered one G+5 reinforced concrete (RC) frame building model located in seismic zone V (IS 1893-2016). To evaluate seismic damage probability and damage stage of proposed structural model used time-history analysis. To performed time-history analysis, past earthquake database required those are recorded in systematic way and mapping properly done by GIS. GIS provides many facilities to collect seismic historical data such as Map Navigation, Legends. Layer control, information viewer, Search, Routing etc. Using these information designers make better plane and view about the considerable place.

**KEYWORDS:** Volunteered Geographic information (VGI), Spatial Data infrastructure (SDI), Seismic Collapse Probability, Collapse Stages, Retrofitting, Remote Sensing (RS).

**ESTIMATION OF NET RADIATION USING LANDSAT-8 (OLI+TIRS) IN TARAI REGION OF UTTARAKHAND**

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**ABSTRACT:** Net radiation is an essential input for wide range of applications. But the in situ measurement of Rn is difficult and is insufficient representation of spatial distribution. Satellite remote sensing provides spatial mapping at different temporal scales. The present study was conducted for the
computation of net radiation using energy balance method over Udham Singh Nagar region in tarai belt of Uttarakhand. The net radiation flux at the surface (Rn) represents the actual radiant energy available at the surface. It is computed by subtracting all outgoing radiant fluxes from all incoming radiant fluxes. The study includes the computation of surface albedo, emissivity, shortwave transmissivity and land surface temperature (LST) as indirect parameters for the computation of components like incoming shortwave, incoming longwave and outgoing longwave radiation. Furthermore, effect of net radiation on evapotranspiration was also studied. The coefficient of determination between temporal net radiation and evapotranspiration was observed to be 0.701, signifying net radiation as an important parameter affecting evapotranspiration. The study was conducted using LANDSAT-8 (OLI+TIRS) image acquired during the year 2015 and 2016. The results were later validated with the radiation values obtained from Clouds and the Earth’s Radiant Energy System (CERES) and modelled data using Hargreaves’ radiation formula calibrated for study area.

KEYWORDS: Emissivity, energy balance, LST, Evapotranspiration, Net radiation

ACCURACY ASSESSMENT OF OPEN ACCESSIBLE DIGITAL ELEVATION MODELS IN URBAN AREAS

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ABSTRACT: Digital Elevation Model (DEM) represents the altitude of reflective surfaces of earth surface features. SAR interferometry and Photogrammetric techniques are few of the techniques, which has been widely utilised to generate global DEMs. They are broadly used as a vital geospatial information sources for various geographic and multi criterion analysis. In this paper, DEMs which are available from different openly accessible platforms were assessed with respect to ground control points (GCPs). The openly accessible DEMs are based on varied microwave and optical remote sensing datasets. TANDEM-X DEM (TerraSAR-X add-on for Digital Elevation Measurement) derived from a SAR sensor at 90m spatial resolution with the main objective of creating precise 3D maps of earth features and SRTM (Shuttle Radar Topographic Mission) also a microwave dataset at 30m resolution were assessed for their accuracy. ALOS PRISM (Advanced Land Observing Satellite Panchromatic Remote-sensing instrument for Stereo Mapping) is an optical sensor at a spatial resolution of 2.5m used widely in geological surveying and disaster monitoring, CartoDEM V3 R1 at 30m resolution and ASTER GDEM V2 at 30m spatial resolution are used for landscape modelling, visualisation techniques was used for the analysis. Three urban regions (cities) in different terrain conditions were chosen namely, Ahmedabad, Bhubaneshwar and Rishikesh with respect to GCPs collected through differential GPS (DGPS) survey. The presented study was mainly focused on the comparative assessment of these DEMs in which the TanDEM -X 90m has very a high accuracy with a RMSE of 1.78 m in Bhubaneshwar, 1.95 m in Ahmedabad 3.33 m in Rishikesh.

KEYWORDS: Geospatial, DEM, SRTM, TanDEM-X, ALOS PRISM, openly accessible

STUDY OF GNSS INTERFEROMETRY TO ANALYZE THE EFFECT OF SOIL MOISTURE ON MULTIPATH PHASE

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ABSTRACT: The presented works aims to investigate relationship between multipath phase of Global Navigation Satellite System (GNSS) and volumetric moisture content (VMC) of soil. The carriers to
noise ratio (C/N0) data of multipath signal at two different frequencies have been analyzed. The first one is India’s NavIC L5 frequency (~1176 MHz) and second one is GPS L1 frequency (~1575 MHz). The multipath data has been collected by IRNSS/GPS/SBAS (IGS) through single antenna, situated in agricultural field at a height of 2.16 m from the soil surface. The observations were taken and analyzed continuously for 30 days. The received multipath signals are highly dependent on dielectric value of soil and elevation angle of satellite. Various research works suggest that the range of elevation angles that can be considered for soil moisture studies with GPS L1 is 5° to 30°. Whereas, the variation of elevation angle to determine the phase of NavIC multipath signal is 15° to 30°. It was observed that the time taken by NavIC satellites to complete this elevation range is almost double the GPS satellites and an extra crest has been seen for GPS in comparison to NavIC C/N0 data. The received multipath signal is interference of direct and reflected signal which are sinusoidal in nature and contains several high frequencies noise signal. In order to analyze the received signal the noise was removed by low pass filter and further detrended to zero level in order to remove all aspect of distortion. The analysis of this multipath signal is done to retrieve the phase of the received signal. The in situ soil moisture was collected with soil moisture probe from the first Fresnel zone of reflection, which is about 6 m². Daily, 18 soil moisture samples were collected and average of these samples were used to calibrate the multipath phase of NavIC and GPS signal. The relationship drawn for the NavIC and GPS C/N0 data is based on phase analysis and in situ soil moisture. The correlation coefficient observed for these parameters was 0.9 and the value of observed RMSE was 0.045. Similar analysis is performed for GPS multipath phase to investigate VMC of soil. The correlation coefficient for GPS L1 frequency is 0.63 and the value of RMSE is 0.4. The result from both GNSS shows good sensitivity and could be used to estimate the soil moisture for agricultural land.

KEYWORDS: Multipath Phase, GNSS, GPS, NavIC, Volumetric moisture content, Soil Moisture.

REAL TIME IONOSPHERIC AND TROPOSPHERIC DELAY RETRIEVAL FROM IRNSS/NAVIC

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ABSTRACT: The very severe cyclonic storm OCKHI was observed on 5th December 2017 over the south-east Arabian Sea and heading towards north-westward direction and hitting over the south Gujarat coastal area Surat region. The unfavourable environmental conditions, like high wind shear and colder sea surface temperatures near the coast, were observed in the Surat city. The navigation signals received at the reference station about 8-10km from the coastal area were observed. The IRNSS/NavIC receiver module receives the real-time log data of satellite navigation signal and out of which observation and navigation file are generated which are helpful for the near real-time estimation of the Ionospheric delay and Tropospheric delay received at the ground-based receiver. The GNSS signal behaviour under the natural OCKHI storm is done using the two IRNSS_GPS_SBAS GNSS receivers provided by the Space Application Centre ISRO Ahmedabad. One receiver is stationary at SVNIT and the other receiver is stationary 8 km south-east direction to it at BMCET. In this experiment the impact of the Ochki cyclone on GNSS signal is observed. The IRNSS/NavIC, GPS and SBAS signals are observed. The results obtained during the 24-hour observation were compared to the previous 2-year data of the user receiver station along with IIRS-ISRO, Dehradun station and found that under extreme cyclone weather condition, the positioning of the user using standalone IRNSS/NavIC receiver was very poor. The algorithm for precise positioning of the user under the harsh environmental condition is to be developed for PPP. The receiver will be receiving IRNSS/NavIC signal and the correction signals will be transmitted to the receiver from the base station for precise positioning during harsh environment and
multipath effect. With this, the user will be having the precise point positioning which is useful for accurate navigation.

**KEY WORDS:** OCKHI, Ionosphere, troposphere, cyclone, IRNSS/NavIC

**ASSESSMENT OF WATER RESOURCE MANAGEMENT BY PRIVATE DEVELOPERS IN GURUGRAM, HARYANA**

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**ABSTRACT:** Water is a natural resource, fundamental to life, agriculture and sustainable development. The Haryana Sub-region is a water scarce, dependent to a large extent on surface water and sources located outside. A Functional Plan on Groundwater Recharge for NCR was prepared in 2009 by NCR Planning Board to assess groundwater resources in NCR and to guide the participating states on various aspects of ground water management in NCR. The distribution of piped water to Gurugram began in year 1990, when city began drawing water from the Yamuna canal in Sonepat. Prior to this, the area was entirely dependent on the ground water as there was no other major source of surface water, such as river to draw from. The launch of city’s first water treatment plant in Basai, helped augment the supply for the then developing sectors between Sector 1 – 57. Since then, these sectors were supposed to rely on the canal water. Despite that, the illegal ground water extraction continued and currently there is a grave water supply shortage particularly in the privately developed areas. Geographical Information System along and Open Data Kit (ODK) which have come as great tools for efficiently collection of data and land use analysis, has been used to study of evolution of water resource in Gurugram. ODK has been used for collection of primary data of Gurugram along with Geographic Coordinates and primary survey of the core of these towns. This data has been used in QGIS along with imagery from google Earth and town and country planning records to study the chronological development of water supply in Gurugram, and formulate policy for sustainable urban water resource management

**KEY WORDS:** Urban Water Resource Management, GIS, ODK

**DELINEATION OF GROUNDWATER POTENTIAL ZONE USING RS AND GIS, IN DEVANAHALLI TALUK, KARNATAKA**

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**ABSTRACT:** Groundwater is the major source of water in the Bengaluru Rural as the city progresses due to the developmental activities the demand for water is also increasing. Groundwater is a portable form of water that can be used without treatment for domestic purposes. Identification of aquifer is a complicated task that can be executed by integrating various thematic maps such as drainage map, geomorphology map, slope map, aspect map, land-use/land cover map and validated with in-situ Borehole data by using Remote sensing and GIS. The Satellite imagery IRS-LISS-III is used for map water bodies. The data are having the 23 m spatial resolution, a swath width of 142 km, temporal resolution one year and spectral resolution of 3 bands from 0.52 to 0.86μm are used to prepare a thematic maps. Devanahalli taluk is a severely drought-affected area in the recent past with hard Gneissose terrain which again does not hold good for the groundwater. Lineaments are another geological structure that can yield a good quantity of water. Terrain belongs to the hard rock runoff is more and infiltration
is very less. Northern part of the terrain has very little groundwater as it contains the high slope and hilly terrain. Southern part of the study area is having good potential zones of groundwater as it has more tanks and 7th order drainages. Slope and aspect of the area reveals that the southern part of the study area has a gentle slope. East and West part of the study area have moderate groundwater potential zones, as they have moderate slopes.

**KEY WORDS:** Aquifer, Water, Drought Management, Gneiss terrain

**DECADAL CHANGES IN LAND USE LAND COVER IN SUB-ALPINE REGION OF DISTRICT BHADERWAH, JAMMU AND KASHMIR USING REMOTE SENSING AND GIS-TECHNIQUES**

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**ABSTRACT:** Having continual, historical and precise information on the Land Use Land Cover (LULC) of the earth surface is very much essential for implementing any kind of sustainable development program. It provides various factors relating to environment, such as soil erosion, hydrological balance, climate and biodiversity. This effect eventually affects the well-being of the society. To perform the Land Use Land Cover, serves as a major input criterion. This study is being conducted to illustrate the approach of Geospatial techniques (Remote Sensing and GIS) in assessing the Land Use Land Cover dynamics. In this study, an ecological assessment of timberline vegetation was carried out during five Decades during 1976-2016 at selected location in the sub-district Bhaderwah of District Doda of Jammu and Kashmir. The classification was applied to five LANDSAT images (1976, 1989, 1996, 2006 and 2016) that were collected to provide the historical conditions of Land Use Land Cover (LULC). This classification was done in eCognition and ENVI, with licensing authority provided by a prestigious institute for better and precise classification. Seven LULC categories were identified in the areas which are forest, Settlement, Water Body and Grassland.

**KEYWORDS:** LULC, Change Detection, Vegetation

**PERFORMANCE ANALYSIS OF TERRESTRIAL LASER SCANNERS FOR POINT CLOUD INTEGRATION**

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**ABSTRACT:** Nowadays, there are various type of Terrestrial Laser Scanner (TLS) scanners with their respective accuracy and product quality. Thus, accuracy assessment is a requisite step if we need accurate result while integrating those scans into one. Precision valuation of multi-data integration is also essential as point cloud density vary with distance and elevation. The current study emphasises on accuracy assessment of two terrestrial laser scanners. The laser scanning systems used for this study are Faro Focus350 and Leica P50. In this paper, the individual as well as comparative study of both the scanners is done, keeping the environment constant in which scans are been acquired. The intensity data was studied for the diagnostics of a building and other structures. The point cloud variation is studied on increasing the elevation of the sample while keeping its XY coordinates constant. In accordance with the result, the RGB value of data obtain from Leica P50 Canon EOS 60D camera differ from Faro Focus350 integrated colour camera. Thus, the final product from these two scanner may show variation when view in true colour composite. But there is not much difference in their point cloud density, so
they are compatible with each other. Though point cloud obtain from Faro scanner shows more detail features for small distance.

**KEYWORDS:** Terrestrial Laser Scanner, TLS, Lidar, Leica, Faro, accuracy assessment

**SCIENTOMETRIC REVIEW OF PUBLICATIONS ON GEOSPATIAL TECHNOLOGY**

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**ABSTRACT:** In the present study, a Scientometrics study was done on the literature present on Web of Science for “Geospatial Technology”. Geospatial technology is a booming area of research which refers to the acquisition of data through different technologies such as Geographic information system, remote sensing, and global positioning system followed by its evaluation to interpret the results. The evaluation and interpretation include raw data processing, analysis, modelling, simulation, visualization and its interpretation. The main objective of this study was to find out research trend in the field of geospatial technology. The result of the search on web of science yielded 242 results. It was found that the highest number of publications were published in 2019 and almost an increasing trendline observed since the year 2000. In terms of document types, research articles were recorded as highest with 214 publications. The country leading in terms of publication in “geospatial technology” is USA followed by India, China, Australia and Canada. The leading journal in terms of publication is Remote Sensing followed by Computers and Electronics in Agriculture and Applied Geography. The leading research areas in which the geospatial technology is applied environmental sciences ecology followed by geology and then remote sensing. From this study it can be concluded that the geospatial technology is highly applied in the field of Environmental Sciences Ecology while its use in the field of agriculture and engineering should be emphasized to meet the sustainable development goals.

**KEYWORDS:** Geospatial Technology, Scientometrics, Geographic information System, Remote Sensing, Global Positioning System

**IMPACT OF CHANGING LANDUSE ON GROUNDWATER, CASE OF ALWAR URBAN AREA**

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**ABSTRACT:** Urbanisation is induced by human activities resulting in landuse –landcover (LULC) change affecting the quality and quantity of water resources (Mukherjee, 2018). Groundwater being the most important resource, has depleted at the rate of 19.2 gigatons per year in northern India (Jain, 2018). Prime reason for groundwater depletion is cited as crop irrigation (Prasad 2018). The authors have explored the changing landcover and landuse in Alwar Urban area to decipher the reason, other than irrigation, for the depletion of groundwater. Alwar, the study area lies in north eastern part of the desert state of Rajasthan, is a semi-arid climatic region. An effort is made to find reasons for depleting groundwater as in the current era of smart, it is pertinent that smart measures be adopted to maintain the water resources, especially in this age when cities are totally drying up. Through this paper, landuse transformation in the region is mapped over a 30years timeline from 1991 to 2020 using LandSAT satellite images. Simultaneously, Groundwater levels are mapped for the same timeline using secondary as well as primary sources. A correlation is established between changing landuse and depleting groundwater using Geographic information System (GIS) and Remote Sensing tools.
ASSESSING THE IMPLICATIONS OF DENSIFICATION ON QUALITY OF LIFE IN RESIDENTIAL AREAS THROUGH GIS: A CASE OF GHAFFAR MANZIL COLONY, OKHLA

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ABSTRACT: House or home is the most important and complex of the three basic needs of human being i.e., food, clothes and shelter (Roti, kapda or makaan). A house is that place where the person rejuvenates from the tiring daily life routine and consider it as a place of happiness. But in today’s scenario brisk urbanization and uncontrolled population growth has resulted in acute housing shortages and has resulted in the depletion of overall quality of life of human beings. Because the area is getting densified, it means that the streets starts getting narrower and obstructs the free flow of natural resources like air, water and light. Looking at present housing typologies, it seems that people are not happy and satisfied with their living conditions and are deprived of basic human needs which are crucial for living as a healthy human being. It is the duty of every urban planner to formulate planning strategies and development guidelines that will contribute to the betterment and satisfaction of each and every household. It is very tedious and difficult to relate the happiness or satisfaction level of individuals or quality of life with respect to housing spatially. But somehow if we are able to relate this issue spatially, it will be very helpful in dealing with the problems arising in urban and regional planning. We all are aware of the fact that now a days GIS technology is widely used in many research disciplines and scientific fields for analysis and as a solution finder to many complex problems. This research paper intends to use GIS technology to map and analyse the implications of densification (built form) on quality of life in residential areas. The study area selected for doing this research is a densified residential colony in Okhla. Initially the parameters for assessing the quality of life is framed and the data is accumulated through questionnaire. It is very important to locate the position of particular data on the map, because then only it can be studied how quality of life changes with respect to location within the same settlement. For this GPS location is noted for all the household that were sampled. With spatial data and mapping, it will be viable to relate how change in built-up foot print and densification impacts quality of life and satisfaction level of each household. The hypothesis of the research is that those houses which are located in the congested areas where the sunlight or air does not enter will be the one having poor quality of life. With appropriate analysis methods and proper mapping, areas with issues and its causes will be highlighted. It will be then easier for the planners to find the solution of the problems that are degrading the quality of life of individuals because now it is known that, what is the problem and where it is.

STUDY AND ANALYZE THE EFFECTS HYPERPARAMETERS OF CONVOLUTIONAL NEURAL NETWORK AND THEIR OPTIMIZATION FOR OBJECT DETECTION IN SATELLITE IMAGERY

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ABSTRACT: The presented works aims to investigate relationship between multipath phase of Global Navigation Satellite System (GNSS) and volumetric moisture content (VMC) of soil. The carriers to noise ratio (C/N0) data of multipath signal at two different frequencies have been analyzed. The first one is India’s NavIC L5 frequency (~1176 MHz) and second one is GPS L1 frequency (~1575 MHz). The multipath data has been collected by IRNSS/GPS/ SBAS (IGS) through single antenna, situated in agricultural field at a height of 2.16 m from the soil surface. The observations were taken and analyzed continuously for 30 days. The received multipath signals are highly dependent on dielectric value of
soil and elevation angle of satellite. Various research works suggest that the range of elevation angles that can be considered for soil moisture studies with GPS L1 is 5° to 30°. Whereas, the variation of elevation angle to determine the phase of NavIC multipath signal is 15° to 30°. It was observed that the time taken by NavIC satellites to complete this elevation range is almost double the GPS satellites and an extra crest has been seen for GPS in comparison to NavIC C/N0 data. The received multipath signal is interference of direct and reflected signal which are sinusoidal in nature and contains several high frequencies noise signal. In order to analyze the received signal the noise was removed by low pass filter and further detrended to zero level in order to remove all aspect of distortion. The analysis of this multipath signal is done to retrieve the phase of the received signal. The in situ soil moisture was collected with soil moisture probe from the first Fresnel zone of reflection, which is about 6 m2. Daily, 18 soil moisture samples were collected and average of these samples were used to calibrate the multipath phase of NavIC and GPS signal. The relationship drawn for the NavIC and GPS C/N0 data is based on phase analysis and in situ soil moisture. The correlation coefficient observed for these parameters was 0.9 and the value of observed RMSE was 0.045. Similar analysis is performed for GPS multipath phase to investigate VMC of soil. The correlation coefficient for GPS L1 frequency is 0.63 and the value of RMSE is 0.4. The result from both GNSS shows good sensitivity and could be used to estimate the soil moisture for agricultural land.

KEYWORDS: Multipath Phase, GNSS, GPS, NavIC, Volumetric moisture content, Soil Moisture

ANALYSING IMPACT OF METEOROLOGICAL DROUGHT ON AGRICULTURAL USING GOOGLE EARTH ENGINE: A CASE STUDY ON PENNAR RIVER BASIN

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ABSTRACT: Drought is one of the frequently observed natural hazard resulting from precipitation deficit and increased evapotranspiration caused by high temperatures. Remote sensing indices are used to analyse spatio-temporal distribution of drought conditions and identify drought severity. In this study, we analysed the relationship between precipitation anomaly from ERA-5 dataset with respect to MODIS derived Normalized Differential Vegetation index (NDVI). The time series were also created for some specific locations to deeply analyse the drought conditions in 20-year period. Our results show that there is a good correlation between both the parameters. Moreover, GEE platform is very handy and rapid tool to reach related satellite images and conduct remote sensing analysis of huge and long term date efficiently. Geospatial big data could be successfully accessed and processed in this platform not only for drought monitoring but also for other environmental monitoring applications.

KEYWORDS: NDVI, GEE, ERA-5, MODIS.
Oral Presentations

Theme 1: Geospatial Applications in Geosciences and Natural Hazards
REMOTE SENSING & GIS TECHNOLOGY AND FIELD BASED MONITORING OF URBAN FLASH FLOOD ZONE FOR FUTURISTIC MANAGEMENT, KANPUR, UTTAR PRADESH, INDIA

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ABSTRACT: In the era of climate change world population facing multiple disaster (i.e. Flood, earthquake, mass wasting, landslide, hurricanes, drought, cyclone, Tsunami, heat wave and cold wave, volcanic eruption) situation with changing geological clock, ecological clock and biological clock. Now science & technology play vital role in many ways for managing this climatic shift scenario for the sustainable development. At global level almost all the continents facing variety of environmental issues as per their biogeography like Australia, South Africa, America facing forest fire in tropical zone, temperate zones suffering cold waves and extremes snow fall on lithosphere like Canada etc. National, regional and local regions also facing environmental challenges due to rapid population growth, technological trash, changes in biogeochemical cycle in the ecosystem, artificial world and intelligence etc. In current scenario the metro cities of India during monsoon period frequently are facing the urban flash flood problem from last many decades due to urban and periurban sprawl and urban heat island etc. Due to this life style of urban people became tough in low lying and artificial waterlogged areas (depression zones) due to excessive overflow of water in the drainage of the city. During this period the public face some additional issues like congestion in traffic, seepage in drinking water pipes, electricity, import and export of goods like vegetables(specially for local vendors), inflation, lack of medical facility, blockage of roads diversion of route and delayed in railways, airways etc., effects in community crops and gardening, communication, health issues (water borne disease) etc. Remote sensing and Geographical Information System play very significant role in this study with rainfall data and limited field data to know the urban flash flood prone zone and field situation during the monsoon season as well as causes of urban flash flood in the Manchester of north India. This would be added advantage to the administration of the city for the preparation of future urban flash flood zone management plan, flood affected compensation plan map at each level through cadastral map to know the priority zones and severity areas for immediate action and aware, alert the public before pre-monsoon, during monsoon and post-monsoon for the adverse impact.

KEY WORDS: Urban, Environment, RS &GIS, Planning

ANALYSIS OF UTTARAKHAND FOREST FIRE WITH LANDSAT 8 IMAGERY FOR YEARS 2015 TO 2019: A CASE STUDY OF PAURI DISTRICT

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ABSTRACT: forest fire is one of the disasters causing threat to biodiversity and it has various adverse effects on the environment. The burning can reduce the soil nutrients and makes it more vulnerable for soil erosion. The smoke and pollution release due to fire can cause various types of respiratory diseases. Therefore, it is vital to have accurate and timely information of fire. With the adoption of free data policies and advancement in instruments and technology, this life taking threat can be detected and managed timely. Though the ultimate goal is to protect our forests from this life taking threat, the main objective of this paper is to review the capability of existing fire detection algorithms on Landsat 8 data for Pauri Garhwal region of Uttarakhand, India. The studies have been conducted for the years 2015 to
2019 with the help of high spatial resolution (30 m) Landsat-8 imagery. The algorithms used to study the active fire were developed by Schroeder et.al, 2015. These algorithms are mostly based on fire sensitive short wave infrared channel 7 which uses the emissive component of fires in the 2.2 μm spectral window, near infrared channel 5 which is mostly unresponsive to fire and accompanied by visible channels 1-6 data. Initial validation has been done with visual interpretation but the conformity has been done using fire points from existing fire detecting and monitoring instrument (MODIS and VIIRS) which provides real-time forest fire data regularly. The result of Landsat 8 fire detection algorithms shows the significant increase in the detection of small fires which is not possible with existing fire detection system. More detailed mapping of fire front can also be done with the help of Landsat 8 due to its much finer spatial resolution than MODIS and VIIRS. Due to higher temporal resolution of 16 days of Landsat 8 data, analysis of burnt area, determination of fire risk zone and a wide range of applications such as air quality monitoring and a strategic fire management can also be carried out. This paper also suggests that the remote sensing with the combination of GIS tools can be the most promising technique to deal with such life causing threats.

KEY WORDS: forest fire, Fire detection, Landsat 8, MODIS, VIIRS, OLI data

ASSESSMENT OF MORPHOMETRIC PARAMETERS OF SUB-WATERSHED FOR GHATSHILA REGION USING REMOTE SENSING AND GIS

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ABSTRACT: Assessment of morphometric parameters is important in prioritizing any sub-watershed. Moreover, the geomorphological characteristics of a watershed has been more commonly used for developing the regional hydrological models for solving various hydrological problems of the ungauged watersheds in inadequate data situations. Although, the physical characteristics of watershed is one of the regions of sedimentation in the watershed. Remote sensing (RS) and Geographic information Systems (GIS) techniques has been very effective tool for delineation and stream generation of watershed. In the present study, ArcSwat extension tool interfaces in ArcGIS 10.2 were used for automatically delineation of Ghatshila watershed of Subernrekha River Basin. The watershed then further divided into 25 sub-watersheds using ArcSwat extension tool. The Alos Palsar digital elevation model (DEM) having high resolution of 12.5m were used for delineating and stream generation for the watershed. The ArcSwat extension tool identify the outlets in DEM and automatically delineate the watershed for selected outlet. For stream generation, the various tools like spatial analyst tool, data management tool etc. were used. The area of sub-watersheds varies from 49.8311 km2 minimum and 664.738 Km2 maximum. The drainage map of eight order stream were obtained for Sub_Ws4, Sub_Ws5, Sub_Ws9, Sub_Ws11, and Sub_Ws12. The basin length for sub-watersheds varies from 10.74 km to 49.04 km. The results showed that the values vary for drainage density circulatory ratio, infiltration number and relief was 1.378 km/km2-1.604 km/km2, 0.118-0.238, 1.95-9.41 per km3, and 68-802 m respectively for sub-watersheds. The many other parameters were evaluated such as stream frequency, drainage texture ratio, length of overland flow, form factor, compactness coefficient, and ruggedness number. These results show that the watershed be treated with suitable conservation measures and proper water harvesting structures. Thus, the present study demonstrates the utility of RS and GIS techniques in morphometric analysis.

KEYWORDS: Morphometric parameters, ArcSwat, ArcGIS 10.2, Remote Sensing, and Ghatshila
ABSTRACT: Forest fire is one of the major causes of the ecological degradation and biodiversity loss. Forest fires have social, economic and environmental impacts. It affects the flora and fauna of the region, livelihood of people depending on it, causes increase in the greenhouse gases emissions like CO2 etc. The objective of this paper is to assess the forest fire progression during the fire season i.e. In the months of April and May (2019) and how this is affected by the vegetation type, topography, meteorological and anthropogenic factors in parts of Pauri district of Uttarakhand. Sentinel 2A & 2B data is used to calculate Differenced Normalized Burnt Ratio (dNBR) to monitor and assess the progression of forest fire in the study area using datasets for approximately every 10 days interval. The results shows that the area affected by fire was initially less in the beginning of April but by the mid of April it progressed at a larger area of around 50 thousand hectares in approximately 13 days. Then the fire progression gradually slowed down and towards the end of fire season it covered only the area of about 550 hectares. This study also concludes that the progression of the forest fire is observed more towards the steeper slope with an elevation of about 1000m to 2000m and as expected the proximity to the road plays an important role in the initiation of the fire. This study will help in understanding the fire behaviour for the planning of forest fire mitigation measures and restoration and rehabilitation activities.

KEY WORDS: Sentinel, fire progression, NBR, forest fire, Uttarakhand

ABSTRACT: The Gravity Recovery and climate experiment (GRACE) is a very important tool to monitor the changes in water resources over the globe which was launched as a twin satellite in May 2002 in the lower earth orbit by NASA and German aerospace center. The objective of this work is to explore and study the scope of drought monitoring using gravity recovery and climate experiment (GRACE) in Marathwada, Maharashtra (India) and for validation, the 2009-2010 drought of Maharashtra is considered. The GRACE provides 250 gravity profiles per day and that leads to changes in water storage within the earth's surface. The data from GRACE as terrestrial water storage represents the combination of the surface as well as subsurface water and therefore it is an important tool to analyze the overall changes in terrestrial water storage that lead to a better understanding of drought. For drought, the terrestrial water storage data of GRACE from Jet Propulsion Laboratory (JPL) is used in the form of equivalent water thickness and the monthly average is calculated from the year 2002 to 2015 for determining the monthly deficit in terrestrial water storage by taking the difference between average water storage and the monthly values. The monthly deficit will represent the drought severity by multiplying the duration of deficit and its magnitude. The same approach can be used for analyzing flood by GRACE, in which the excess terrestrial water is calculated from its monthly average of GRACE terrestrial water storage anomaly. The data shows the average magnitude of 2009-2010 is -157.794 mm, the highest deficit in the GRACE series. The summer of 2010 also showed a deficit of about -101.774 mm and the deficit can be observed as a negative value in the deficit curve from May 2009 to May 2010, a twelve-month drought duration. As GRACE is capable of providing the surface as well as subsurface water storage data, it can be a very powerful tool to analyze the drought than the
other indices. For validation, the GRACE based drought index is then compared with the other conventional index and it shows a good correlation with the different indices in the different seasons. The GRACE based drought index is compared with the monthly SPI and NDVI based drought index for premonsoon, monsoon, and post-monsoon seasons. The study shows the GRACE based drought index includes all aspects of water storage deficit including groundwater and soil moisture which important for a region like Marathwada, as many farmers depend on groundwater resources.

KEYWORDS: GRACE; Drought; water deficit; Marathwada; Drought indices

ESTIMATION OF SOIL EROSION USING GEOSPATIAL TOOLS: A CASE STUDY OF INDRAVATI BASIN, CHHATTISGARH

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ABSTRACT: Soil erosion is a major issue for an agriculture dependent country like India causing the loss of top fertile soil. The quantitative assessment of soil erosion by geospatial method can help in designing control measures to reduce the erosion. In the present study, Revised Universal Soil Loss Equation (RUSLE) is adapted to calculate the annual loss of the soil from indravati Basin, Chhattisgarh. The indravati Basin is a northern tributary of the Godavari River spreading over 40634 km2 area and observes the highest amount of erosion compared to other catchments of India. Inputs parameters RUSLE were derived using remote sensing and ground observed data. In the present study both magnitude and spatial distribution of erosion was calculated. The derived annual soil erosion map was classified into five zones varying from slight to severe soil erosion hazard. Further the soil erosion map is linked with different elevation and land use land cover zones to identify the area of conservation to reduce the soil loss. The average soil loss rate from the basin was found to be 9.2 tons/ha/year and the maximum soil loss rate was around 56 tons/ha/year. The sediment yield found at the outlet is around 24.50 million tons per annum which shows a surge compared to the average annual sediment yield (1992-2002) of 21.20 million tons from the observed value of Central Water Commission (CWC).

KEYWORDS: Soil Erosion, RUSLE, GIS, Remote Sensing

MORPHOLOGICAL CHANGE STUDIES OF CAMORTA ISLAND, INDIA: A REMOTE SENSING & GIS BASED APPROACH

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ABSTRACT: During the 2004 Sumatra-Andaman earthquake and tsunami, Nicobar group of Islands apprehended the attention of the world Ocean scientific community and the Indian Ocean Countries for its devastating loss of lives and damages to the Islands coast. Use of Earth observation data and techniques are of great importance in the case of Nicobar Islands as ground access is restricted due to their protected status. Most of the studies on the shoreline and coastal morphological analysis were carried out in many parts of the main land coastal region but found limited for Islands. There is an immediate need of continuous monitoring of Shorelines to understand the causes and consequences that occurred due to the impact of the Tsunami Waves, especially in the case of Islands. The present study aimed at main objective viz., computing the rate of erosion and accretion. To achieve the objectives, we attempted the shoreline and morphological change analysis using high-resolution earth observation
satellite images of Camorta Island because of its worse impact during the 2004 tsunami event. Based on Earth-observation data analysis, we observed a shift in coastal shoreline towards inland in Island due to erosion. However, in few cases, accretion was seen due to outward shift of shoreline. This study can play a significant role in coastal management, which in turn may be utilized to protect the Central Nicobar Islands, recognized as the World Biosphere Reserve by the UNESCO and gives an outlook of the change that occurred due to the 2004-tsunami.

ESTIMATING SEDIMENT YIELD AND RUNOFF USING GEOWEPP OF WATERSHED IN NORTH WEST HIMALAYAN REGION

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ABSTRACT: Sediment yield and runoff are two parameters to determine soil erosion dynamics. Many model exist in literature which estimate these parameters, Geo-WEPP is a special model as it verifies the site and time of sediment yield and runoff occurrence and detects possible deposition areas. We estimated sediment yield and runoff using Geo-WEPPP for sitlarao catchment area in the North-West Himalayan Region of Uttarakhand state, India. GeoWEPP model requires input data of land cover, slope, climate, soil and management generated within the GeoWEPP interface. The climate parameters were estimated by CLIGEN (CLImate GENerator). Soil texture, OC, bulk density, and coarse fragment were used to describe a rationale range of properties. Calibration and validation of the model was done by observing data of the outlet from 2015 to 2017. Total runoff and sediment yield data collected in 2015 and 2017 were used for calibration, and for validation, we used 2016 data. Runoff and sediment yield outcomes from the GeoWEPP model were compared with the observed results to analyse the performance of the model. High coefficient of determination (0.85 and 0.89) and low RMSE values of 4.35 mm and 2.53 t/ha confirm the robustness of the investigated model.

KEYWORDS: GeoWEPP, Sediment Yield, Runoff, GIS.

PLANNING OF SOIL EROSION AND CONSERVATION PRACTICE FACTOR FOR REDUCTION OF SOIL LOSS BELOW TOLERABLE LIMIT IN KONKAN REGION OF MAHARASHTRA

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ABSTRACT: Soil and water are vital natural resources. Today, soil erosion is major global issue in many parts of the world, especially in tropic and sub-tropics. Soil erosion exceeding the soil formation rates leads to decrease the soil fertility, agricultural productivity which ultimately reduces the farmer income. Thus, it is important to attaining long-term sustainability balance between soil-forming and depleting processes (Kumar and Pani, 2013). Assessment of soil erosion is an expensive and intensively long exercise. Modern geospatial techniques such as Remote Sensing (RS), Global Positioning System (GPS) and Geographical information System (GIS) have been providing newer dimensions to monitor and manage soil resources for their effective utilization as well as effective for mapping and characterizing land resources. The present study estimates the soil erosion by combined use of USLE model and geospatial technologies. Similarly, pedogenesis process was considered for estimation of soil formation rate in Konkan region of Maharashtra. The tolerable limit was estimated by considering soil, climate and productivity of land, to find out conservation practice factor to reduce the soil loss below tolerable limit. Estimated average annual soil loss per year in Konkan region of Maharashtra was found as 119.84 M tonnes before adoption of soil and water conservation measures. Result shows that,
more than 70% of area comes under severe (20-40 t/ha/yr) to extremely severe (>80 t/ha/yr) erosion classes in Konkan region which was cause of concern. This proves the high need of soil and water conservation measures in the watershed for the sustainable management of natural resources. Average tolerable soil loss was estimated as 9.44 t/ha/yr for Konkan region. Conservation practice factor (P) was found as 0.3 to bring the soil loss below tolerable limit. Various conservation measures and recommended crop cycle needs to be adopted to achieve the average annual soil loss as 9.02 t/ha/yr which is below tolerable limit. The study shows that, the combined use of USLE model and geospatial technologies are effective tools for planning of soil and water conservation measures in Konkan region.

KEYWORDS: Soil erosion, USLE, RS and GIS, tolerable soil loss, conservation practice factor.

ASSESSMENT OF SEDIMENT YIELDS FROM MPKV WATERSHEDS USING REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM (GIS)

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ABSTRACT: Assessment of sediment yield and prediction of soil erosion hazards are playing vital role for effective soil conservation planning of a watershed for sustainable development. Soil conservation is now a necessity in almost every country of the world under virtually every type of land use. Remote sensing data and GIS techniques have been used to compute sediment yield from the MPKV, central campus (east) watersheds occupying an area of 3903.3 ha. The sediment yields of watersheds were calculated by Revised Universal Soil Loss Equation 3D (RUSLE 3D) using remote sensing and GIS techniques. The results of the analysis pertaining to soil erosion revealed that the average annual soil loss of the MPKV, central campus (east) watershed WS_1 was ranged between 0 to 1.3 t ha-1 year-1 and 0 to 21.72 t ha-1 year-1 for WS_2. It indicates that the area under these watersheds is under very low to low erosion risk class. The sediment delivery ratio for the WS_1 was 0.238 and 0.212 for WS_2. Sediment yield for WS_1 watershed ranged between 0 to 0.273 t ha-1 year-1 and 0 to 4.6t ha-1 year-1 for WS_2 watershed. These results will be useful for watershed management of MPKV watersheds and for assessing water availability in the study area for efficient water management. This approach could be applied easily for other watersheds for efficient and effective planning and implementation for various conservation measures.

KEYWORDS: Soil erosion, runoff, sediment yield, watershed planning and management

APPLICATIONS OF REMOTE SENSING AND PHOTOGRAMMETRY TECHNIQUES IN LANDSLIDE INVESTIGATION AROUND GURUDA- ODISHA

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ABSTRACT: Landslides are one of the most common natural disasters in mountainous/hilly regions all over India. According to a recent report of the Geological Survey of India on the landslide vulnerable zone, approximately 0.42 million square kilometers of land area in India is prone to landslides. However, landslide vulnerable hot spots in the Eastern Ghats remain unknown and do not appear in this figure. The primary trigger for landslides in hilly terrains is rainfall, which saturates the soil and lowers the stability of a slope. With the onset of climate change, such natural disasters have been intensified causing tremendous damage. The state of Odisha is frequently hit by severe storms and tropical cyclones, which trigger numerous landslides in the districts encompassing the Eastern Ghats. No detailed landslide studies have been carried out in this vulnerable region and neither does slope stability data exist, mainly due to the ruggedness of the topography, lack of infrastructure and manpower to
physically survey the region. One of the alternative and low cost approaches for pilot study slope stability mapping terrain is using Remote sensing techniques. In this study, we highlight the outcomes of our pilot study on mapping and identification of landslide susceptible areas in an around Guruda in the Ganjam district of Odisha that suffered major landslides after cyclone Titli in October 2018. A study of the area through high resolution satellite imagery yielded 3 hotspots for future study. Analysis using ArcGIS and Global Mapper software packages was used to create a drainage basin map and using an SRTM DEM the slope angles were also obtained. Slopes greater than 30 degrees were found to be theoretically unstable, but this was not the case. Hence there was a need to carry out an in-depth study of what caused the landslides. This was done by creating a digital elevation model (DEM) using satellite imagery. The slope stability analysis was then carried out using the DEM and a software package developed by the USGS called Scoops3D which requires an input of certain parameters obtained by testing soil samples collected on field. This enabled us to create a 3D model of the area, calculate the displaced volume, identify unstable slopes and calculate the factor of safety for each point which can also be presented as a map layer. This 3D model of slope stability can also help generate a landslide susceptibility map created with various other geofactors, for future studies in the region thereby providing information to the government and the locals about the risk prone areas to prevent loss of life and property.

KEYWORDS: Landslide susceptibility, Slope stability, Scoops3D, DEM, Soil testing

AUTOMATIC FLOOD MAPPING USING SENTINEL-1 GRD SAR IMAGES AND GOOGLE EARTH ENGINE: A CASE STUDY OF DARBHANGAHI, BIHAR

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ABSTRACT: Bihar has been highly affected due to the catastrophic flood events occurring every year. Mapping near real-time flood inundation is a vital input for decision makers to take effective response. Remote sensing has shown outstanding potential in flood mapping in recent years. With increased availability of active microwave remote sensing data, the operational flood mapping at near real-time can be taken up to support the disaster management authorities. This study presents an automatic flood inundation mapping approach from Sentinel-1 synthetic aperture radar (SAR) data exploiting Google Earth Engine (GEE) platform. The 2019 Bihar floods affected which affected 13 districts of North Bihar, India and caused 130 deaths by the end of July, is selected as study domain for the present paper. Around 88.46 lakhs (8.846 million) people from 1269 panchayats (settlement councils) under 92 blocks of Northern Bihar were severely affected in the flood. For mapping flood inundation the optimal threshold value of VV polarised backscatter image of Sentinel-1 is identified based on Otsu’s method. In addition, degree of slope generated from ALOS PALSAR DEM is also considered in order to minimize the misclassification over back-slope regions of SAR data. Thus, this approach can be utilized exclusively for operational flood inundation mapping and monitoring.

KEYWORD: Flood Mapping, GEE, Sentinel-1
Theme 2: Geospatial Applications in Urban & Regional Development
EVALUATION OF URBAN SPRAWL AS A PARAMETER FOR DISEASE SPREAD USING GEOMATIC TOOLS

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ABSTRACT: Due to rapid urbanization, there is danger in the spread of infectious disease which is high also this leads to bad living conditions. Remote sensing and GIS is integrated to obtain an Entropy matrix by Shannon number. Shannon Entropy is an index used here in quantifying the degree of dispersion/concentration of urbanization. This matrix is used to analyse the infected area also it can be trained to control the spread of disease. Hence with remote sensing, GIS, Photogrammetric techniques the present and future spread of disease can be analysed by Time series data, this facility can assist in monitoring the living conditions of the urban area.

USE OF GIS FOR STUDY OF URBAN FORM OF HISTORIC TOWNS IN KARNATAKA

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ABSTRACT: Urban form evolves constantly due its response to social, technological, economic and environmental policies and development. The study of urban form analyze complex result of historic constraints and how urban form was conceived, analyzed, built and modified over space and time. Karnataka is the 4th fastest urbanizing State in India, with about 34% of its population as urban. Located in the Southern region of India, Karnataka has a population of 61.09 million (Census 2011) making it India’s ninth most populous state. The Government of Karnataka has notified 6 settlements namely Kittur, Bidar, Bijapur, Mysore, Sri-Rangapatnam and Badami as historic settlements in Karnataka in 2005. 14 more in the next list of heritage cities including Gulbarga (Kalburgi). These historic towns trace their history to prehistoric times, having a number of archaeological sites in the near vicinities. The towns are dotted with heritage buildings and sites and predominantly present medieval character, though the towns might be having a number of layers of development. Geographical information System along and Open Data Kit (ODK) which have come as great tools for efficiently collection of data and land use analysis, has been used to study of evolution of historic towns in Karnataka. ODK has been used for collection of primary data of these towns along with Geographic Coordinates and primary survey of the core of these towns. This data has been used to in QGIS along with imagery chronological of these towns from google Earth and historic and town and country planning records to study the growth of these towns and formulate policy for sustainable urban form of these towns. Key words: Urban form, Historic Towns, GIS, ODK

COMPREHENSION OF LAND USE DYNAMICS FOR DESIGNING SMART AND SUSTAINABLE CITY - DHARWAD, KARNATAKA STATE, INDIA

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ABSTRACT: The rapid urbanisation have been posing serious challenges to the city planners due to lack of basic amenities, infrastructure, etc. The increase in urban agglomeration pose serious impacts
on the local environment such as enormous land consumption, air pollution, water scarcity, poverty, social segregation and vulnerability. Planned urbanisation path would help in maintaining the ecological, economic and social integrity of a region. The availability of spatial data at regular intervals helps evolving better urban development strategies with the long term sustainable land use policies with the prudent urban environmental management. Temporal remote sensing data aids in the monitoring and visualization required for sustainable urban planning. Dharwad district has been experiencing rapid urbanization in recent times and the city has been chosen by the Government of India under smart cities program. The study analyses the spatial patterns of urban growth using temporal remote sensing data of 1989 to 2019 along with ancillary data, including virtual data (such as Bhuvan and Google Earth). Land use analyses reveal a decline in forest cover (7.87 %), with an increase in monoculture plantation (4.02%) and built-up (2.73 %). Simulation and visualization of likely growth would help in planning and provision of basic amenities and infrastructure. CA_Markov model integrated with AHP has been used for simulating the likely spatial growth by 2029. The built-up cover will increase to 7% with loss of forest cover and agriculture. The city sub-urban areas and new satellite towns will witness largescale changes. The results provide a base for decision-making and framing sustainable land use policies towards prudent management of natural resources.

KEYWORDS: Land use Dynamics; Natural Resource management; Fuzzy-AHP-CA; Modelling

STUDY OF HEAT WAVES AND URBAN HEAT ISLAND INTERACTION IN A SINGLE FRAME USING REGIONAL CLIMATE MODEL: WRF-URBAN

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ABSTRACT: A heat wave is a short-term phenomenon. Severe heat waves have a negative impact on human health, increases the mortality rate (more in children and older age groups), water resources, agriculture etc. Therefore, it is important to study heat wave events, so that an adequate warning system can be introduced for the safety of common people. Currently, the analysis and illustration of heat waves in a comprehensible and manageable way is a critical challenge for climate services. The recognition of heat waves is based on high quantities of daily temperature distributions, and can be applied to any temperature series. The heat waves are indicated by their duration, frequency and intensity. Urban environments and heat waves interact synergistically and increase the thermal environment through the effect of the urban heat island (UHI). The potential for a projected warmer future climate to compound heat waves in urban environments is a matter of concern. In this case study, heat wave analyses has been done over the region of Delhi using WRF-urban model. Domain configuration has been done in the manner that regional phenomenon (heat wave) and local phenomenon (pre-existing UHI) both could be covered and heat wave variation in the core built up area due to presence of pre-existing heat island could be observed. The simulation has been carried out for six days of May 2016. As this study includes fine resolution domain, and performing 5 nested (online) model simulations need huge computational resources that can be reduced if major characteristics are observed from coarser resolution, before performing finer resolution WRF simulation. So, a very limited explored technique named nest down (n down) technique has been used in which the output of coarser domain has been used as input for finer domain and these simulations have been performed offline. NCEP GFS data at 0.25° has been taken for boundary and initial conditions and LSPs like LAI, Fapar, Albedo, etc., have been updated in the model. The results were validated through IMD data. Temperature and relative humidity correlation between model and IMD values at Delhi (for example) were observed as 0.96 and 0.62 respectively in domain3, 0.95 and 0.74 respectively in domain4, and 0.86 and 0.48 in domain5. These correlations when compared with the earlier studies using nested (online) simulation, it was found to be at comparable scales. Hence, nest down approach could be used to study the regional and local phenomenon that too with the low computational resources and time.

KEYWORDS: Heat Waves, UHI, WRF-Urban, n-down, Domain Configuration
SPATIO TEMPORAL VARIABILITY OF AIR POLLUTANTS AND ITS RELATION WITH URBANIZATION AND VEGETATION IN DELHI

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ABSTRACT: Timely information with respect to variations in the levels of air pollutants in urban regions is needed for implementing appropriate preventive actions. Present research is an integrated approach to attain the spatio-temporal attributes of air pollution index of particulate matter (PM10 and PM2.5) and traces gases (O3, NO2, and CO) pollutants in Delhi. Values of different vegetation indices and urbanization indices resulting from Satellite images were employed to understand the relation with Air Pollution indices (APIs), which were intended from field based air pollution data. The spatial variation of API for different air pollutants was simulated using the inverse distance weighted (IDW) interpolation method. It was observed that among all the vegetation indices, the highest correlation of pollutants was with SAVI. Results also revealed a positive correlation of air pollutants with urban settlement density. Among all the urban indices, the highest correlation of pollutants was with UI. The correlation between APIs, vegetation/urbanization based indices suggests that areas with low vegetation and dense urbanization are consistently pertaining to elevated concentrations of air pollutants.

KEYWORDS: Air Pollution index (API), Satellite Data, Correlation, Vegetation indices, Built-up indices

MONITORING SPATIAL LULC CHANGES AND ITS GROWTH PREDICTION BASED ON STATISTICAL MODELS AND SATELLITE DATA OF LUCKNOW CITY

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ABSTRACT: Rapid augmentation of cities all over the world has become an inevitable phenomenon. As the population continues to grow, the geographical boundaries are expanding too. Various aspects of urbanization such as high rise buildings, easy commute via metro, modernized recreational spaces over the period of 19 years and which are still flourishing very rapidly, are the major factors contributing to the intensified population shift from rural areas to metropolis. This attraction is especially strong in developing countries such as India, where cities have had a disproportionately large share of modern residential & commercial growth. The study focuses entirely on the developments in urbanized cities and its expansion with help of spatial variation using time-series data and statically generated models to observe the pattern of LULC transition in the last 19 years of one of the most expeditiously urbanizing city of India Lucknow the city sits on the banks of the Gomti River, a left bank tributary of the Ganga River. The Landsat satellite data is used to achieve the metropolitan area’s spatial transition from 2000 to 2019. The classified report showed an increase of 96.51 km2 of built-up area and an overall shrinkage in covers of agricultural land and vegetation cover. To measure the changing spatial trends in urban extension, Shannon Entropy index method is applied over the selected period of time based on LULC change and statistical approach. Prediction of changing pattern is also done for year 2029 using Artificial Neural Network (ANN) on QGIS 2.18. The observation we got from this study is on the basis of classification and statically developed model of a satellite data. The predicted information will be
valuable for our urban policy and decision makers of different competent authorities to understand this in a better way for sustainable urban and regional planning in cities.

KEYWORDS: LULC change, Shannon entropy, ANN, Prediction

REVIEWING THE IMPORTANCE OF THREE DIMENSIONAL MAPPING OF UNDERGROUND UTILITIES IN BIHTA, BIHAR

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ABSTRACT: India’s urban population is growing to see a manifold increase in the coming decades. With increasing load on urban management and infrastructure, one way to provide an efficient infrastructural facility will be through efficient urban infrastructure and utilities. Growing cities will create a need to utilise the underground or space below the stratum to ensure efficient infrastructure service delivery to all its end users. In order to ensure optimum performance and monitoring of the service, the utilities and infrastructures must be mapped in three dimensions. Both new and existing infrastructures must be mapped which will make the monitoring and maintenance efficient. This paper highlights the importance Geospatial applications in the development of 3-d utility maps in Indian scenarios, taking a specific case of the city of Bihta, Bihar. Several case studies from cities already using such maps have been studied to ensure establishing best practices in geospatial applications from across the globe in ensuring better mapping services. The intended outcome of the study is reliable information about the advantages of three dimensional utility and infrastructure mapping in Indian cities. This study can be of vital information for practical application by urban administrators and practitioners.

KEYWORDS: urban infrastructure, utilities, three dimensional mapping, geospatial services

ASSESSING THE THERMAL BEHAVIOUR OF URBAN MATERIALS USING HYPERSPECTRAL DATA IN AHMEDABAD CITY, INDIA

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ABSTRACT: With accelerating urbanization, natural landscapes are tremendously changing to urban landscapes and impervious built surfaces. This is leading to the degraded thermal environment in urban areas because of the higher thermal capacity and conductivity, solar radiation and absorption associated with the materials present. The heterogeneity in urban landscapes with different types of land-use/land-covers and surface materials plays a vital role in regulating the urban thermal environment within a city. The study focuses on the identification of major urban materials in Ahmedabad City through HSRS imagery and analyzing the role of different surface materials on the urban heating scenario in the study area. The hyperspectral imagery procured by Airborne Visible and infraRed Imaging Spectrometer – Next Generation (AVIRIS-NG) during February 2016 was used to classify urban materials and Landsat-8 data was used to estimate land surface temperature (LST) through Radiative Transfer Model (RTM) for quantification of urban heating. Two classification techniques, Spectral Angle Mapper (SAM) and Support Vector Machine (SVM) were performed to classify the selected study area into five natural materials (water, bare soil, grass, crop, and trees) and six man-made materials (asphalt, PVC, marble, tin, concrete, china mosaic). The overall classification accuracy obtained through SVM (95.41%) was better than that obtained through SAM (70.68%). The highest mean LST of man-made urban material is observed for tin (29.68°C) followed by asphalt (29.49°C) and the lowest is observed for china mosaic
The range of LST of man-made surface materials is between 5-11°C, lowest LST values are observed in areas surrounded by vegetation and water and highest in areas surrounded by high heat absorption materials like asphalt and tin. This indicates that a material’s heating behaviour is not only dependent on its thermal properties but also depends on the surrounding materials. The integration of information acquired from both HSRS and TIR shall add in understanding the relation of the urban thermal environment with urban surface characteristics.

**KEYWORDS:** urban heating, urban materials, hyperspectral remote sensing, land surface temperature

**ANALYSIS OF URBAN SPATIAL GROWTH PATTERNS IN RUDRAPUR CITY**

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**ABSTRACT:** Incessant urban growth has drastically transformed the urban landscapes. This has necessitated understanding of the spatial and temporal patterns of urban growth. Hence, the current research attempts to study and analyze the spatio-temporal patterns of urban growth using Urban Landscape Analysis Tool (ULAT) in the city of Rudrapur, Uttarakhand. In this study, land cover maps having three classes of urban, water-bodies and others are used to extract the degree of urbanization in the study area for the period 2009-2019. Subsequently, the Urbanized Area (UA), Urban Footprint (UF) and New Development (ND) maps are the resultant outputs generated. The urbanized area (UA) determined three levels of spatial density in the built-up area, namely, built-up area, the urbanized open land, and the captured open land. Similarly the urban footprint (UF) also discerns the built-up area, the fringe open land, and the captured open. New development map had the following three classes, infill (newly developed pixels that are in the urbanized open); extension (newly developed pixels that are in the fringe open land of the previous time period); and leapfrog (newly developed pixels that are outside of the rural open land of the previous time period). The sub classes of the built-up area give insights to the changing morphology of the city with time. The findings of the study suggest that the pattern transformation in the city of Rudrapur is taking place towards the north, north-western and south-eastern directions. Hence this study enables in understanding and analyzing the urban expansion and its patterns; and eventually the identification of the priority areas for better planning and management of the city for sustainable urbanism.

**KEYWORDS:** Urban Growth, Urban Landscape Analysis Tool, Spatial density

**SPATIO-TEMPORAL DYNAMICS OF THE THERMAL COMFORT INDEX IN DEHRADUN**

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**ABSTRACT:** Urban thermal Field Variance index (UTFVI) is used for the ecological evaluation of Urban Heat Island (UHI). In the present study spatio-temporal dynamics using UTFVI has been for evaluating the thermal comfort index and extent of UHI. An attempt has been made to find out the ecological evaluation of UHI in Dehradun planning area. Dehradun, the capital of Uttarakhand state is situated in the foothills of Himalayas. Landsat data of three time period has been used in the study. Low values of UTFVI indicates excellent thermal comfort whereas higher values indicate worst thermal comfort. This study would also be helpful in knowing the extent of UHI.
ASSESSMENT OF LST, NDVI AND ITS IMPACT ON URBAN HEAT ISLAND OF VADODARA AND RAJKOT, GUJARAT

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ABSTRACT: Over the past few years, population and economic growth have escalated urbanization in the country and thus fostered city expansion. Environmental consequences such as elevated warmths of urban surfaces compared to surroundings i.e. non-urbanized surfaces. LST (Land Surface Temperature) corresponds closely with near surface temperatures and Vegetation Abundance (NDVI) is also known to influence LSTs and UHI conditions through the process of evapotranspiration. This study focuses on recognizing the urban thermal hotspots of the Vadodara and Rajkot city, Ward-wise LULC and UHI analysis during summer and winter seasons, derive the general relationship between LST and NDVI in the study area and to explore the relationship between LST and NDVI for each LULC classes. In this study, the UHI and LST of Rajkot and Vadodara cities was analysed using LANDSAT data of 2020 & 1999 of summer and winter seasons. LANDSAT-8 (January 2020 & May 2019) and LANDSAT-5 (January 2000 & May 1999) satellite digital data was downloaded from https://earthexplorer.usgs.gov/ .the satellite data was analysed using open source software QGIS wherein LST and NDVI values of summer and winter seasons were computed and ward wise UHI intensities were generated. The results indicated that the LST values of built-up areas and open spaces were higher as compared to the urban green spaces and waterbodies whereas, NDVI values of vegetation were significantly higher as compared to built-up areas and water bodies. Over the period of 20 years i.e. 1999/2000 - 2019/2020, it was observed that the ward level temperatures within the city have increased remarkably. Significant seasonal variation in temperatures was also noted. The LST and NDVI values were observed to be an inverse relationship, implying that an increase in vegetation abundance would generally reduce surface temperatures, and thus UHI intensity. However, this relationship demonstrated that there are distinct differences depending on specific LULC classes. The present study finds its applications in proposing the future urban land-use planning and constructions to provide better environmental conditions that might be most conducive to reducing urban heat temperatures and mitigating the UHI phenomenon in the areas where UHI intensity is more pronounced.

KEYWORDS: Urban Heat Island, Land Surface Temperature (LST), NDVI, LANDSAT, Landuse and Land-cover, QGIS

ANALYZING RELATIONSHIP BETWEEN LAND USE/LAND COVER DYNAMICS AND LAND SURFACE TEMPERATURES OVER BHILWARA DISTRICT USING GEOSPATIAL TECHNIQUES

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ABSTRACT: Land use land cover (LULC) changes on the surface of the earth are classic manifestation of the relationship between man and his environment. Various studies have analyzed LULC changes and land surface temperatures (LST) to study the environmental livability and sustainability, especially
of urban areas. The combination proves reasonable to understand the variations in surface heat fluxes due to changing landscape dynamics. The present study investigates LST variations over Bhilwara district in correspondence to the land cover distribution. Multi-spectral satellite data of Landsat 8 OLI and TIRS (October, 2017) have been used to derive LULC and LST patterns in the region. Supervised classification using maximum likelihood classifier has been employed to map five LULC classes: water body, agriculture, vegetation/grass, built-up and barren/scrub. Thermal bands of the satellite data have been used to estimate LST by applying NDVI threshold methods. Results show a high correlation between spatial patterns of LULC and LST. ‘Barren/scrub’ class corresponds to highest surface temperatures followed by ‘built-up’ class while the lowest temperatures are recorded over ‘water’ and ‘agriculture’. The study underlines immense potential of geospatial technique to address dynamic environmental issues over regional level.

**KEYWORDS:** Land Use/ Land Cover, LST, Remote Sensing, Urbanization, NDVI
Theme 3: Geospatial Technology & Recent Advances
DEVELOPMENT OF WEB BASED FRAMEWORK FOR HEALTH DISORDER ANALYSIS USING OPEN DATA KIT: A HEALTH GIS APPROACH

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ABSTRACT: Health disorder is an abnormal condition which negatively affects both physical and mental health. Currently, different factors like changed lifestyle, pollution etc. works as a catalyst for health disorder. But the main problem is people can’t understand that he/she is suffering by any health issues or not. Sometimes they simply ignore some common symptoms thinking it as a simple health issue. According to World Health Organization (WHO), any health issue can be detected by some question answer method. This paper presents a web based framework for automatic health disorder analysis based on some predefined yes/no question using Open Data Kit (ODK). ODK community produces free and open-source software for collecting, managing, and using data in resource-constrained environments. It consists of several components like ODK-Collect, ODK-Build, ODK-Sensor, ODK-Briefcase, and ODKAggregate. According to doctor’s advice, a questionnaire is made and published through ODK Build. Any user can fill and submit this questionnaire using ODK-Collect android app. The information is stored in ODK Briefcase server with GPS coordinates of the user. Using QRealTime Plugin in QGIS, the data is fetched and stored in PostGRE database. Also a list of specialized doctors about that problem is stored in that database. A website is developed where the client can check whether he is affected or not. If affected, then the coordinates of near doctors is shown on map. Also the shortest route is shown from the client’s location to the nearest doctor’s chamber so that the client can take quick action. This framework is scalable for any health disorder whether it is mental or physical. Also it makes people aware about its current health issue and intimate about nearest doctor.

LAND-COVER CLASSIFICATION OF SATELLITE IMAGES USING DEEP LEARNING

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ABSTRACT: The Satellite remote sensing technology gathers data/images at regular intervals. The quantity of received data is very large and is increasing rapidly with the growing technology. The task of classification in remote sensing is usually achieved on a pixel level, object level or scene level. Land cover classification of satellite images using deep learning technique aims to achieve uniform categorisation of landforms. In this paper, a supervised learning technique- convolutional neural network (CNN) model for satellite image classification was developed. High resolution satellite imagery datasets of 0.5 m resolution is used to classify the satellite images into semantic categories. An approximate 97% accuracy of classification is achieved. Furthermore, the study will be extended to resolution of 1m satellite images. Also a brief study of different CNN models used in satellite image classification is shown. The scene level classification classifies images into semantic categories such as forest, commercial area, residential area, etc. It is also observed that scene level classification has the potential to overcome some limitations of pixel and object level classifications. This demonstrates how use of scene-level classification in CNN can assist in improving classification accuracy.

KEYWORDS: Deep learning, CNN, Scene-level, Supervised learning techniques
IMPLEMENTATION OF SEMANTIC SEGMENTATION ON UAVSAR DATA

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ABSTRACT: Simultaneous advances in the fields of deep learning and SAR based remote sensing has opened doors to plethora of research opportunities in a multi-disciplinary field of SAR data analytics. With recent developments in SAR sensors, we can capture high resolution data which can be used for better feature identification and thus highly accurate classification of SAR images. In this research, we have implemented a deep learning model for segmentation of every pixel present in our target area. We have chosen UAVSAR data of Houston City because it covers wide variety of features (Urban, forest, Water Bodies and Grassland). For target decomposition, we have used G4U decomposition and the output of target decomposition is used for creating training dataset for our deep learning model. We have created a synthetic dataset consisting of 4000 images (size - 500*500 pixels each) and corresponding masks for training and we have done prediction on a small cropped image taken from original full image (size- 3300*24151 pixels). We are using Deeplab V3 model available in Tensorflow library in Python for implementing Semantic Segmentation on SAR data. The coordinates of UAVSAR data used are- Upper Left Latitude & Longitude = 30.451693023°, -95.870641693°; Upper Right Latitude & Longitude = 30.554906778°, -95.673900697°; Lower Left Latitude & Longitude = 29.107619024°, -94.943386924°; Lower Right Latitude & Longitude = 29.210412641°, -94.746501515°.

Fig.1 shows the flow chart of the work.

Initial experiments on this SAR data set has given promising results with overall accuracy of 99.16% on synthetic data and 80% on original image data. For further improvement, we are annotating actual images in addition to working with synthetic data. The benefit of using synthetic data is that it can be created within minutes by running a python code while creating real dataset requires manual annotation of hundreds of images which is very cumbersome and time consuming task. Thus, we can quickly create synthetic dataset as per requirement for training our model and we can make predictions on real data from that trained model. The scope of this paper will be limited to the discussion of methodology followed and results obtained by training of synthetic dataset only.

KEYWORDS: Deep learning, SAR, Semantic Segmentation, G4U decomposition.

ROLE OF GIS AND ADVANCE GEOSPATIAL APPLICATION IN AGRICULTURE, SOILS AND FORESTRY SCIENCE

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ABSTRACT: Geospatial science has a major role to play in securing both food and nutritional security in agricultural system. GIS and remote sensing also play important role in forestry science. Nowadays demand for healthy food increases, everyone wants to see more nutritious food filled in every platter thus to fulfil all this requirement these advance technologies of geospatial application are needed.
Technologies help in high yield of crop, time saving and cost efficient also, less use of pesticide as by using GIS and remote sensing technologies it can be specify that in which specific area crop needs pesticide. Geospatial application can be used to assemble various information such as soil nutrient, moisture content, elevation and topography to generate a map to show which factor influence crop yield. Nowadays precise agriculture method is used, in which farmers optimised inputs such as water and fertiliser to enhance productivity, quality and yield to minimise pests and diseases through specially targeted applications of precise amount of pesticide helps in observation and evaluation of field. Geospatial technologies such as GPS, GNSS, remote sensing and drones play important role in precise method of agriculture. Farming is getting smarter with the availability of advanced technologies like precision equipment, the internet of Things (IoT), sensors and actuators, Big Data, geo-positioning systems, Unmanned Aerial Vehicles (UAV), soil land inference model (SoLIM) etc. Advances technologies used in agriculture are as such to construct growth profiles and retrieve yield related parameters at region level IRS P3 WiFS (Wide Field Sensor) are used, crop condition and its performance indicated by considering growth and decay in spectral response curve, LISS3 and IRS-1C WiFS have a good periodicity. for crop irrigation management canopy temperature variability (CTV) is used and canopy air temperature difference (CATD) used as an indicator of water stress in crop, Arc MAP software is used to prepare digitized maps for soil pH, soil nutrients and organic matters. Soil data can easily handle and analysed using ArcGIS, SMPM (Soil Moisture Proxy Model) is also applicable in the field of agriculture. Similarly, in the field of forestry science also GIS and RS technology are a very valuable tool. GIS database like multiobjective forest management, forest fire risk mapping, forest fire simulation, forest fire monitoring, LIDAR based timber volume estimation, forest mapping and data collection etc all are necessary tool for better study and management of forestry science. It creates database which are crucial for wildlife conservation, reconnaissance (investigation of forest population), monitoring deforestation, reforestation, measuring forest heights, vertical point profile, tree lines, illegal logging, forest carbon reserves, global forest watch, vegetation potential, leaf area index, 4D GIS, dead zone etc. Satellites such as Landsat Multispectral Scanner (MSS), thematic Mapper (TM), Radar of the ERS-1, the SPOT Multispectral and Panchromatic instruments, DEM (Digital Elevation Data) by using GIS analysis etc. All these technologies are applicable in forestry science to make the study, research and management more convenient and effective.

ANALYSIS OF COSINE SQUARED DISTRIBUTION BASED MULTIPLE COMPONENT SCATTERING MODEL

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ABSTRACT: Polarimetric Synthetic Aperture Radar (SAR) decomposition is the process of extracting the characteristics of terrain features from the SAR data. Various polarimetric decomposition models have been proposed for the fully polarimetric SAR data but possesses many drawbacks. These include the ambiguities present in the representation of the actual scattering mechanism present in the terrain. Cosine squared distribution based multiple component scattering model (MCSM) is a five-component decomposition model including surface scattering, double-bounce scattering, volume scattering, helix scattering, and wire scattering. The scattering power contribution from the urban area is modeled as the sum of wire scattering, helix scattering and double bounce scattering in this model. The cosine squared distribution is used here to model the volume scattering power. In this work, the potential of cosine square distribution based MCSM is analyzed to assess the representation of scattering mechanism of terrain objects. This model is implemented on multiple data sets of Radarsat-2, Gaofen-3, AIRSAR, and RISAT-1 acquired over the San Francisco area. The patch analysis is done by selecting small patches of urban area, vegetated area, and the water body to calculate the percentage of power contribution of surface, double-bounce and volume scattering. The patch analysis result is analyzed and compared with the Google Earth images to interpret the ambiguities present in the decomposition result. The result shows that the model performs well in representing the urban area by improving the double
bounce scattering power with remarkably less volume scattering power. The dominance of volume scattering power in the forest and highly vegetated areas is also observed from the patch analysis result.

**KEYWORDS:** Synthetic Aperture Radar (SAR), polarimetric SAR decomposition, cosine square distribution, multiple component scattering model, patch analysis.

**WEB BASED INFORMATION SYSTEM USING GIS FOR RURAL DEVELOPMENT**

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**ABSTRACT:** Web based geographic information system for rural development” is a GIS based application which gives comprehensive spatial information relating to demography, infrastructures, utilities and natural resources for a specific Village, City, Tehsil, District. Utilizing techniques of remote sensing and GIS on spatial domain, a spatial database is arranged, this database is then examined in a web GIS stage to make thematic maps. When the maps are prepared, they are distributed over internet on an easy to understand interface. User can peruse through the interactive maps and get comprehensive spatial information. User can likewise make questions to get some explicit information, download maps, etc.

**VISUALIZATION OF UNESCO WORLD HERITAGE SITE ON WEB GEOPORTAL TO AID FOR FUTURE EXCAVATION**

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**ABSTRACT:** The Ruins of Nalanda Mahavihara is a large and revered Buddhist monastery, in the historic city of Bihar in India. It is said that Nalanda was probably raided and destroyed by an army of the Mamluk Dynasty of the Delhi Sultanate under Bakhtiyar Khalji in the 13th century. The excavation of Nalanda ruins was initiated in early 20th century by Archeological Survey of India. Ruins founded until now covered an area of about 12 hectare that includes stupas, chaityas, viharas, shrines, many votive structures and important art works in stucco, stone and metal. Archaeological stated that only 10% of the ruins is been excavated so far as Nalanda Mahavihara occupied a far greater area in medieval times. It is believed that other ruins are beneath the ground, hence DEM is essential to mark the extent of the ruins. in this paper, Cartosat-1 stereo pairs have been used for generating Digital Elevation Model (DEM) of UNESCO Heritage Site i.e. Nalanda Ruins, Bihar (India), using Ground Control Points that was later acquired by Differential Global Positioning System (DGPS). DEM of pixel size 3 x 3m is obtained. For better visualization purpose of the features of Nalanda Ruins the LISS-IV data of 5.8m spatial resolution is draped on DEM. Many different Buddhist sculptures were found in these ruins during excavation in 20th century. Out of these, the location for some of the sculptures were accurately traced and represented in the paper. This study could also help in finding the probable location of the next excavation.

**KEYWORDS:** Heritage Site, Nalanda Mahavihara, Excavation, DEM, Cartosat, Liss-4, DGPS
ANALYSIS OF BACK-SCATTERING COEFFICIENT OF NOVASAR-1 S-BAND SAR DATASETS FOR DIFFERENT LAND COVERS

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ABSTRACT: NovaSAR-1 is a joint technology demonstration initiative of SSTL (Surrey Satellite Technology Ltd.), UK, and Airbus DS (former EADS Astrium Ltd, Stevenage, UK). The NovaSAR-1 minisatellite was launched on 16 September 2018 and it is operating on S-band frequency range, which is less common in Spaceborne SAR systems. Both higher and lower SAR frequency bands (L-band & X-band SAR) have their advantages as well as limitations in different kinds of applications. High frequency (X-band) SAR systems are useful for top surface information extraction such as DSM generation. However, at the same time, more noise and less coherence issues are also associated with high frequency SAR systems. Low frequency SAR (L-band) systems exhibit better ground penetration, high coherence and low noise, but less precise scatterer level information. The S frequency band comes approximately at the middle of X and L-band SAR frequency range and may be used as a trade-off between high and low frequency SAR systems to overcome the limitations up to some extent. In this present study, the statistical analysis of radar back scattering coefficient of HH polarization (Stripmap and ScanSAR) datasets of NovaSAR-1 S-band datasets corresponding to different land use and land covers (LULCs) has been done to analyze potential of S-band data. The analysis was carried out at 4 experimental sites in parts of Jharkhand, West Bengal, Maharashtra, Odisha and Chhattisgarh. The statistical analysis of $\sigma^0$ for five different sites of India for different (LULC), such as bare soil, forest, water, urban, crop land and concrete road has been carried out. The range for minimum and maximum mean $\sigma^0$ values for urban, bare soil, forest, water, crop land and road features were found to be -5.45 to 4.76, -18.14 to -13.44, -17.17 to -14.34, -27.29 to -26.9, -16.88 to -13.31 and 26.64 to -14.98 respectively. Range of $\sigma^0$ pixel values of Calibrated datasets corresponding to different LULC's depicted that the data quality is good for identification of various land covers. The separability analysis of the different land cover classes depicted that classes have good separability except few pairs such as road-water and crop-forest. With the availability of fully polarimetric as well as single look complex (SLC) interferometric data in future, the polarimetric scattering behavior and phase information along with interferometric performance of the data may be analyzed.
Theme 4: Geospatial Applications in Water Resources
ABSTRACT: In the recent past, concentrations of Cyanobacterial Harmful Algal Blooms (CyanoHABs) in inland and estuarine water bodies have been increasing not only in India but throughout the world. Lake Chilika in India, lakes Utah and Okeechobee in the US are few of the many water environments that suffered heavy algal blooms in 2018. CyanoHABs or blue-green algae are amongst the first of prokaryotes that are increasingly becoming a health hazard, as they are capable of producing various toxins that can potentially affect human and aquatic life. The consequences of water quality degradation include and are not limited to a decline in aquatic life, animal and human health due to toxic water and sea-food consumption, hampering recreational activities, ultimately being detrimental to the country’s economy. This demands a robust solution to monitor and conserve the water quality for inland and estuarine water environments. This study presents a cloud-based infrastructure developed on the opensource Google Earth Engine (GEE) platform using the Sentinel 3 Ocean and Land Color Imaging (OLCI) sensor data, for near-real-time monitoring of such inland and estuarine water environments. The GEE dashboard developed in this study uses the level-1 Sentinel-3 OLCI data available in GEE, enables the user to import the data according to date range and cloud cover range, performs automatic correction for Rayleigh scattering before providing different visualizations of the data such as true color composite and false-color composite. It also generates heat maps for the suspended sediment concentration, chlorophyll-a (Chl-a) concentration, cyanobacterial cell density, and phycocyanin concentrations as water quality parameters, for the selected waterbody. Moreover, the spectra for any pixel can also be visualized by simply clicking on that pixel. This helps in continuous spatial and temporal analyses and monitoring of the water environments in a simplified way, particularly for CyanoHAB detection – since the phycocyanin component in the blue-green algae absorbs light at 620nm, which is a distinct band (band 7) in Sentinel-3. Since the dashboard is essentially a cloudbased infrastructure, no computationally expensive resources are required – an active internet connection and a browser are sufficient for operation, hence making it inexpensive and userfriendly. The observations and results of the analyses thus performed can be insightful in detecting and identifying the occurrence of such algal blooms. This data can then be shared with the respective water management authorities for the amelioration of water quality.

WATER HARVESTING SYSTEMS OF THE PAST- A CASE STUDY OF BADAMI

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ABSTRACT: Badami, former capital (5th Century) of the Early Chalukyas, is located in the north-eastern part of the Malaprabha River Basin, in Karnataka, India. This Chalukyan capital was not only a centre for temple building activities but also witnessed the construction of fortifications since the Early Chalukyan times, and later developments were made during the period of Vijayanagara rulers and Tipu Sultan’s reign. Badami and its fortifications are nestled in a ravine, surrounded by red sandstone outcrops, in the Deccan Plateau, and has some the most iconic monuments scattered across the rocky terrain. The settlement overlooks the 5th century Agastya Tirtha, a large reservoir, (a main source of water in the past). It falls under the hot semi-arid climatic zone with minimal rainfall throughout the year. This historic settlement exhibits certain planning characteristics and water harvesting features that are influenced by the local landscape. The case study of Badami sets a good example to discuss the
water harvesting systems engineered in the past for sustenance of the settlement with an understanding of the topographical conditions.

This paper explores Badami and its fortification area, by the various applications of geospatial technology to identify and document the various man-made water systems (like tanks, wells, and aqueducts) that functioned as crucial water resources in the region. This understanding has been achieved by studying and analysing geo-referenced old maps, satellite imagery (Google Earth, BHUVAN, Cartosat1 and Corona imagery). Furthermore, analysing topographical models generated using stereoscopic spaces imagery with Geographic information Systems (GIS) tools and techniques, like the Digital Elevation Model (DEM) and anaglyphs. These GIS tools help in visualisation of the landscape, study the terrain, and carry out various hydrological analysis (like, recognising the stream networks and extract catchment areas). This has led to identifying one of the catchments that gathered water into a man-made cistern, which in turn distributed water in two ways: 1) Agastya Thirtha- a large reservoir amidst the settlement and 2) an aqueduct that supplied water to the fort area. The geospatial analysis of the region is further validated by field study and ground-truthing. The findings have helped assess the historic landscape and the role of water harvesting systems in the hot semi-arid region of Malaprabha river valley mainly focussing on Badami and its immediate environs. This study contributes to a body of knowledge in the realm of ancient water systems in Malaprabha valley through understanding the interrelationship between human, water systems and the environs, and creating digital outputs. This would further enable us to conduct a comparative analysis of other such settlements across the region.

KEYWORDS: Geographic information Systems (GIS), Water harvesting systems, Badami, stream network, catchment analysis

STREAMFLOW MODELLING OF PIN DAR RIVER BASIN, CENTRAL HIMALAYA USING REMOTE SENSING DATA AND TEMPERATURE INDEX MODEL

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ABSTRACT: Assessment of snow cover area (SCA) is important input for snow/glacier melt runoff, glacier mass balance study and other hydrological studies. Snow/glacier melt is a vital component of the riverflow for the Himalayan river system. The major river system of India i.e., the indus, Ganga and Brahmaputra River systems originated from the Himalayan region, are considered the lifeline of the Indian continent. The main source maintaining the flow of the Himalayan rivers are snow/glacier melt runoff, rainfall runoff and baseflow. The present study is to find out the variation of SCA and streamflow modelling in the Pindar river basin which is originated from Pindari Glacier in the central Himalayan using MODIS Terra (MOD10A2) data for the study period from 2005-2016. The annual mean SCA is found to be maximum (21.25%) in the year 2014 while it is minimum (12.85%) in 2016. On the basis of 12 years average analysis, January, February and December are found maximum SCA while the minimum is observed in August. Snowmelt runoff modelling has been carried out using the SNOWMOD model, and the snow/glacier melt runoff contribution is estimated to be ~33 %, while rainfall runoff and baseflow contribution is to be estimated ~24 % and ~43 % respectively.
SMART WATER METERS AT IITB CAMPUS

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ABSTRACT: Water stress is posing a great threat to the people. With increase in population the demand of water has increased, calling out for more number of water supply networks. These supply systems connects raw water sources to consumers through a gigantic infrastructure, which includes buried water mains, service connections, metering systems and thousands of other networking parts. However, these supply networks cause huge wastage of water because of leakages, pipe bursts, fraud and manipulation etc. This wastage accompanied by traditional metering system sometimes goes as high as 40% of the total water supply. To address these issues, recently a new technology in the form of real-time smart water meters has emerged, which is based on the internet of Things (IoT) concept. This can be used to monitor the water usage both by water supply providers and users. This research aims at development of smart water metering network by integrating IoT and Geographical information System (GIS). This Project was done to increase the efficiency of water distribution and management system by optimally locating the position and installing smart water system. It was done in three stages: the first stage was ZONE IDENTIFICATION which was performed by using various parameters like Distance from hostels, existing water and sewerage network etc. Then the land suitability analysis was carried by giving weightage to these parameters according to the AHP (Analytical Hierarchy Process) method of normalization. Thus this weightage analysis gave the suitable locations for installation of water meters. The second stage was installation of water meters in cost efficient manner and connecting it to the SCADA system for centrally controlling and making effective use of IoT. The third stage was the key element of the system. In this we did the HOTspot analysis of the installed water meters to find out the hot (excessive) and cold (least) spots of the water consumption in the campus. GETIS ORD Gi* statistics was used for the purpose and the consumption of water meters was compared with the existing standards of CPCEED guidelines. These hotspots were spatially located in the campus and could be centrally monitored and regularized. A certain code block was written in python scripting to generate the HOTspot without user feed in the central system. Based on the meter readings this code block would automate the process and regularly generate the spatial map for the users. The user interface of this can be made available Through AI application of arcgis. Thus, the residents of the campus can easily access the information of their daily consumption of water through this meter readings available on their smart phones. Further, the system would help to analyse the meter criticality index and the loss of centrally control the usage of excessive water in a single building. The administration can detect water leakage and excess consumption and can function accordingly. User can easily detect any leakage or water wastage in the household through emails or messages. User can get real time data of their usage through a dashboard or an android app. This technology will save water as well as change consumer behavior. The NRW loss can be controlled.

GENERATION OF HISTORIC, PRESENT AND FUTURE SNOW COVER DATASETS USING MODELLING APPROACH

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ABSTRACT: Snow cover maps plays an important role in the study and impact of climate change in the mountainous region which receives snowfall. The snow line shift has been observed in the recent time at an alarming rate due to the rapid increase in temperature. Traditional snow cover maps are generated from ground based or space based observations. These observations have limitations in terms of spatio-temporal coverage; resolution; repetivity, etc. Snow cover maps can also be generated using
physically based distributed land surface models. In the current study the Variable infiltration Capacity (VIC) model, a semi-distributed land surface model is used for generation spatio-temporal of snow cover data of Jhelum Basin at 0.025° × 0.025° spatial resolution. The Jhelum Basin receives ample amount of snow fall in winter season. The dataset used in setting up of land surface model are digital elevation model, land use/land cover map (ISRO-GBP- LULC Project), soil map (FAO) and other land surface parameters derived from remote sensing data. The model simulation are created using Era-interim and CORDEX dataset for the period 1979 to 2018 and 2019 to 2099, respectively. Model calibration and validation is done for the winter season using the discharge data observed at Asham and Sangam outlet by the Irrigation and Flood Control Department, Kashmir. The model generated snow cover is validated for the time period 2000 to 2018 using the MODIS eight daily maximum snow cover product (MOD10A2). The historic snow cover maps are generated from the time period 1979 to 2000 and present maps are generated for the time period 2001 to 2018. The future snow cover maps are also generated for the period 2019 to 2099. The trend line for the maximum snow cover area in the winter season for each year is also plotted along with the temperature anomaly. The impact of increase in the temperature during winter season was clearly observed on the maximum snow cover area during winter season. The snow cover area has shown tremendous turbulence in the curve due to increase in the extreme events in the near future time period. Snow cover products (in GeoTIFF format) generated in this study will be made available to other researchers for validation and further utility through web based data dissemination portals of IIRS, ISRO.

KEYWORDS: Snow Cover, VIC, CORDEX, Snow line, Temperature anomaly

VULNERABILITY ASSESSMENT OF ARSENIC IN GROUNDWATER AND ITS OCCURRENCE IN DISTRICTS OF BIHAR, INDIA

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ABSTRACT: Groundwater arsenic vulnerability is an important aspect of determining the groundwater vulnerable zones and for developing management options to preserve the quality of groundwater resources. Central groundwater board investigated and revealed that ten states of India including Bihar is being affected by arsenic contamination. Surface water sources are more amenable to pollution, therefore, it becomes necessary to use groundwater at an increasing rate. As there is no proof regarding natural emission of arsenic in the groundwater and yet to be established. Hence, this study aims to provide a spatial and statistical analysis of the prevailing subsurface, hydrogeochemical parameters and environmental conditions under which groundwater may get polluted due to arsenic for the state. Usage of secondary data by reviewing and analysing, it has proved to provide a cost effective way of conducting the correlation studies and helped in portraying the present scenario. In the present work, available methods for the assessment of groundwater vulnerability have been reviewed and appropriate framework was developed, suitable for the prevailing conditions using Multi-Criterion Decision Making (MCDM) model. The arsenic vulnerability index has been developed with attempts to prepare a multipurpose database in Geographic information System (GIS) environment. Maps were prepared using ArcGIS to find out the groundwater arsenic vulnerable zones for twelve as affected districts of Bihar lying on Ganga Basin. The integrated vulnerability map exhibits the high risk imposed on the north western parts of Patna and Bhojpur along with the central parts of Munger, Bhagalpur and Vaishali districts due to the existence of shallow groundwater with low elevation and high silicate and iron contents in the region. Most of the districts of the state lies under low or moderately vulnerable zones, representing the state being vulnerable. Validation of the index applied was performed against arsenic concentration of the state and by evaluation of importance of each covariate for groundwater arsenic vulnerability. The GIS technique applied has provided an efficient environment for the analysis and

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handled the large set of spatial data. The groundwater vulnerability maps may assist in decision making and future planning of the sustainable water resource development as elevated arsenic concentration in the groundwater (current source of drinking water) causes chronic diseases.

**KEYWORDS:** Groundwater Arsenic Vulnerability, Arsenic Vulnerability index, Multi-Criteria Decision Making (MCDM), Geographic information System (GIS).

**ESTIMATION OF EVAPOTRANSPIRATION USING REMOTE SENSING BASED SEBAL MODEL: A CASE STUDY OF PANTNAGAR AGRICULTURAL FARM**

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**ABSTRACT:** Evapotranspiration (ET) is an indicator of total water needed by a crop for their growth. If irrigation will be given in the cropped field as per the ET estimation for that crop, the wastage of water can be controlled. India still lack a policy which can implement water distribution to agricultural field based on ET estimations. In the present study, evapotranspiration has been estimated using remote sensing technique. The farm experimental plot of Pantnagar has been used as a case study. The experimental farm land of GB Pant University of Agriculture and Technology, Pantnagar is situated in Kumaon division of Uttarakhand which has a coordinates of 28° 58' 41.8728'' N and 79° 23' 58.6032'' E. The image for the same has been collected from Landsat 8. The ET estimation has been done for the month of February 2018. Surface Energy Balance Algorithm for Land has been used to estimate ET. Surface Energy Balance Algorithm for Land, which is commonly abbreviated as SEBAL computes an instantaneous ET flux for the acquired image. The Evapotranspiration flux is calculated for each pixel of the image as a “residual” of the surface energy budget equation. The results from this study suggested that NDVI for the study area varies between 0.084 to 0.464. The Surface albedo has a range of 0.149 to 0.265. Surface temperature of the study area varied from 286.175 K to 291.244 K. Finally, evapotranspiration can varied from 0.569 mm per day to 1.566 mm per day.

**KEYWORDS:** Evapotranspiration, Landsat 8, SEBAL

**GEO-ATTRIBUTES AND PARAMETRIC STUDIES OF PART OF SATNA RIVER BASIN USING GEO-INFORMATICS**

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**ABSTRACT:** in the present paper, an attempt has been made for the purpose of exploring morphometric characteristics of Satna river basin, which itself is part of the Ganga River basin. The quantitative approach of the basin development of Satna River basin carried out in the current study based on morphometric parameters. The drainage network was extracted using Cartosat-1 (30m) Digital Elevation Data. For the purpose of drainage basin analysis, the study area is divided into six sub watershed units. The stream numbers, orders, lengths and other morphometric parameters like bifurcation ratio, drainage density, stream frequency, shape parameters etc. were measured. The present work shows that the Satna River basin is less prone to flood, vulnerable to soil erosion and a good resource of surface water. This study would help to utilize the water resources and extended for sustainable development of the Satna River basin area. The variation in bifurcation ratio suggests that the structural control on the drainage pattern of the Satna watershed. The numerical value of circulatory ratio for Satna river basin, signifies higher infiltration rate and mature to old stage of the river
The Satna watershed has a low value of coarse ratio infer that the area is less prone to soil erosion and has essential structural intricacy in connection with relief and drainage density.

COMPARATIVE ASSESSMENT OF MIF & AHP TECHNIQUES FOR DELINEATION OF GROUND WATER POTENTIAL ZONE: A CASE STUDY IN COOCHEHAR DISTRICT, WEST BENGAL

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ABSTRACT: in the context of depletion of ground water throughout the world, demarcation of potential ground water Zone becomes an emergent task to the Hydrologist and Geographers. Irrational and excess withdrawal of ground water to fulfill the need of growing population, widespread irrigation, incompetent use of surface water are leading the ground water storage more vulnerable to depletion. The present study, delineation of ground water potential zone in Cooch Behar district of West Bengal, deals with comparative assessment of Multi influencing Factor Analysis (MIF) & Analytical Hierarchy Process (AHP) techniques in GIS platform using same parameters. On the basis of literature review and personal experience the researchers have decided to consider eight main parameters providing more or less same logical importance to specific parameter for the both techniques. The parameters are i) Land use & land cover (LULC), ii) Soil texture, iii) Rainfall, iv) Drainage Density (DD), v) Geomorphology, vi) Lithology, vii) Vegetation and viii) Topographic wetness index. The resultant map of potential ground water potential zone of in Cooch Behar District of West Bengal using MIF technique shows that the very poor, poor, moderate, good and excellent potential areas are covering 9%, 21%, 30%, 27% and 13% respectively whereas the result in AHP technique displays that the very poor, poor, moderate, good and excellent potential areas are covering 8%, 15%, 24%, 33% and 20% respectively. The result of both techniques are validated with actual ground water table data of Central Ground Water Board, India for same identical points using Receivers Operating Characteristic Curve (ROC) on SPSS software and found that MIF technique gives 73.7% accuracy whereas the AHP technique provides 89.7% accuracy.
Theme 5: Geospatial Applications in Agriculture, Soils and Forestry Sciences
**ABSTRACT:** Agriculture and forestry are the two major land use classes providing sustenance to human population. With the pace of development, these two land use classes continue to change over time. Dynamics in land use change is driven by multiple drivers including climate change. However, tracing trajectory of the changes is difficult while making projections for the future time steps. Intergovernmental Panel on Climate Change (IPCC) and Food and Agriculture Organisation (FAO) have identified the importance of agriculture and forestry land use classes and the term Agriculture forestry and Other land use (AFOLU) is used much frequently in their policy documents. We present a future projection of AFOLU for the year 2050 using current land use transitions under the influence of climate change for the Uttarakhand included South Asian Association for Regional Cooperation (SAARC) nations. The SAARC nations is represented by Afghanistan, Bangladesh, Bhutan, India, Nepal, Maldives, Pakistan and Sri Lanka. The AFOLU of SAARC nations for the year 2050 was mapped for the four scenarios of IPCC fifth assessment report presented by RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5. The Normalized Difference Vegetation index (NDVI) products of remotely sensed Moderate Resolution Imaging Spectroradiometer (MODIS13A) data for the year 2005, 2006, 2007 and 2016 in raster format at 250 m resolution based Land cover classified data, world-clim, bio-climatic for future scenariois and topographic data were used to access the potential changes. Multilayer Perceptron Neural Network (MLP-NN) was used to project the future AFOLU using multiple predictor variables of climate, land use transition, and topographic variations represented by elevation, slope, aspect, curvature, road network, urban sprawl. The MLP-NN is a class of artificial neural network that uses a feed-forward process for data training. It uses a nonlinear function to train input data as neurons. The entire processes involved two distinctive phases consisting of training and the run phase. The training phase forms non-linear relationships between inputs to hidden nodes and hidden nodes to an output layer. The training phase of the model learns to assign weights to various nodes to select the best performance of the neuron network among input and output layers. Once trained with assigned weights, the network is activated during the run phase. The back-propagation algorithm is used by the ML-PNN to learn and assign weights. Modeler calculates transition potential of the driving input variables while analyzing the land-use change between two-time periods. It considers net changes between the AFOLU classes under the influence of driving variables by creating evidence likelihood change image, which is an essence map for suitability of each transition. Agriculture land use was found to increase to be increased in Uttarakhand state of India and for all the countries with the highest rate of change for Pakistan and Maldives followed by moderate change witnessed for Afghanistan, India, Nepal, while the least rate of change was observed for Bangladesh, Bhutan and Sri Lanka. We present potential changes for a future scenario of AFOLU for the Uttarakhand and SAARC nations.

**KEYWORDS:** Artificial Neural Network, Geospatial modelling, Land Use Land Cover, Multilayer Perceptron

**HABITAT DISTRIBUTION MODELING FOR MEDICINAL PLANT VARALIANA JATAMANSI IN SHIVALIK FOOTHILLS OF DOON VALLEY**

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ABSTRACT: Valeriana Jatamansi is one amongst the most important medicinal plant species is distributed in subtropical to temperate region between 1000 to 3000m in Himalaya. It is well known for its medicinal and other ethnobotanical properties. Due to overharvesting from the wild, its population is decreasing at an alarming rate and this species is placed in the endangered categories. The present study depicts the potential distribution of Valeriana Jatamansi in Shivalik foothills of doon valley. The Worldclim bioclimatic variables, slope, aspect, elevation, and the forest types (based on IRS LISS-IV) data and 58 spatially well-dispersed species occurrence points were used to predict the potential distribution of V.jatamansi in 1164.23 km2 study area. The suitable habitat for V.jatamansi was recorded 207 km2 in the study area. Jackknife test was used to evaluate the importance of the environmental variables for predictive modeling. Maxent model was highly accurate with a statistically significant AUC value of 89. The result showed that temperature (31%) and precipitation (15%) is the key influential factor that affect its distribution. Our findings can be applied in various ways such as the identification of additional localities where V.jatamansi may already exist, but has not yet been detected, this approach could be promising in predicting the potential distribution of medicinal plant species and thus, can be an effective tool in species restoration and conservation planning.

KEY WORDS: Valeriana Jatamansi, Maxent Algorithm, Bioclim, Suitable Site, Habitat Modelling, Doon Valley

SENSITIVITY OF CROP BIOPHYSICAL PARAMETERS TO SHANNON ENTROPY DERIVED FROM DUALPOLARIZED SENTINEL 1 DATA

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ABSTRACT: The concept of deriving Entropy (H) from quad-polarized SAR data is extended to dualpolarized dataset. A C2 matrix generated from polarimetric Sentinel 1 (SLC) data was used to derive Shannon entropy (H) in order to examine the temporal change in the entropy for mustard and wheat crops. The temporal entropy profile for mustard and wheat manifests the dynamic entropy values at various growth stages of mustard and wheat crops. The entropy values for mustard was observed to increase as the crop grows due to random scattering from the plant canopy. The entropy value for late sown mustard increased in January and February whereas for early sown mustard it started to decrease February onwards. For wheat, the temporal entropy profile indicates a decrease in entropy value with the advancement in the crop due to higher absorption against scattering. In the early sown wheat the entropy decreased in January and February and was observed to increase in March. For the late sown wheat crop two consecutive drops in the entropy values were observed in February and March, later than the early sown wheat. The temporal entropy profile for mustard and wheat manifests the dynamic entropy values at various stages of mustard and wheat crops. The sensitivity of Shannon entropy to plant height and fresh biomass was also investigated. Plant height for mustard was found to have weaker relationship with the Shannon entropy though it increased with increasing plant height. A sharp increase in entropy was observed in the initial crop stages (90<height<150 cm) whereas no significant changes in entropy were noticed during the advanced stages (crop height > 170 cm). Similarly, the entropy increased with an increase in the plant biomass predominantly for biomass ranges up to 5.5 kg/m2. The entropy remained constant for biomass greater than 5.5 kg/m2 indicating the signal response saturation observed in C-band. A reverse trend was observed for wheat, the entropy values decreased with an increase in plant height and biomass. A low to moderate correlation was observed between wheat plant height and the entropy. The coefficient determination (R2) of 0.35 was observed between the Shannon entropy and wheat biomass. The entropy was observed to decrease with an increase in biomass. The entropy values almost remained constant for biomass> 6 kg/m2. No significant response in the entropy range was observed thereafter.
RECENT DEVELOPMENTS IN CLOUD COMPUTING OF REMOTE SENSING AND CLIMATE DATA FOR FORESTS MONITORING OVER THE SEMI-ARID REGION IN INDIA

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ABSTRACT: Novel technologies such as cloud computing, big data, machine learning and artificial intelligence have improved pace in addressing the challenges of applying big Earth data for scientific research and geospatial applications. Recent developments in the cloud computing of Earth’s remote sensing and climate datasets is rapidly advancing the way of conducting research by researchers and scientists, building applications, and planning and decision making for the long-term sustainability of natural resources. Climate engine (http://climateengine.org/) is a recent, free web-based application developed by a team of scientists at the Desert Research Institute, University of Idaho, and Google aims to enable users the rapidly process and visualize extensive climatic and satellite Earth observations datasets for an advanced monitoring and processes understanding as well as to improve early warning of drought, wildfire, agricultural and forest monitoring. Climate Engine comprises an on-demand mapping of environmental monitoring remote sensing and climate datasets of different sensors, customizable analyses, time series and statistical summaries, downloadable data in GeoTIFF format, and URL link sharing that reproduce outcomes in real-time. It provides access to a range of geospatial datasets that monitor vegetation, snow and water across the globe, as well as climate datasets that track temperature, precipitation, solar radiations and winds. Data in climate engine is stored and processed in the cloud on the Google Earth Engine; therefore, excluding the requirement for handlers to download, store and process extensive data collections on their computers systems. In this study, we aim to identify the use of climate engine in deriving outcomes which could be useful in effective monitoring of changes in forest natural resources with climatic conditions. For this, a time series analysis of normalized difference vegetation index (NDVI) with palmer drought severity index (PSDI) derived from MODIS through climate engine was evaluated to assess the differences in the forests. Normalized difference water index (NDWI) data from MODIS observed with drought conditions over the ranges of NDVI over the semi-arid region in India. A relation has been derived to indicate the drought assessment impacts on forests natural resources. Early investigation for 2001-2019 of MODIS NDVI, NDWI and PSDI shows that a strong relationship exists among NDVI, NDWI, and drought conditions over the semi-arid regions in India. NDWI values decreased more in response to drought conditions than NDVI, indicating that NDWI is more sensitive than NDVI to drought conditions. The difference between NDVI and NDWI also increased to some extent during summer drought conditions. Overall, the remote sensing and climate data derived from cloud computing-based climate engine app provide tremendous opportunities to researchers for deriving relevant outputs to monitor natural resources in a real-time and effective way.

COMPARATIVE PERFORMANCE OF RS BASED MODELS FOR GPP ESTIMATION IN AGRICULTURAL ECOSYSTEM

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ABSTRACT: Quantification of GPP (Gross primary productivity) is achieved by quantifying the amount of carbon fixation by plants via photosynthesis in a given period. In the recent decade, the Eddy Covariance technique emerged as a promising alternative to measure carbon fluxes and enable accurate estimation of GPP. Scaling up of tower-based GPP over a region is critical to understand the dynamics of the regional carbon budget. In recent years, remote sensing-based GPP models dealing with satellite-
FOREST COVER DENSITY & LAND SURFACE TEMPERATURE RETRIEVAL FROM LANDSAT 8 USING Q GIS

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ABSTRACT: An essential tool for sustainable management of natural resources is monitoring of forest cover. Identification of forest gaps and their subsequent refilling gave a better idea about the woody green cover of the forest. Such canopy openings can be identified by forest canopy density (FCD) mapping, which is the most useful parameter considered for the planning and implementation of afforestation and restoration programme. An important parameter of ecological conditions is forest canopy density which can be measured via forest landscape. The study enables a prior analysis of Puruliya district, West Bengal to show the existing canopy density present there. The FCD was classified into four categories: high dense forest (HDF; FCD > 80%), moderate dense forest (MDF; FCD 80% – 60%), low dense forest (LDF; FCD 60% - 40%) and non-forest (NF; FCD > 40%). The forest canopy density along with Land surface temperature is incorporated and analyzed from Landsat 8 (Operational Land Imager and thermal infrared sensor) using Q GIS.

KEYWORDS: FCD, LST, Remote Sensing

IDENTIFYING POTENTIAL CLIMATE REFUGIA: PREDICTING THE CLIMATE CHANGE IMPACT ON THE BIODIVERSITY WITHIN THE PROTECTED AREAS OF INDIA

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ABSTRACT: The changing climate has caused an adverse impact on the distribution of species of different taxa. In addition to providing essential ecological, social and economic services, Protected Areas (PAs) are a crucial tool for safeguarding diverse number species and ecosystems within a particular region. Although PAs have limited human intervention and resource exploitation, the
changing of climate will impact the species diversity within PA nonetheless. Therefore, understanding species distribution under future climatic conditions becomes of utmost importance. This study aims to assess the impact of climate change on species diversity under future climatic conditions. We have used species information from Global Biodiversity information Facility (GBIF) and worldclim 1.4 data in Maximum Entropy (MaxEnt) species distribution modeling to predict the species distribution of different taxa in current conditions and projected it into future climatic scenarios (RCP 2.6 and RCP 8.5) to predict the species distribution in 2050. The current study also aims to identify potential climatic refugia, i.e. protected areas where at least 75% of the species distribution are predicted to present under future climatic conditions. We have found that in the RCP 2.6 scenario the distribution of Amphibia has been shifted to central regions, Mammals covering the eastern part of India and distribution of Reptilia expanding its range in the North-Eastern and east-central region compared to the current climatic scenario. However, in RCP 8.5, amphibian distribution has been projected to the semi-arid region, distribution of mammals covering the entire eastern part of the study area and the distribution of the Reptilia can be seen occupying the North-Eastern region and expanding towards the East-Central region.

KEYWORDS: Protected areas, RCP, MaxEnt, Worldclim, GBIF, Climatic Refugia

QUANTIFYING SPATIO-TEMPORAL RICE YIELD GAP PATTERN DURING KHARIF 2019 OVER PAKUR DISTRICT, JHARKHAND (INDIA)

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ABSTRACT: Agriculture and allied sector is the mainstay of the Indian economy and is the crucial segment for the preservation of national food security. Well-timed information on agricultural crops is vigorous for making well-versed resolutions on food security issues. Estimating and explaining the yield gap is indispensable for sustainable intensification of agricultural systems in order to keep pace with increasing food demand in India driven by population and income growth. In this study, the time-series MODIS-based Normalized Difference Vegetation index (NDVI) and Enhanced Vegetation index (EVI) data were used for paddy yield gap analysis in Pakur district, Jharkhand during the monsoon season in 2019. Based on satellite data, paddy yield based on NDVI and EVI were forecasted during the peak stage of rice growing seasons for the last fifteen years (2014 - 2018). Further, the cumulative mean of paddy yields were recorded for the last 15 years to estimate the exploitable yield gap for the Kharif season 2019. Results showed that based on NDVI and EVI data the estimated yield gap was projected to be 1548 kg/ha and 1448 kg/ha, respectively. Thus, such a methodology can be followed for assessing the variation in crop yield from the potential yield of a particular location.

KEYWORDS: Rice (Oryza), Yield gap, Remote sensing, NDVI, EVI

MAPPING AND MONITORING OF SALT AFFECTED AND WATERLOGGED AREAS IN ALLUVIAL PLAIN USING MULTI TEMPORAL SATELLITE DATA

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ABSTRACT: The major problem Indian Agricultural practice, facing today is, land degradation due to soil salinization/alkalization in arid and semi-arid region where precipitation is below potential evapotranspiration. Hence, salt left behind in the soil begins to accumulate and restricts plant to absorb moisture and nutrients and lessens the soil productivity. Therefore, rational spotting of the salinization
process is needed for sustainable soil management. A remote sensing based, quantitative approach was used in present study area for identification and delineating salt affected soils in Mathura district, Uttar Pradesh. Remote sensing data of Landsat 8 OLI for years 2013, 2016, 2019 was used to study the spatio-temporal changes in the area specific. Before taking any reclamation techniques for such soil, spatio-temporal monitoring is needed to evaluate the progress of salinity hazard. Different spectral indices such as, several Soil Salinity indices (SI), Brightness index (BI), Normalized Differential Salinity index (NDSI) were used to assess soil salinity. Among these indices NDSI was found to be comparatively most appropriate in identifying and classifying salt affected areas. The total salt affected area was approx. 93490 ha in 2013, 85818 ha in 2016 and 78802 ha in 2019. It was found that the total salt affected area decreased gradually over the years from 2013 to 2019. Salt affected area in 2019 was decreased by 14.64% compared to 2013. The paper outlines the framework of a method where data was obtained from Landsat OLI sensors to predict the different levels of soil salinity in the efficient way and the results demarcate the salt affected areas and thematic maps were satisfactorily produced.

**KEYWORDS:** Soil Salinity, Salinity index, NDSI, Remote Sensing, Landsat OLI
Theme 6: Geospatial Applications in Atmospheric & Marine Sciences
EXTRACTION OF PERSISTENT LAGRANGIAN TRANSPORT PATTERNS IN THE BAY OF BENGA: AN APPLICATION TO THE OIL SPILL TRAJECTORY PREDICTION

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ABSTRACT: The surface currents play a vital role in determining the trajectories of oil spills in the sea and hence the authentic trajectory prediction often require the realistic currents. Nevertheless, the spatio- temporal gridded in situ measurements are sparse, rather, only available for a particular location. Therefore, for large basin scale studies one has to rely on the model simulated or the satellite derived currents. For instance, the uncertainties and errors exist in those simulated currents may alter the trajectory prediction of any pollutants. In this study, an attempt has been made to improve the Lagrangian transport pattern by using a method called Lagrangian Coherent Structures (LCSs). LCS is the concealed skeleton that shapes transport in the oceans. We construct the climatological LCSs (CLCSs) utilizing 23 years long HYbrid Coordinate Ocean Model (HYCOM) currents during 1994-2015 in the Bay of Bengal. The computed CLCSs have revealed the mean Lagrangian circulation that preserved a better meaningful transport information. The CLCSs are agree well with the BoB circulation. As a case study, we have used these CLCSs and OSCAR currents for tracking the real oil spill that has occurred off Ennore, southeastern India on 27 Jan 2017. The CLCSs trajectory agree better with the movement of oil spill that inferred in sentinel-1 satellite imagery than the OSCAR trajectory. Thus, we confirm the persistent CLCSs are the best to provide meaningful prediction to track the any real oil spill incidents and their risk analysis.

KEYWORDS: Oil Spill, Trajectory prediction, Lagrangian Coherent Structures, BoB

TRACK FORECAST OF EXTREMELY SEVERE CYCLONIC STORM MAHA USING NWP MODEL

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ABSTRACT: Tropical cyclone (TC) forecasting is always an important research area and challenging task to the meteorologists since it causes major effect on human life, properties and economy. The operational and research centres around the world have been working to better understand the multiscale interactions pertaining to the progress of the TC forecast. Various statistical and dynamical methods for the track forecast of TCs over the North Indian Ocean (NIO) basin have been developed in recent years. The present study focuses on track prediction of TC with the aid of numerical weather prediction (NWP) strategies over the NIO region. In this study, the WRF-ARW model is used to predict the track of MAHA cyclone formed over the Arabian Sea. The track error of the TC MAHA has been estimated w.r.t. The best track observation provided by the IMD. More details will be presented during the seminar.


VARIATION AND DISTRIBUTION OF TOTAL OZONE DURING TROPICAL CYCLONES AND THE EXCHANGE PROCESS

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ABSTRACT: The distribution of Total Ozone over the earth varies with location on timescales that range from daily to seasonal and the increase in the tropospheric ozone leads to the warming of earth surface. The exchange of gases in the atmosphere by the atmospheric ocean coupling possess a greater influence in the Total Ozone variation in the Indian region. Cyclonic storms are one of the influencing parameters for varying Total Ozone amounts. Several cases of cyclonic storms occurring over Bay of Bengal is deeply investigated and the columnar variation of Total Ozone is clearly observed. It is observed that during the mature phase of cyclone the tropopause height has shifted by 1-2 km. The variation in the height of tropopause during severe cyclonic storm like Phailin, Hud Hud, Vardha and Fani shows Total Ozone decreases steadily before and during the formation of a Tropical cyclone. When the Tropical cyclone reaches its peak intensity indicated by its maximum wind speed, there is a sudden fall in Total Ozone over those regions where the Tropical cyclone has intensified. It is evident that Tropical cyclones play a predominant phase in modifying the tropopause structure and dynamics.

KEYWORDS: Total Ozone, Tropical Cyclone, Tropopause variation

SEASONAL VARIABILITY OF METHANE OVER GLOBAL

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ABSTRACT: The GEOSChem Model was employed at 2x2.5 degree spatial resolution over the globe with 47 vertical layers between pressure levels 1006 hPa to 0.01 hPa. The Model is driven by GEOS meteorological fields along with surface boundary fluxes and emission fluxes from different sources. The model was implemented for the period 2010-2018 and the solution sat three hourly intervals were stored for the analysis. To identify local source and sink for atmospheric CH4, Seasonal and inter annual variability of the surface layer atmospheric CH4 over the Global region was studied based on Goddard Earth Observation System Chemical transport model (GEOS Chem), the Greenhouse gas Observation Satellite (GOSAT) and in situ measurements during 2010-2018. Annual and semi-annual harmonics and the climatological mean of CH4 were estimated from the model solutions and satellite observation. There exist good coherences between model and satellite observation. We observed that in 2010–2018 period, growth in atmospheric methane is attributed mostly to increase in emissions from India, China and areas with large tropical wetlands. Maximum surface flux emits from both India (4.756Tg y-1) and China (6.898 Tg y-1). Compared to other regions, China and India have a high source of methane. The hydroxyl radical is the main contributor of the methane’s sink (tropospheric OH). In India, CH4 concentration is maximum in September and minimum is in February/March. The tropical wetland or agricultural or combination of both of the rising global methane 2008 on words.

TIME SERIES GRIDDED PRECIPITATION PREDICTION USING LONG SHORTTERM MEMORY MODEL

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ABSTRACT: Quantitative prediction of precipitation has a very important role in flood and drought forecasting, early disaster warning system and other hydro-meteorological processes. The current study proposes a Long Short-Term Model (LSTM) based on Recurrent Neural Networks (RNN) as an alternative to the computationally expensive physical models to predict precipitation information. In this study, daily ERA5 0.250 precipitation data from European Centre for Medium-Range Weather
forecasts (ECMWF) for the period of 1979-2019 was used over Uttarakhand state of India. The model was structured and trained using precipitation data from 1979-2004 as the training set and data from 2005-2019 as the validation set. The model was tuned using simple grid search which selects the best combination ensuring higher accuracy. The validation of model output against the validation set showed a high agreement of the model with the available precipitation data. The precipitation trends in both the model output and ERA5 data from Mann-Kendall test and Sen’s slope estimator was compared. The daily precipitation forecast for the year 2020 was generated using the model. The work indicates the scope of application of Artificial intelligence techniques in the field of hydro-meteorological variables prediction.

KEYWORDS: LSTM, Precipitation forecasting, RNN, rainfall trend analysis, ERA-5, Artificial intelligence

SPATIAL AND TEMPORAL PRECIPITATION VARIABILITY ANALYSIS USING CONCENTRATION INDEX FOR UTTRAKHAND

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ABSTRACT: Analysis of precipitation spatial and temporal variability is important for mitigating the impacts of flood and drought risks. Various statistical procedures are used to investigate the precipitation variability. Concentration index, expressed on the basis of the exponential curves, enables the evaluation of contrast or concentration of the different daily amounts of the precipitation by regionalizing the study area into lower and higher variability. In the present study three indices precipitation concentration index (CI), annual precipitation concentration index (APCI) and seasonal precipitation concentration index (SPCI) are used for assessing the precipitation concentrations and the associated spatial patterns for part of Uttarakhand region. Daily precipitation data from 83 rain gauge stations for 18 years (2000-2018) obtained from IMD is used for the present study. The CI values in the study area vary from 0.43 to 0.62 with an average value of 0.52. The results show that higher precipitation CI values were mainly observed in Shiwalik Range and districts near Pauri, Nainital, Haridwar, Roorkee and parts of Chakrata and Tehri whereas lower precipitation CI values were mostly detected in Dehradun and parts of Uttarkashi.

CORAL REEF MAPPING USING SENTINEL-2 MSI DATA IN NARARA, POSITRA AND PIROTAN ISLANDS, GUJARAT

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ABSTRACT: Coral reefs are important part of biodiversity (Plaisance et al., 2011) that provide multiple natural resources and ecosystem services to human societies (Mumby et al., 2011). Hard corals used to dominate the seascape of tropical reefs; but as coral reefs are extremely sensitive to the environmental conditions, they are often used as important indicators of climate change (Chaudhury et al., 2014). Remote sensing is more practical way to monitor the change in health and coverage of the reef ecosystem covering larger area. And one of the method to map and monitor different coastal classes is spectral indices. Spectral indices are generally used to measure absorption and scattering processes, which are strongly negatively and positively correlated to the chemical and structural properties of the
object and to monitor a direct response to relatively small changes in coral cover, across a range from low to high cover levels (Joyce et al., 2013).

In present study landuse-landcover maps of reef ecosystem of Narara, Positra and Pirotan Island in Gulf of kuchchh were generated to identify the changes in total cover of coral reef area in last 20 years. The Sentinel-2 Digital data of the year 2019 and Landsat-5 Digital data of the year 19971998 were downloaded from https://earthexplorer.usgs.gov/. The image with 6 Km and 3 km Buffers from the center of the islands were extracted for further analysis. The Land use maps of these Islands were prepared by on screen digitization of different landuse classes including coral reef and coral features. The digital numbers of each landuse class was extracted and plotted to study the spectral separability of corals and other landuse classes. Result of the study shows that the coral area in different islands have decreased during last 20 years except for Pirotan Island; where it shows increase by almost 50 ha. Which shows significant impact of different anthropogenic activities and natural parameters in Narara and Positra. The main aim of generating spectral signature of different classes is to differentiate corals from other classes. The according to values generated from polygons of different classes shows that corals can be easily separated by spectral signatures.

**KEYWORDS:** Coral Reef, Spectral Signature, Landuse-landcover, Coastal area, Sentinel-2, Landsat, QGIS

**PERSISTENCY OF THERMAL FRONT AND ITS SEASONAL CYCLE IN THE NORTHERN ARABIAN SEA**

Reba

**ABSTRACT:** The persistent location of sea surface Temperature fronts are detected and identified using Global 1km SST (G1SST) and MODIS 4km SST daily time series data for the northern Arabian Sea. The weekly composite datasets of thermal front density are generated from the daily time series using gradient of 0.07/km for the g1SST and 0.075/km for modis based on the sensitivity experiments. Least square based harmonic analysis is carried out on both TFD datasets to investigate their observed seasonal variability in northern Arabian Sea. The outcome of this study can be used as a support for the utility of G1SST to provide gridded, gap free and daily thermal front datasets for PFZ advisories along the Indian EEZ.

**DETECTION AND CLASSIFICATION OF MARINE SLICKS THROUGH DECOMPOSITION AND SUPERVISED CLASSIFICATION USING POLSAR DATA**

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**ABSTRACT:** Oceans are the largest ecosystem covering 70% of the earth’s surface and supporting the greatest biodiversity of this planet. The accidental oil spills in the oceans have become a major concern for the environment. The oil spills are accidental seepage of oils into water bodies due to collision, illegal transportation, and blowouts like Deep Water Horizon in the Gulf of Mexico (2010). A million gallons of oil have been dumped into the ocean in the last decade. If the current conditions persist, the majority of the ocean species will die in the coming 60 – 70 years. Detecting oil spills is more of a tedious task. Remote Sensing plays an important role in timely capturing these oil spills as this technology is not dependent on weather and season conditions. SAR images are proven to be robust in acquiring the oil spill images within the right time and that too quite effectively. The oil spills spread
over the water surface with time depending upon its chemical composition, viscosity, specific gravity, and intermolecular surface tension, etc. The backscatter value of oil spills differs with the age of the oil spills. UAVSAR L-band Quad-Pol dataset is used for the oil spill extraction and the region of interest is the North Sea, Norway. The captured oil spills were a part of the Norwegian Radar Oil spill Experiment (NORSE, June 2015). The dataset was already between 0-1 pixel range, and following the normal probability distribution curve, hence no need to radiometrically calibrate the data as well. Refined Lee filter of window 9*9 is applied to the dataset to remove the salt and pepper effect from the data and for smoothening without any substantial information loss. Van-Zyl, a model-based incoherent decomposition, and Yamaguchi decomposition are applied to the filtered dataset to get insights about the scattering behavior of the ocean and oil spills. A comparative analysis between the two decompositions has shown better classification accuracy when Van-Zyl decomposition is used. Since the evolution of technology, the classification of remotely sensed data is a great tool for segmenting different features. Wishart Supervised Classifier with window size 15*15 is used for classifying the oil spills. It is found that Wishart Classifier gives quite promising results as the pixels in an image are distributed by the Wishart distance principle, hence making the classifier more effective in classification. The output of the classifier has distinguished the oil spills from water effectively. The noise cannot be removed completely from data and due to this property, some classes can be misclassified during classification. For examining the accuracy, the confusion matrix, and the AUROC curve are plotted to know how accurately the oil and water classes are classified.

**KEYWORDS:** Oil Spills, PolSAR, Decomposition, Supervised Classification

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