

2nd International Symposium on Geo-Informatics

“Geo-Informatics for Conquering New Frontiers Towards National Development”



GEOSYM 2022

2022 | **30th November**
01st December

ABSTRACTS

Faculty of Geomatics
Sabaragamuwa University of Sri Lanka



**2nd INTERNATIONAL SYMPOSIUM ON GEO-
INFORMATICS (GEOSYM) 2022**



**GEOSYM
2022**

Abstracts

November 30, 2022

December 01, 2022

Faculty of Geomatics

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GEOSYM 2022 – AGENDA

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30 th November 2022	0900-0905	Opening Remarks
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	0915-0930	Speech by Chief Guest Prof. Udaya Rathnayake Vice-Chancellor, SUSL
	0930-1010	Keynote Speech Prof. Vassilis Gikas National Technical University of Athens
	1010-1015	Closing Remarks Dr. H.M.I. Prasanna Conference Chair
	1030-1245	Technical Session: Surveying & Geodesy
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01 st December 2022	0830-1100	Technical Session: Hydrography
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	1400-1630	Technical Session: Remote Sensing & GIS

SYMPOSIUM CHAIR - Dr. HMI Prasanna

SYMPOSIUM SECRETARY - Dr. K.M.S. Bandara

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- Land Management, Cadastre and Land Use – Dr. N.M.P.M. Piyasena
- Hydrography – Dr. M.D.E.K. Gunathilake
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- Remote Sensing & GIS – Dr. H.A. Nalanie

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MESSAGE FROM THE VICE CHANCELLOR

I am delighted to pen this message for the 2nd Students Research Session (GEOSYM 2022) of the Faculty of Geomatics on "Geo Informatics for conquering new frontiers towards National development".

This forum is a pinnacle of the undergraduate quadrennial period of learning and training and it promulgates the scientific knowledge and experience to the global community. The effort, encouragement and dedication the students had on the research work despite the crucial situation of the country should be highly appreciated. I hope that the students would pursue their dreams and aspirations by continuing their motivation and interests. The experiences they attain in these consecutive four years will sharp their lives as responsible citizens in upcoming years.

The effort, encouragement and dedication the students had on the research work despite the crucial situation of the country should be highly appreciated. I hope that the students would pursue their dreams and aspirations by continuing their motivation and interests. The experiences they attain in these consecutive four years will sharp their lives as responsible citizens in upcoming years.

Finally, I wish to thank the Dean, Heads of the Departments, Chairperson, Secretary and the members of the Organizing Committee who contributed to the success of GEOSYM 2022

Wish you all the best.

Snr. Prof. Udaya Rathnayaka
Vice-Chancellor
Sabaragamuwa University of Sri Lanka

MESSAGE FROM THE DEAN

On behalf of the Faculty of Geomatics I warmly welcome you to the GeoSym2022 at Belihuloya. The GeoSym2022 is a biennial event comes under the GEOWEEK2022. The conference provides us with the opportunity to celebrate the 25th anniversary of the Faculty. As the Dean of the Faculty, I am privileged to issue a message to the GeoSym2022 at this milestone.

Over the last 25 years, the Faculty has made a tremendous contribution in research, teaching and practice, resulting in a remarkable impact in many sectors including academia, industry and society as well. The conference would give researchers a platform to disseminate their findings through a carefully selected theme **GEO-INFORMATICS FOR CONQUERING NEW FRONTIERS TOWARDS NATIONAL DEVELOPMENT.**

We have experienced local and international in-person conferences till the global pandemic situation hit the academic and professional atmosphere. Nonetheless, it turned the day-to-day life upside down. This confinement paves the way to execute an extensive array of online conferences, educational webinars and hybrid events throughout the period. These hybrid events and tools are creating a new window for critical research to reach a larger audience, inspire interactions and more networking. We have an exciting program at this conference that will allow members to reflect upon and celebrate our past accomplishments, renew friendships and extend our networks, and jointly explore current and future research directions.

I am confident GeoSym2022 will play an important role in spurring research, encouraging continuous program improvement and providing excellent opportunities to build more and better collaborations between colleagues.

Thanks to all members of the Organizing Committee of the GeoSym2022. Thanks also again to all our Faculty members, the sponsors, the distinguished participants and all who have contributed papers to this conference. This Book of Abstracts is a prelude to the Conference Proceedings.

I wish you a very successful conference and an enjoyable hosting of the Faculty of Geomatics.

Mr. PGV Abeyratne
Dean, Faculty of Geomatics
Sabaragamuwa University of Sri Lanka

MESSAGE FROM THE CHAIR-GEOWEEK2022

I am immensely pleased and honored to welcome you all to the 2nd international symposium of the Faculty of Geomatics, the Sabaragamuwa University of Sri Lanka which has been scheduled on 30th November and 1st December 2022 as one of the most vital elements of the GEOWEEK2022. In this year we are glamorously continuing GEOSYM2022 as a prominent portion of the GEOWEEK2022. We initiated this academic activity in 2019 with the intention of providing a platform to all the final-year students to unveil their research achievements. I am glad to note that today this event has been nurtured to be a major academic event conducted by the Faculty with the prime concern of exchanging and sharing experiences and research findings among the research scholars, academic staff, and students of the faculty. I am confident to state that this symposium has reached its importance as one of the major annual events for disseminating high quality research, networking, fostering interaction and exchanging ideas among professionals, researchers, academics, and students in the field of special science.

As the only faculty which offers the Surveying Science Degree within the state governed Universities, we owe a great responsibility to society. Research is one such responsibility that we carry out within the field of academia. Surfing for the untouched spheres of knowledge is our prime concern. As an authentic reality of our contribution to emerging knowledge, GEOSYM2022 is aiming to encourage young researchers by providing a forum to share their insights into recent research and cutting-edge technologies. I am pretty sure that the outstanding bunch of undergraduates that we have produced are delighted to have this event as this sharpens their experience of disseminating research findings in the forum of experts and colleagues.

In conclusion, I would like to thank each and every person who shed their sweat on making this event a success. Further, I should pay my heartfelt gratitude to the Faculty of Geomatics for their dedication towards successfully organizing GEOSYM2022. Also, I would like to express my gratitude to all the invited speakers, guests, and presenters whose contribution has enlightened this event.

I wish you all a fruitful academic experience at the GEOSYM2022.

Dr. GSN Perera
Chair-GEOWEEK2022
Faculty of Geomatics
Sabaragamuwa University of Sri Lanka

MESSAGE FROM THE CHAIR-GEOSYM2022

It is with great pleasure and honour to be the Chair of the 2nd international symposium on Geo-Informatics (GEOSYM) 2022 scheduled to be held on 30th November and 1st December of 2022 organized by the Faculty of Geomatics, Sabaragamuwa University of Sri Lanka. This is the main academic activity in GEOWEEK 2022 organized to celebrate the 25th anniversary of the Faculty of Geomatics. The Geographic Information System, Remote Sensing Technology, Global Navigation Satellite System and Spatial Databases play an important roles for the national development planning in many countries. Therefore, we organized this symposium with the theme “Geo-Informatics for conquering new frontiers towards national development.” I am happy to announce that we got more international participations this year through plenary talks by eminent researchers and presentations by research scholars.

Research for new knowledge is one among the three essential functions of a university, the other two functions being teaching/training and community service. Universities in the country are required to be in the forefront of this drive towards creation of new knowledge. In the view of supporting this, GEOSYM is focused to encourage young researchers by providing a forum to share their insights into the recent research and cutting edge technologies. I am confident that the geospatial community in Sri Lanka are delighted to have this event continuously since this would be an important forum of disseminating research findings with experts. Further, I believe that GEOSYM will enhance the image of the Faculty of Geomatics and Sabaragamuwa University of Sri Lanka as research is an essential and integral part of teaching at the University level.

In concluding, I would like to thank the organizing committee of GEOSYM 2022 for their dedication and untiring efforts to make the GEOSYM 2022 a great success. Also, I would like to express my gratitude to all the invited speakers, guests and presenters whose contribution has enlightened this event.

I hope that you all will have a fruitful academic experience at the GEOSYM 2022.

Thank you.

Dr. H.M.I. Prasanna
Chair-GEOSYM 2022
Faculty of Geomatics
Sabaragamuwa University of Sri Lanka

SESSION OVERVIEW			
Date	Time	Technical Session	Chairperson (C) Rapporteur (R) Judges (J)
30 th November 2022	1030- 1245	Surveying & Geodesy	C – Dr. Brian Rupasinghe R – Dr. Nishamanie Ranasinghe J – Dr. M.D.E.K. Gunathilake J – Mr. A.N.D. Perera J – Mr. K.K.D.W.S. Kannangara
	1400- 1630	Land Management	C – Prof. Jagath Munasinghe R – Dr. N.M.P.M.Piyasena J – Dr. H. Divithure J – Dr. A.K.R.N.Ranasinghe J – Ms. D.S. Munasinghe
01 st December 2022	0830- 1100	Hydrography	C – Dr. S.U.P.Jinadasa R – Dr. Eranda Gunathilaka J – Mr. A.N.D. Perera J – Mr. P.G.V. Abeyatne J – Dr. H.M.I.Prasanna
	1115- 1330	Integrated Spatial Science Applications	C – Prof. Saman Koswatta R – Ms. Kalani Illeperuma J – Prof. H.R.S. Bandara J – Dr. G.S.N.Perera J – Dr. P.G.R.N.I. Pussella
	1400- 1630	Remote Sensing & GIS	C – Dr. Lal Muthuwatta R – Dr. Nalani Hettiarachchi J – Dr. D.R. Welikanna J – Ms. J.A.S Jayakody J – Ms. D.S. Munasinghe



TECHNICAL SESSION 01

SURVEYING & GEODESY



GEOSPATIAL INVESTIGATION OF TORRENTIAL RAINFALL-INDUCED LANDSLIDES ON THE WINDWARD SIDE OF WESTERN GHATS- A CASE STUDY OF KOOTICKAL, KERALA, INDIA

Amrutha A.S, Abin Varghese, Sreelakshmi Prakash, Baiju K.R*
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Abstract

On the windward side of western ghats, the frequency of landslides has significantly increased in recent years. Kerala had catastrophic landslides and floods in 2018, 2019, 2020, and 2021, resulting in the loss of lives and property. In October 2021, a cloudburst occurred in middle Kerala, causing multiple devastating landslides in the districts of Kottayam and Idukki. The study focuses on how the topographic, physical, geological factors, and anthropogenic activities in the windward slope of Western Ghats influence the occurrence of landslides. The landslide susceptibility was analyzed by frequency ratio based on paleoslide locations in the Manimala river basin with special reference to Kootikal. The impact of each factor was analyzed. The findings showed that the torrential rainfall experienced in Kerala and the anthropogenic activities, especially the watershed management work performed in the area, significantly affected landslide susceptibility. About 5% of the manimala river basin is highly susceptible to landslides, and this area comes under Kootikal region. The study recommends a rigorous geophysical assessment of the influence of watershed management operations on a landslide and an EIA of roads in the Kootickal region.

Keywords: *Landslide, Kootickal, Frequency Ratio, Cloud Burst, Watershed Management Works*

EXTRACTION OF POWERLINE CORRIDOR BY USING DRONE IMAGES AND ITS POINT CLOUD DATA

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Abstract

In today's world, it is critical to have an uninterrupted power supply for human activities, industries, and other operations that rely on electricity to work properly. Power lines are cabling that transports electricity from a power station to cities and villages where it is needed. They must be connected between the tower's frameworks. These towers and power line cables are constructed with safety and economic feasibility in mind. There is no insulating covering around these transmission wire lines. As a result, high vegetation around or under powerlines is one of the leading sources of short circuits that destroy power lines. Power lines in Sri Lanka have conventionally been studied using the traditional manner. The study's aim is to develop an automatic system for locating electricity line corridors and checking the clearance of the powerline corridor. Maintainers can quickly locate cut-off ranges and locations using this method, and it can be used for future power line construction. To determine the power line corridor and its safety ground clearance, 3D point cloud data can be used in combination with an automated method. This research was conducted near the Southern Campus of Kotelawala Defence University. The low-cost drone is used to collect data after choosing a suitable place. Python programming language was used to develop the final automated software. Drone photos were used to produce a point cloud as the result. When a point cloud is inserted as an input to the Python system, the output represents a power line, safety line, powerline corridor, and caution location.

Keywords: *Powerline Corridor, Point Cloud, Drone Images, Python*

ACCURACY ANALYSIS OF SHORT AND LONG BASELINES WITH DIFFERENT COMBINATION OF SATELLITE CONSTELLATIONS

Kuganan. V, Prasanna H.M.I.*

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Abstract

The use of satellites for precise positioning has become crucial in the modern world. The highest positional accuracy cannot be obtained using a single satellite constellation alone. This study aimed to assess the horizontal and vertical positional accuracy in both long and short baselines with different combinations of multi GNSS satellite constellations and their frequencies. The continuous GNSS observations of three stations: The Institute of Surveying & Mapping Diyathalawa (ISMD), SUSL, and Colombo CORS, were used for accuracy assessment. The precise point positioning (PPP) technique was used for determining the accurate locations of three base stations. It was found that GLONASS+GALIELO satellite constellations showed the best horizontal accuracy in short baselines of deviation of 7.43 mm while the constellation of GALILEO showed the highest vertical accuracy of deviation of 1.29 mm. For long baselines, the combination of GPS+GLONASS+GALILEO constellations showed the best horizontal accuracy of deviation of 3.42 mm while the constellation of GALILEO alone showed the best vertical accuracy of deviation of 2.66 mm. The accuracy analysis of different frequency combinations was performed for these best satellite constellations. The results showed that both modernized and legacy signals provide the best solutions to the horizontal positioning of deviation 1.43 mm in a short baseline while only the use of the modernized signals for the best vertical accuracy of deviation 1.14 mm. The results of long baselines showed both modernized and legacy signals provide the best solutions to the horizontal positioning of deviation of 1.14 mm while only the use of modernized signals for the best vertical accuracy of deviation of 1.42 mm.

Keywords: *GNSS constellations, PPP positioning, frequency and satellite combinations, baseline processing.*

ASSESSMENT OF HIGH-RESOLUTION GLOBAL GEOPOTENTIAL MODELS TO FILL THE LEVELLING HEIGHT VOID FOR THE SRI LANKAN REGION

Edirisinghe E.A.D.U., Welikanna D.R., Thunendran P., Bandara R.
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Abstract

Due to the unavailability of a dense gravimetric network, Sri Lanka belongs to an area where gravity anomaly data are of poor nature. When developing the Global Geopotential Model (GGM) EGM2008, fill-in gravity anomalies using the Residual Terrain Model (RTM) gravity forward modeling technique has been used for the Sri Lankan context. Particularly, it is noted that fill-in values are the least quality gravity data used in constructing EGM2008. This EGM2008 data set has been used later to develop high-degree/order (2190) GGMs, as EIGEN-6C4, GECO, XGM2019e-2159, and SGG-UGM2. EIGEN-6C4 has been developed by combining EGM2008 data with more terrestrial data, which shows significant improvement over the Australian region up to 9.1cm considering Root Mean Square (RMS) about the mean of GNSS / leveling minus GGM-derived geoid heights. GECO was developed by combining GOCE satellite data with EGM2008. The proposed combination compared and showed which weights the different input contributions can outperform, locally, other more sophisticated combinations from global contributions. In XGM2019e, ground gravity observations regarding Sri Lanka are filled with a pre-compiled 15' global geographic grid. Even so, the resolution is not adequate enough to convert the ellipsoidal height to orthometric height in practical GNSS uses. SGG-UGM-2 does not notably represent ground gravity data, with respect to EGM2008. Hence, GNSS surveys using GGMs for levelling height determination in Sri Lanka cause accuracy anomalies. In order to fill the levelling height void for the Sri Lanka by using high resolution GGMs, assessment of the suitability of them for the region is important. The analysis shows that RMS Error for GGMs derived geoid heights have ranged from 0.094m to 0.074m over Sri Lanka.

Keywords: *Global Geopotential Models, Geoid Heights*

ACCURACY AND STABILITY ANALYSIS OF GPS AIDED GEO AUGMENTED NAVIGATION (GAGAN) FOR HYDROGRAPHIC APPLICATIONS IN SRI LANKA

R.K.A. Ariyaratna¹, Y.M.R.N. Kumari¹, R.D.M.I. Rathnayake¹, P.V.D. Tharanga¹, T.L. Dammalage², M.D.E.K. Gunathilaka³

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Abstract

With the growing demand for accurate and reliable positioning and navigation applications in various inland and offshore hydrographic surveying applications, there has been a significant move towards the use of real-time Global Navigation Satellite System (GNSS) with local and wide area differential positioning capabilities (DGNS). The common methods used in Sri Lanka in such applications for many years were the use of local DGNS technique or get the commercial DGNS service from international service providers. However, Satellite-Based Augmentation Systems (SBAS) are being developed worldwide for many purposes and having a unique advantage of wide area coverage. GPS Aided Geo Augmented Navigation (GAGAN) is an Indian implementation of SBAS. This study focused on analyzing the improvement in position solution with GAGAN corrections over Sri Lanka for Hydrographic survey applications. Further, to analyse the stability, performance and availability of GAGAN SBAS service, some field experiments were conducted at Jaffna and Colombo. Static observations were done using three different GNSS instruments and compared with the accuracy with respect to L1 and hand held GNSS standalone observations. Then, near shore tastings were conducted at Norochcholai. GAGAN augmented SxBlue IIB L1 and Seastar 8300HP L1 receivers were configured to transmit the NMEA 0183 data string at 1 Hz sampling frequency. Both receivers were linked with Hypack 2018 data accusation software and navigate along the 7 km pre-planned survey line. Position deviation of both GPS receivers were compared with the preplanned survey lines. At each of the field test, the GAGAN activated receiver has always shown a significant stability against the uncorrected observations. Further, the calculated average 2D positional error was lower than 1m and it is shown acceptable positional accuracy for less critical areas.

Keywords: Hydrography, DGPS, GAGAN, SBAS, Navigation

INFLUENCE OF ANTENNA HEIGHT AND SATELLITE GEOMETRY ON PSEUDO RANGE MULTIPATH

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Abstract

Multipath is known to be a hard to mitigate, site-dependent error in determination of positioning solutions of Global Navigation Satellite Systems (GNSS) applications. There are several better antenna designs and processing algorithms are being introduced at receiver level multipath mitigation. However, the combination of instrumentation setup and the receiver model used in field surveying varied the amount of multipath residual error remain in the position solution. This study analysis the pseudo range multipath effect on different GPS antenna configurations of (i) satellite geometry (ii) varying antenna heights and (iii) with two different GNSS brands. GPS observations considering the satellites above 150 elevation were performed over three experiment sites in a GNSS friendly environment for three continuous days. The results were comparatively analysed for same sidereal time of each day to ensure the repeatable availability of the GNSS satellites for the observations at each site. The multipath error induced by satellites was high varying between ± 0.015 m while evolving at low elevations of 250 to 450 and was low varying between ± 0.006 m when the satellites moved to higher elevation above 500. Influence of multipath residual increase with the increment of instrument heights by approximate 15% in comparison when the instrument was placed on the ground, at zero-level. The least multipath impact was noted during the instrument was placed at zero-level. Leica GS15 receiver performed effectively in mitigating multipath residuals when compared to trimble 5700 receivers, where the trimble antenna and receivers were comparatively older. Carrier L2 signal responded well with least error impact of multipath residuals when compared to L1. A combination of well calibrated GNSS antenna and receiver design, ground level instrument height and better satellite geometry would be a better solution to mitigate basic level of multipath error in a practical scenario.

Keywords: *GNSS, GPS, Multipath, Pseudo range*

TECHNICAL SESSION 02

LAND MANAGEMENT



DISCERN CONSTITUENTS INFLUENCING THE INTEROPERABILITY OF SPATIAL DATA IN RELEVANCE TO THE NATIONAL SPATIAL DATA INFRASTRUCTURE (NSDI) OF SRI LANKA

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Abstract

A spatial data infrastructure (SDI) provides a operational framework for geographic data, metadata users, and associated tools that are interactively connected to use spatial data efficiently and flexibly. A National Spatial Data Infrastructure (NSDI) concerns on improving data sharing and utilization ability, so that decision-makers can easily make use of spatial data for their functions. The Sri Lankan NSDI (SL NSDI) is mainly concerned with integrate and optimize the development and sharing of fundamental geographical and statistical information across all government agencies and institutions. The design, build, implement and maintain a National Spatial Data Infrastructure (NSDI) requires involvement of various disciplines and examination of numerous issues and challenges. The main objective of this study is to identify the challenges of interoperability of spatial data between different government departments and agencies, which were mainly created for a unique organizational purposes. The Key issues and challenges associated with data interoperability between organizations are framed through expert opinions and the same are evaluated through structured questionnaire. . It has found that even though spatial data creators use their own local data standards for spatial data, they need to be improved to the international standards in order to improve the interoperability. The Metadata Availability, poor knowledge, inadequate human resources & training, and organizational level legal policies that hinder the sharing of spatial data among other institutes are other major challenges to overcome. It is recommended to follow ISO TC211 and OGC standards as much as possible to create and convert existing spatial data. Metadata handling policies also should be implemented in order to enhance the spatial data interoperability.

Keywords: *Interoperability, Spatial Data, National Spatial Data Infrastructure, Spatial Data Infrastructure*

FIT-FOR-PURPOSE SOLUTIONS FOR PROBLEMS ASSOCIATED WITH LAND USE PLANNING AND LAND CONSOLIDATION: A CASE STUDY IN WEWATHENNA GN DIVISION, SRI LANKA

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Abstract

To regulate the distribution of the benefits of a certain land area for specific uses, land rights give immense support. Land consolidation and land use planning are the main aspects of land management which show importance in environmental issues locally as well as globally. Large and negative effects on society externally can be generated through land conflicts. As a developing country, in Sri Lanka, with a growing population, it is better to find proper solutions for emerging problems in land use planning and land consolidation activities. In land use policies, the lack of a systematic and reliable database on land and water resources is one of the major weaknesses. The main objective of this study was to identify land management-related problems and feasible solutions in a rural area of Sri Lanka in a scientific manner. The research area was the Wawathenna GN division of the UVA province and used questionnaires, modern surveying technology, and tools to obtain data. Identified social and economic opportunities for improving their lifestyle and interventions of government officers, institutions, organizations, and non-government officers on villagers' problems through this research. The results explain the capabilities to implement solutions for the burning issues on the ground level. Overall, the synthesized research exposed the land use planning and land consolidation strategies towards the village economy and villagers' well-being accordingly.

Keywords: *Land use planning, Land consolidation, Wewathenna GN division, Land conflicts, Government interventions*

IMPACT OF LAND TENURE SECURITY ON REAL ESTATE INVESTMENT IN BANDARAWELA MUNICIPAL COUNCIL AREA FOR THE DEVELOPMENT OF THE TOURISM INDUSTRY

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Abstract

Tourism has substantial importance on the economy of Sri Lanka. For developing lands to gain more profit from the tourism industry, requires real estate with secure land tenure thus land tenure, in its simplest meaning, implies the way of holding the land. The main objective of the study was to investigate the impact of land tenure security on real estate investment in the Bandarawela municipal council area. The most important types of land tenure were identified and categorized into five levels of tenure security and assigned a score from 1 to 5 for each level, while 5 represents the highest level of security and 1 the lowest. Also, this study envisaged developing an acceptable index ($DI_{Tourism}$) to determine the tendency of each land parcel toward real estate investment in the Bandarawela area. To determine $DI_{Tourism}$, 7 measurable factors were selected based on experts' opinions in the fields of real estate, tourism, and land management through a questionnaire and previous publications. The Analytical Hierarchical Process(AHP) was used to assign weights. To ensure the accuracy of those respective weights, the consistency ratio was checked and it was 0.0550. Then $DI_{Tourism}$ was calculated for all selected land parcels and the Pearson correlation test was performed by IBM SPSS Statistics 25 software between land tenure security level and the values obtained for the $DI_{Tourism}$ for all selected land parcels. Pearson correlation coefficient (r) was 0.119 which shows a low degree of correlation between land tenure security level and the values obtained for the $DI_{Tourism}$. The highest mean value for $DI_{Tourism}$ was achieved by a moderate tenure security level that includes renthold and leasehold tenure types.

Keywords: *Land Tenure, Real Estate Investment, Analytical Hierarchical Process, $DI_{Tourism}$*

A REVIEW: PERFORMANCE EVALUATION OF LOW-COST RECEIVERS UNDER DIFFERENT ENVIRONMENTS FOR CADASTRAL SURVEYS

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Abstract

Currently, geodetic receivers with high specifications for real-time data acquisitions, are marketed for an enormous price which is unbearable for most users. Hence, as a solution, a series of high-precision positioning products were developed with the capabilities of providing carrier phase measurements and the original observation data at a low cost for high-precision satellite positioning. These receivers allowed the user to acquire more signals through channels from more satellites for time-to-first-fix in kinematic applications thus, satellite positioning has become less difficult to realize, and it was achieved by the manner of Real-time kinematic (RTK), Precise Point Position (PPP) and static relative positioning methods. But was very prone to noises which caused errors. To optimize the quality of measurements, Signal to Noise Ratio (SNR) constraints must be set and receiver noise level is detected by zero baseline or ultra-short baseline comparison. With a thorough literature survey it can be concluded that, the aforementioned GNSS receivers can perform better in most areas with strong signal strength. Even in some areas with weak signal strength, centimeter and sub-meter levels of accuracy can still be obtained for cadastral surveys.

Keywords: *low cost receiver, SNR, RTK, Accuracy, cadastral survey*

GENERATING THE HIGH-RESOLUTION ORTHOPHOTOS AND DIGITAL ELEVATION MODEL(DTM) FOR CONSTRUCTION OF SALINITY BARRIER ACROSS NILWALA RIVER

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ABSTRACT

Due to the freshwater scarcity resulting from the increment of the sea level and followed exacerbated along with the deepening of the river beds through unregulated sand mining activities, it has been necessitated to have a salinity barrier across rivers in Sri Lanka. Having salinity barriers enable the upstream water drinkable and can use for agricultural purposes mainly while automatically sensing the salinity levels. Nowadays, with the convenience of modern technology, with high-resolution imagery different kinds of digital models can be prepared. The main purpose of this study is to provide the basis for identifying +1.0m contour and to demarcate the +0.6m contour (with respect to the MSL) and quantity of the exact inundation area during the gate close period of the Matara Stage IV water Supply Project. The resulting approach allows the acquisition of a rapid, standardized, and low-cost Digital Elevation Model (DEM) and high-resolution orthophotos. The selected research location was the Salinity Barrier (1) of the Nilwala River and the adjacent areas. After a thorough field inspection to identify information about obstacles, heights of man-made features, tree clusters, and terrain variations, with a questionnaire survey, an Unmanned Aerial Vehicle(UAV) Survey and a GNSS RTK receiver all the relevant data were acquired. Modern general digital photogrammetric technique and Pix4D Mapper software is used for data processing. The expected accuracy level of ground sampling distance was 1.98cm since the expected value was 2cm. And we received a vertical accuracy of 5cm as we expected. Ground truth information and transferred MSL value to the study area were used as the main quality control methods. This study showed that the exact inundation area was more enormous than the expected level from the previous preliminary studies and a vast area will be affected negatively if the salinity barrier is implemented rather than beneficial.

Keywords: *Unmanned Aerial Vehicle, Digital Elevation Model, Salinity Barrier, Nilwala River*

DIGITAL INDIA LAND RECORDS MANAGEMENT INFORMATION SYSTEM USING OPEN SOURCE GIS PRODUCT BHUNAKSHA

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Abstract

This paper briefly introduces the tools used for the issue of Record of Rights (RoR) to the land owners containing the ownership details, the extent of the land, the land parcel map with boundary details and information related to adjacent plots. There is also a provision of splitting the plot into different parts because of ownership transfer, merging of plots because of court orders and annotating the land parcel map with various alamsats (symbols). This tool is being used for Digital India Land Records Modernization (DILRMP), where the land parcel is updated through the workflow system of Bhunaksha. The existing cadastral maps are also digitized and integrated with the attribute data. Each land parcel is given a unique id consisting of 14 digits known as Unique Land Parcel Identification Number (ULPIN). "BHUNAKSHA" is developed using the open source java library called "GeoTools" to facilitate the management of the digitized parcel maps. The digitized parcel maps are stored in the PostgreSQL database with PostGis extension as a spatial database for secured access and updations of the land parcels. Use of Java Topology Suit (JTS), PostGis geography and geometry data type and sample screens of the application for various States are also shown. The spatial data infrastructure proposed to be implemented at Tehsil/District and State is also explained in this paper. The software is operational at Tehsils. The objective of this study is to facilitate end-to-end solutions for cadastral mapping starting from digital verification of raster and vector data of cadastral maps, integration with RoR and services such as mutation, updation, distribution of RoR and map to the citizen. It also caters to the requirements of the DILRMP project in G2G and G2C domains.

Keywords: DILRMP, ROR, JTS, GIS, Geotools, ULPIN

TECHNICAL SESSION 03

HYDROGRAPHY



IMAGERY DERIVED BATHYMETRY: FACILITATING EMERGING POST COVID-19 DEMANDS IN COASTAL BATHYMETRIC MAPPING

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Abstract

Acquiring hydro-spatial information across the marine environment has traditionally been appeased by submerged ship-based acoustic gears. For the first time in history, the continuous nationwide lockdown across the globe has created a wide scope of socio-economic interruption since the coronavirus outbreak started in 2019. The unpredictability nationwide lockdown has made it very difficult to arrange the physical mobilization of survey crews for field data acquisition. With the emerging geospatial technology, hydro-spatial specialists today have to accommodate the “new normal”. Apparently, hydrographic surveying is undoubtedly enduring dramatic change and has an expanded role to serve an increasing number of stakeholders in the blue economy. In order to seek the maximum benefits from the espousal of the fourth industrial revolution (IR4.0) paradigms, utilization of high-resolution satellite imagery (multispectral, hyperspectral, etc.), airborne optical sensors (LiDAR, RADAR, SAR, etc.), and various unmanned surface vehicles (USV) for bathymetric acquisition to generate actionable hydro-spatial data to support the hydrographic communities. In response to the COVID-19 outbreak, hydro-spatial communities have been forced to accelerate the adoption of evolving geospatial technologies to mitigate its impact. Indeed, imagery derived bathymetry has become a reconnaissance tool for data collection to yield actionable hydro-spatial data that can alleviate future economic upheavals. With proper calibration and precise bathymetric modelling, reliable water depths information can be derived via high-resolution multispectral imagery. Thus, this approach here can also be an efficient and repeatable way to derive the seafloor topography along vast coastline segments. Our insight into the true fitness of the hydrographic industry under the ravage of COVID-19 flare-up is largely based on very limited data and greatly dependent on exceptionally restricted information. Therefore, this non-contact method is possible to harvest reliable coastal bathymetry in a comparatively less cost and labor-intensive manner in the post COVID-19 era.

Keywords: *Imagery Derived Bathymetry, Coastal Mapping, Coastal Monitoring, Hydro-spatial*

NORTH CELTIC SEA SURVEY: A GREEN REBEL'S HYDROGRAPHIC, GEOPHYSICAL AND GEOLOGICAL CHARACTERISATION PROJECT

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Abstract

To face the undergoing climate and energy crises, Irish Government planned to develop a significant network of offshore wind infrastructures. Since last March, Green Rebel started surveying the North Celtic Sea area, awarded to the offshore wind developer Energia. This comprehensive survey utilises an array of different geophysical sensors to generate distinct datasets, that after processed and analysed, will provide a complete characterization of the seabed and subseafloor. The life of a surveyor onboard of an offshore survey vessel is full of ever evolving challenges, which defy personal and professional skills but also provide reward, technical knowledge and personal development.

Keywords: *Hydrography, Offshore Wind Power, Geo-physical Survey*

RESERVOIR SEDIMENTATION ASSESSMENT USING SUB-BOTTOM PROFILER AT SAMANALAWEWA RESERVOIR

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Abstract

Sub-Bottom Profiler (SBP) is one of the effective tools used to identify the sediment layers beneath the seabed or bottom of any water body. SBP is similar to the echo sounder, but parts of the sound pulse penetrate the seabed and reflect the various layers below the surface. The Stratabox HD is a pinger-type SBP capable of detecting soft sediment layers at high resolution. Data was collected in the Samanalawewa Reservoir, one of the largest hydropower plants in Sri Lanka which generates 120 MW to the national Grid. There is a leakage on the right bank of the dam started in 1992. This leakage has continued from 1992 to today and is still to find a solution. The study focused on the remedial actions taken to prevent the leakage. A large amount of soil was cast to those areas as a solution called “Wet Blanketing” from 1997 to 1999. But no study was done to analyze the effects of wet blanketing to the right bank of the dam. The results have shown that the final expected design bed shape has not achieved. Further to that, using the SBES data, existing Digitized plans, and SBP data were used to analyze the overall sedimentation of the reservoir and the results were validated using grab samples. The initial sediment layers of the soft subsurface closely matched to the grab samples and clearly showed a significant increasing trend of sedimentation from the dam to the upstream area where Belihul Oya and Hirikatu Oya discharged to the Samanalawewa reservoir. But there is no significant sedimentation deposition according to the analysis in the reservoir to affect the Minimum Operational Level (MOL).

Keywords: Hydrography, Bathymetry, Sub-bottom Profiler, Reservoir Sedimentation

APPLICATION OF USV TO OBTAIN HIGH-QUALITY BATHYMETRIY: CASE STUDY OF COASTLINE SURVEY OF THE TRIANGLE ISLAND SITUATED SOUTH OF CHINA

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Abstract

USVs (Unmanned Surface Vehicles) have been placed in the industries and applied from hydrographic surveying and coastal oceanographic surveying to open sea areas. Improved efficiency and safety will be the driving factor behind the acceptance of USVs for this application. This paper discusses the application of the OceanAlpha M80 long endurance multi-functional USV platform deploying a Reson T20P MBES to conduct an underwater topography survey around a triangle island. With a large capacity for oceanographic survey instruments, the USV is able to conduct multi-purposed hydrographic surveys on the deep sea. The surveying process includes navigating the survey area, confining the survey area, setting up survey lines, autonomous surveying, recording data and returning, and the total survey range of this project is 41 km. The case and its result demonstrated in this paper prove that USV is an efficient and developed platform for off-island bathymetric and topographic surveys, and the data quality can reach IHO-44 Premiere Standard. USV can be adopted to obtain bathymetric data from the extremely shallow area around island reefs, providing necessary data support for marine navigation and island development.

Keywords: *Unmanned Surface Vehicles (USV), Hydrography, Bathymetry, Automation*

CORAL REEFS AND BLUE ECONOMY

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Abstract

Coral reef ecosystems are rich in biodiversity and provide a number of services and products relevant to blue economy that include, for example, sectors such as tourism, fisheries, biotechnology/bioprospecting, and coastal protection. Almost half a billion people, 8% of the total global population, live within 100 km of a coral reef and about 100 developing countries are highly dependent on coral reefs for their livelihoods. Today, the health of coral reefs is affected by ocean warming and ocean acidification (bleaching, regime shifts) and other land- and sea-based human activities that lead to coral disease and destruction of reef habitat, among other damage. This study addresses aspects of coral reef ecosystems that are critical for their contribution to sustainable blue economies. In order to discuss the current status of their distribution, the threats that they experience and their potential impact as a blue economy resource. The needed measures to detect, monitor, and ameliorate the adverse impacts and the available science and technology tools to monitor reefs also discussed with the ongoing international efforts to apply state-of-the-art tools that might be of interest to countries developing blue economies

Keywords: *Coral Reefs, Symbiosis, Blue Economy, Reef Research and Monitoring, Conservation of Coral Reefs*

BENEFITS OF THE CROWDSOURCED BATHYMETRY (CSB) IN THE HYDROSPATIAL DOMAIN AND THE EMERGING SUSTAINABLE BLUE ECONOMY

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Abstract

The hydrospatial domain represents all types of spatio-temporal data, information and knowledge about the Blue of our Blue Planet and its contiguous zones. Hydrospatial is the Blue Geospatial. Hydrography is “THE” foundational piece of the hydrospatial domain. Crowdsourced bathymetry (CSB) is depth measurements collected and shared from vessels of opportunity using standard navigation instruments, while engaged in routine maritime operations. Industries including commercial and luxury shipping, cruise-liners, commercial and pleasure fishing, and oil & gas operate across the world’s oceans can support by collecting and sharing some of their data, they can help to fill vast knowledge and bathymetric gaps, contribute to scientific research and improve navigational safety and efficiency. The bathymetric gap around the coast of Sri Lanka and within the Exclusive Economic Zone (EEZ) can be partly filled collecting and using CSB data. However, to do so, coastal states must give explicit consent to the collection, validation and publication of CSB data in waters under national jurisdiction. Sri Lanka not yet responded to the IHO Circular Letter 21/2020, hence a geographical filter is applied to the Sri Lankan waters and there is no CSB data available to download and use. This paper introduces the CSB process to the interested parties to study and to consider a positive reply which might some restrictions if necessary to regulate CSB data. Ultimately this valuable bathymetric data has the potential to utilised for the hydrospatial domain of Sri Lanka to maximize the benefits of an emerging sustainable blue economy in the country.

Keywords: *Blue Economy, Hydrography, Crowd Soused Bathymetry*

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TECHNICAL SESSION 04
INTEGRATED SPATIAL SCIENCE
APPLICATIONS

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ASSESSMENT OF ECOLOGICAL DISTURBANCE ON INDIAN SUNDARBANS WITH SPECIAL REFERENCE TO AMPHAN CYCLONE BY USING GEOSPATIAL TECHNOLOGY

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Abstract

The mangrove ecosystem of Sundarbans region plays a significant ecological and socio-economic role in both India and Bangladesh. An increase in coastal human settlements makes the area more vulnerable to natural disasters such as tsunamis and cyclones. Mangroves as an exclusive group of plants provide many ecological services such as reducing the impacts of cyclonic storms and gales and minimizing the sea level rise due to global warming. Sundarbans were facing immense destruction due to super cyclones during past years. The present study investigates the ecological disturbance caused by cyclone Amphan in Indian Sundarbans using remote sensing multispectral imagery. The pre and post-cyclonic Landsat data were analyzed to quantify the damaged area in Sundarbans due to the effect of the cyclone, Amphan. Normalized Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI) were used to estimate the vegetative changes or loss that occurred due to the cyclone. Normalized Difference Water Index (NDWI), Normalized Difference Bareness Index (NDBal) and Normalized Difference Salinity Index (NDSI) are the other indices used to study the effects of cyclone. The study found that from pre to post-cyclonic period mangroves reduced from 1851.88 km² to 1643.74 km² and about 50.18 km² of vegetation becomes sparse. High salinity values were observed during the post-cyclonic period which indicates that the super cyclone results in the saltwater intrusion. From pre to post cyclone, NDBal results shows an increase in barren land from 908.13 km² to 1365.57 km².

Keywords: *Sundarbans, Cyclone, NDVI, EVI, Salinity, LST*

URBAN LAND USE CHANGE DETECTION IN SRI JAYEWARDENEPURA KOTTE MUNICIPAL COUNCIL, SRI LANKA

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Abstract

The growth of built-up areas has a significant impact on land use by replacing areas of natural vegetation with residential and commercial areas and their related infrastructure development. Rapid land use changes have taken place in many urban and high populated areas of Sri Lanka over the past few decades. Because of this the urban cities face different challenges in achieving their future sustainable urban development goals. This study was mainly focused on detecting the land use and land cover changes in the Sri Jayewardenepura Kotte MC area with special focus on the built-up area growth in this area. Landsat 8 data were downloaded from USGS Earth Explorer for the year 1992 and 2014 were used in this study. After that identify the three-land use categories; built-up, non-built-up and water in the study area using the Supervised Classification Method. The Land Use Change Matrix and descriptive analyses methods were used to identify the land use changes, and it was carried out using Arc GIS 10.8 and MS Excel 2019 software. The study found that 382.86 hectares of non-built-up area and 82.26 hectares of water areas have converted to the built-up areas during 1992 to 2014 time period. In 1992 there were 703.26 hectares (42%) of built-up areas but in 2014, the built-up area had increased to 1208.88 hectares (72%) The annual change of the built-up area in Sri Jayewardenepura Kotte MC is 3.3% (22.98 hectares) during the study period. Identify the urban growth patterns, infrastructure development and their impacts on to the environment is essential when archiving the sustainable urbanization. Therefore, findings of this research will provide a new knowledge for the urban planning and development in this area.

Keywords: *Sri Jayewardenepura Kotte MC, Built-up Areas, Land Use Change Matrix, Urban Growth, Sustainable Urbanization*

A FEASIBILITY ANALYSIS OF MOBILE PHONE CAMERA IMAGES FOR 3D INFORMATION

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Abstract

As a result of the highly modernized technology, mobile phone cameras have developed tremendously in today's era. Due to the low cost and considering the various benefits of using them, it is important to investigate the feasibility of using them in digital close-range photogrammetry. This study evaluated the accuracy of mobile phone cameras in comparison with professional cameras in 3D photogrammetric applications. It also attempted to determine how optimal parameters such as distance from the camera to the object, photo overlap, size and shape of the test area influence in 2D and 3D accuracy. Complete workflow consists of four main steps; preparation, data collection, 3D model generation and accuracy analysis. Six different mobile phone cameras and professional camera were used for data acquisition in three study areas. Therefore, 63 3D models were generated under a total of 9 cases. In accuracy analysis, 3D coordinates of generated 3D models using Agisoft were compared with reference points obtained by sokkia fx total station. The final RMSE i.e. (4.238mm-8.448mm) values shows promising results and demonstrated that smartphone cameras can be easily used as low-cost tool in several applications of digital close-range photogrammetry. Further, among the mobile phone cameras used during this study, the iPhone XS max had the highest accuracy i.e. RMSE value was 4.238mm. Also, the obtained accuracy improved rapidly with increasing the overlap percentage between image i.e. higher accuracy was obtained when 80% overlap was used and decreases as distance between camera and object increases. Further, the shape of the object does not affect the accuracy while the size of the object does affect the accuracy. The finding here were limited to small areas, thus, it is recommended to conduct further work for large areas considering different applications.

Keywords: *Digital Close-Range Photogrammetry, Mobile Phone Camera, Accuracy analysis, Reference points, Professional Camera, Overlap*

WATERSHED MANAGEMENT PRIORITIZATION IN PADDY LAND USES: A CASE STUDY IN HUNGAMALA ELA SUB-WATERSHED IN MAHAWELI BASIN

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Abstract

Prioritization of watersheds is important for proper planning and management of soil and water resources for sustainable development. Morphometric analysis has been commonly used to prioritize watersheds for management. Hungamala Ela sub-watershed of Mahaweli River Basin was selected for this study. Stream network, stream order and micro-watersheds were extracted from Digital Elevation Model derived from 20 m contour interval using Hydrology toolset in ArcMap. 14 micro-watersheds namely HE1 to HE14 could be delineated for the selected sub-watershed. The spatial data needed for morphometric analysis were derived from ArcGIS. Linear aspects viz stream order, stream number, bifurcation ratio, stream length ratio, stream frequency, drainage density, drainage texture and length of overland flow and areal aspects viz basin area, perimeter, length, form factor, circulatory ratio and elongation ratio were calculated at micro-watershed level adopting the methods given in the scientific literature. Watershed prioritization was done by ranking and getting a compound value from those estimated linear and areal aspects of morphometric parameters. Paddy land uses were analyzed for 2003, 2012 and 2020. The results of the morphometric analysis revealed that Hungamala Ela has a 7th order stream network with a dendritic drainage pattern. The results of watershed prioritization revealed that HE6 falls under very high priority category and HE5, HE7, HE8 and HE9 fall under high priority category for soil erosion susceptibility. Moreover, paddy land uses have increased 83% from 2003 to 2020 drastically even in the identified sensitive micro-watersheds. Therefore, proper soil conservation measures are needed to be adopted by planners and policy makers for sustainable paddy cultivation especially, within the identified highly sensitive five micro-watersheds in Hungamala Ela sub-watershed of the Mahaweli River Basin.

Keywords: *Geographical Information System, Morphometric analysis, Paddy land uses, Soil erosion susceptibility, Watershed prioritization*

DEVELOPMENT OF A SYMBOL CATALOGUE APPLICATION TOOL FOR EFFICIENT COMPILATION OF PAPER CHARTS INTO ELECTRONIC NAVIGATIONAL CHARTS

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Abstract

Electronic Navigational Chart (ENC) is a new hydrographic product recognized by international marine organizations as the equivalent of the traditional paper chart designed for use in Electronic Chart Display and Information System (ECDIS) onboard ships. Data acquisition and updating are time-consuming and very cost-effective processes. As a result, there is inadequate coverage of ENCs over the world. However, paper charts are still used with sufficient coverage. Therefore, if ENCs could be compiled using existing paper charts, it would be more productive. Nowadays, there are different software packages to produce ENCs. There are some differences in performance and available operations among those. However, the technology has been evolving and the ENC production processes are being updated even at that moment. When producing ENCs using existing paper charts, intense focus should be given for many factors such as topology, product specification, selection of symbols, and validation. The purpose of this study was to encounter problems that occur with the production of ENCs using paper charts. First, the ENC product for Galle Harbour was produced utilizing the paper chart following the IHO S-57 standard, known as the transfer standard for digital hydrographic data using CARIS S-57 Composer. ENC symbology is different from paper chart symbology. Therefore, when assigning symbols to the ENC product, the correct attribute values for Select/ Object attribute dialog box should be filled. Otherwise, incorrect ENC symbols will appear and cause to mislead mariners. Then considering the difficulties in symbol assigning through the compilation process, a new external tool was introduced to overcome those difficulties.

Keywords: *CARIS S-57 Composer, ECDIS, ENC, Symbology, Navigation, Hydrography*

A SCOPING STUDY TO DEVELOP A PLAN FOR SUSTAINABLE MARINE AQUACULTURE IN SRI LANKA

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Abstract

Fisheries and aquaculture have historically played a key role in providing both food security and financial agency for people worldwide, and the sector continues to grow, with the global consumption of aquatic foods increasing at an average rate of 3% per year since 1961. According to the Director General of the FAO, GU Dongyu: “The growth of fisheries and aquaculture is vital in our efforts to end global hunger and malnutrition, but further transformation is needed in the sector to address the challenges.” The Ministry of Fisheries in Sri Lanka has identified aquaculture as an important new sector that can contribute to the national economy. Strategic investment in aquaculture development in Sri Lanka will expand economic opportunities for the private sector, reduce poverty, and increase food security in the region safely and sustainably. This project will address issues related to creating sustained and reliable income for rural communities to lift their livelihoods and reduce poverty. The outcome of this project will be a guidance document or ‘road map’ that will identify priority site locations for marine aquaculture development in context with the identified priority list of aquatic species. The guidance document will consider factors surrounding sustainable hatchery production, biosecurity, nutrition, animal health, areas of need for technical training and education, potential profitability, and access to local and international markets.

Keywords: *Fisheries, Marine Aquaculture, Training and Education, Blue Economy*

TECHNICAL SESSION 05

REMOTE SENSING & GIS



DERIVE HYDROLOGICAL INFERENCES THROUGH GIS-BASED DRAINAGE MORPHOMETRIC ANALYSIS IN KEHELGAMU OYA DRAINAGE BASIN OF SRI LANKA

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Abstract

Morphometric analysis of drainage basins are significant that inference the hydrologic features of that drainage basin. GIS is one of the effective tools that used for delineating the drainage basins and deriving stream networks and stream orders to facilitate analysis of drainage basin morphometry. Present study was focused to derive the stream network and extrapolate the hydrological characteristics of the drainage basin via morphometric characters of the Kehelgamu Oya. The Kehelgamu oya is one of the origin tributaries of Kelani river and main feeder channel of Castlereigh reservoir. The digitized contour based data published by the Survey department (2017) were used as the base data of the present study. This secondary data were re-projected to build the Digital Elevation Model (DEM) of the basin under the ArcGIS 10.8 platform. DEM was the base raster map with 10 x 10 m resolution was used to delineate the stream network and stream orders through the filled DEM, flow direction and flow accumulation raster maps. The morphometric characters including linear, aerial and relief parameters of the drainage basin were calculated referring established and previously published mathematical formula. Results revealed that the Kehelgamu oya is a 5th order river extending 27.3 kms of basin length covering 440.8 kms of total stream length distribute within the basin area of 208.96 km² showing dendritic drainage network illustrating the elongated basin shape as per the results of form factor (7.66) and circularity ratio (0.19). The maximum numbers of first order streams (518) and Drainage density (2.1) designate the high intensity of permeability and infiltration characteristics that indicates potentials of contribute to groundwater store in the basin. Kehelgamu oya basin yields a low but extended peak flow since having high bifurcation ratio value (6.4) and elongated basin shape. Further it indicates the presence of geological control on drainage. Moreover, indication of low flood risk and low soil erosion are potentially important since the river feeds two main hydro power reservoirs.

Keywords: GIS; morphometric analysis; drainage basin; hydrologic features

MONITORING THE SEASONAL WATER QUALITY VARIATIONS BASED ON REMOTE SENSING IN URBAN LAKES, SRI LANKA

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Abstract

Due to rapid urbanization, lakes water face many challenges in present. Therefore, it become an important phenomenon and identifying the spatial distribution of water quality (WQ), including the seasonally is important. But providing accurate WQ data using situ methods, it's are time-consuming, expensive, and provides lacks of spatiotemporal details. To overcome these issues, remote sensing (RS) has been recognized as an ideal solution. This study is aimed to assess the seasonal WQ distribution using RS in Beira and Diyawanna Lake. Seasonal based Landsat8 satellite data were collected from US Geological Survey in 2020 and observed WQ data obtained from Sri Lanka Land Development Corporation. In methodological terms image preprocessing, empirical methods, regression analysis, and spatial analysis used to estimate the parameters. (Chlorophyll-a, Turbidity, Secchi disk, Nitrate, phosphate, EC, Ammonia, pH, Surface Water Temperature (SWT)). The analysis was carried out using ArcGIS 10.5 and SPSS 23. The findings reveal that the estimated data significantly correlated with observed data with $R^2 > 0.50$ and $p \text{ values} < 0.05$ mostly. According to the seasonal distribution, the highest chlorophyll-a (442.22mg/L) was recorded in NEM and the lowest (85.65mg/L) was recorded in the SWM. Northern and eastern banks of the Beira Lake showed higher EC in the SWM. The pH of Beira Lake was more Alkaline than Diyawanna Lake during all these seasons. Nitrate and Ammonia have shown higher values in Diyawanna Lake in the SIM (3.1, 1.8mg/L, respectively). The highest phosphate, and Sacchi disk values reported in the SIM (0.9mg/L, 3.1m respectively). The SWT of both lakes fluctuated within four seasons, and the FIM (Appendix 1b) reported the highest value of SWT (42.01°C) and the lowest value (14.69°C) reported in the SWM. Finally, this study showed that Beira Lake WQ was lower than Diyawanna Lake. These analytical results will undoubtedly lead to enhanced WQ improvement strategies in the future.

Keywords: Water quality, Remote sensing, SWM, NEM, FIM, SIM

DETERMINATION OF POTENTIAL RUNOFF COEFFICIENT USING GIS; CASE STUDY: KALUTARA DISTRICT

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Abstract

Runoff coefficient is a hydrologic parameter that depends on land use, soil type, and soil moisture to describe the storm water runoff capacity for drainage areas. The Geographic Information System (GIS) technology and available data for a Kalutara district were used to estimate the potential runoff coefficient (PRC). The estimated PRC was used to calculate the depth of runoff. The land use map was categorized mainly into 11 classes including seven impervious areas and four pervious areas. Impervious surfaces were categorized as commercial and industrial areas, built-up land, residential area, open water, rock area, wetland, transportation and communication utilities. Pervious surfaces categorized as forest, grass, bare soil and crop. The slope map was developed from the digital elevation model (DEM) with 30 m resolution. The Sri Lankan wet zone soil map was used to prepare the soil texture map. These maps were overlaid using GIS technology to create the PRC map. Annual runoff depth was derived based on the annual rainfall surplus and runoff coefficient per pixel using the raster calculator tool in ArcGIS. The kriging interpolation technique was used to estimate the rainfall of the study area in GIS environment. Obtained PRC value range varied from 0.13 to 1.0, and runoff depth values vary from 31.0 mm to 479.2 mm. Results indicate that the highest PRC values for frequently flooded areas; Bulathsinhala and Palindanuwara. These results can be useful for identifying floodplains, suitable locations for water harvesting, and improving water resources management programs.

Keywords: *Potential runoff coefficient (PRC), Geographical information system (GIS), Digital elevation model (DEM), Runoff depth*

ANALYSIS OF CHANGES IN COASTAL VEGETATION COVER IN GAMPAHA DISTRICT, SRI LANKA USING REMOTE SENSING AND GIS TECHNOLOGY

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Abstract

This study highlights the coastal vegetation changes of Gampaha District, Sri Lanka, using Geographic Information system (GIS) and remote sensing technologies to generate NDVI (Normalized Difference Vegetation Index) maps from Sentinel-2 satellite images of different acquisitions dates in different years from 2017 to 2021 and calculate the vegetation area. NDVI, a measure of greenness and proxy for vegetation degradation is a reflectance recorded in the red and near-infrared band of the remote sensing imagery. The study was carried out about 28 km starting from Colombo Fishery Harbour to Negombo lagoon (7°12'29.82"N, 79°49'33.67"E and 6°57'51.90"N, 79°51'47.84"E) covering a 300 m buffer zone in the coastal area. The objective of the study is to identify the changes in coastal vegetation pattern cover from 2017 to 2021. According to the results, total vegetation cover in 2017 was 6.205 km² and in 2021 it was 6.747 km². Compared to the results, the total vegetation cover in the study area has increased by 0.5421 km² by 2021. Researches on coastal vegetation cover change need more comprehensive study in the coastal area. The information on vegetation cover can lead to a good recommendation for better management and planning in the coastal area.

Keywords: *coastal vegetation, sentinel-2, remote sensing, GIS, NDVI*

MODELLING URBAN HEAT ISLAND WITH LANDSAT IMAGES AND LIDAR DATA SET

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Abstract

Today, while urbanization and population growth are increasing unpredictably, the negative impact of human beings on nature is also increasing. Depending on the population, the needs of citizens, especially housing, are also increasing. Accordingly, agricultural and bare lands are being replaced by urban and industrial areas. Rapidly increasing urban structures cause an increase in temperature in cities and the formation of urban heat islands (UHI). In this study, it is aimed to produce the severity of the UHI with the help of a model without using thermal images. The city of Sioux Falls in the state of South Dakota in the United States of America was selected as the study area. For this purpose, indices were generated from Landsat using Google Earth engine (GEE) and LIDAR data sets using Point Data Abstraction Library (PDAL) covering the years 2008 and 2020 to estimate the urban heat island severity and these were used as input to the machine learning (ML) algorithm. For ground truth, the UHI severity map produced from thermal satellite images was used. Random forest was used as the ML algorithm and the overall accuracy was found to be 0.45 for 2008 and 0.64 for 2020. Predicted UHI severity maps were produced.

Keywords: *Random Forest (RF), urban heat island (UHI), LIDAR, Landsat, PDAL, Google Earth engine (GEE).*

DEEP LEARNING BASED ARCHAEOLOGICAL OBJECT DETECTION FROM DRONE IMAGERY

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Abstract

The recent technological advancements in the field of geoinformatics has enabled faster surveying techniques that are emerging in the field of archaeology. However, carrying out such surveys in faster means while preserving the original accuracies and reliability which are the properties of traditional archaeological surveys is still challenging. The lower costs, least possible manpower, and a minimal disturbance to the archaeological sites during the survey are also among the general expectations of archaeological surveys. The drone technology, image processing software and cloud-based spatial platforms with analysis capabilities can combinedly assist for achieving the above objectives. This research developed a semi-automated archaeological object detection algorithm which can extract archaeological objects from drone images. The study area of this research was the Ramba Raja Maha Viharaya Archaeological Monastery site situated in Hambantota, Sri Lanka. A series of drone images were acquired using DJI Phantom 4 RTK drone and 20 MP, 1-inch CMOS sensor. The acquired images were processed using image processing functions and object detection and extraction algorithms written in Python language. The results and the accuracy verifications depict that the process of extracting archaeological ruins from the drone images was successful and in an acceptable accuracy. The confusion matrix returned in the model training was used to calculate the accuracy of the model since the raw accuracy is not very reliable when measuring the performance of a neural network. The performance indicators of the confusion matrix, that is the precision and recall were 61.7% and 95.5% respectively.

Keywords: *Archaeological Survey, Automated Object Detection, Drone Imagery, Python Deep Learning*

TOP 100 MOST CITED PAPERS OF THE JOURNAL “REMOTE SENSING OF ENVIRONMENT”: A SCIENTOMETRIC ANALYSIS

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Abstract

The study of the most cited paper helps to understand the quality and popularity of the article(s) or journal in a specific area of knowledge. The highly cited and influential papers enhance the credibility of the author(s), affiliated institution, and the country as well as the profession. *Remote Sensing of Environment* is an interdisciplinary journal indexed in both Web of Science (WoS) of Clarivate Analytics and Scopus of Elsevier. The journal has 2021 CiteScore of 20.7 in Scopus and 13.85 of 2021 Impact Factor (IF) in Journal Citation Report (JCR) 2022 of WoS. The objective of the present study is to evaluate the prominent characteristics of the most cited papers of the journal *Remote Sensing of Environment* in Elsevier’s Scopus database. Elsevier’s Scopus database is the source data for the present study. Microsoft Excel and VOSviewer software were applied for data analysis and visualization. The most cited paper, with 6478 citations, in Scopus was “Red and photographic infrared linear combinations for monitoring vegetation” authored by CJ Tucker, USA in 1979. Curtis E. Woodcock of Earth & Environment Science Department of Boston University is the most prolific author with the most number of top cited papers (8 papers). According to the number of publications, institutions in the USA have published the most (75 papers). Remote sensing of vegetation is the most important research being reported in the journal. MODIS, Thematic Mapper are the most useful sensors, as per the most frequent keywords. ‘*Agricultural and Forest Meteorology*’ and ‘*Agronomy*’ journals are among the most cited non-remote sensing journals. China is the only non-western nation in the most prolific nations, indicating that countries of the Indian sub-continent.

Keywords: *Scientometrics, Citation Impact, Most Cited Papers, Remote Sensing Journal, Scopus, Remote Sensing of Environment*



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