S. No	ID	Title	Author	Abstract
1	4	Ba Lat delta evolution in response to changing fluvial sediment supply by the Red River (Vietnam)	Quang Nguyen	River deltas are coastal landforms that result from the accumulation of substantial quantities of terrestrial sediment near river mouths. They are sensitive to environmental change, resulting from both natural and human processes, as they exist at the interface between rivers and oceans. Deltas of any shape or size form when the ability of rivers to deposit sediment loads at their estuaries overcomes the marine forces of waves, tides, and currents, which tend to remove or redistribute river-borne material, or subsidence (sinking) due to tectonic movement, human activities, climate change, and sea-level rise. While the importance of sediment supply to delta evolution is well recognized, the relative contributions of upstream sediment loads to both subaerial and subaqueous components of most river deltas are not fully understood. Compared to the Mekong and most other Asian mega-deltas, the knowledge we have acquired about the Red River delta system is quite sparse. The morpho-sedimentary dynamics of the delta are still relatively understudied, while the sediment load continues to decline in correlation with the operation of large dam-reservoirs upstream of the river system. To investigate this issue, the present study analyzed satellite images (Landsat) spanning from 1975 to 2022 and nautical charts in different periods to examine the morphological evolution of the active Ba Lat delta, located on the central coast of the second largest river system (Red) in Vietnam, and to examine its relationship with changes in river sediment loads. We proposed a hybrid approach to estimate suspended sediment entering the sea via the Ba Lat mouth, based on a combination of one-line theory and long-term observation from a gauging station. This approach will facilitate more detailed and in-depth research on the evolution responses of both the subaerial and subaqueous components to river sediment discharges, using cost-effective remote sensing and Geographic Information System (GIS) techniques that enable the acquisition of high-accuracy information on finer spatial and temporal scales. The results indicate a significant reduction (~91.5%) in annual sediment load over the entire 64-year estimation period (1958-2021), associated with the operation of large dam-reservoirs upstream. The evolution of the active Ba Lat delta was found to be highly correlated with sediment load. Particularly, between 1975 and 1990, a huge sediment supply from the Red River caused both the north and south sections of the delta to move seaward at a rate of more than 100 m/yr, and the deltaic land area to accrete at a rate of 117 ha/yr. Since the beginning of the 1990s, however, the annual sediment flux has reduced by around 57% (from 16 x106 to 6.9 x106 m3/yr), and more than 50% of the delta's shoreline has undergone severe erosion (i.e., -21 m/yr and -17 m/yr for the north and south, respectively), and the land area and subaqueous delta have also been actively eroding. Active erosion occurred in the subaqueous delta between 1980 and 1995, likely due to the dramatic decline in sediment load since the beginning of the 1990s. The current amount of sediment load delivered to the sea (1.4 x 106 m3/yr) is insufficient to prograde the delta, which could lead to continued land loss in the future. The result implies that the operation of the Hoa Binh dam-reservoir since the end of 1988 has had a great effect on the stability of the active Ba Lat delta. The coastal sediment balance will be further impacted in the future if proper sediment management is not implemented on the operating dams. Most of the delta's sections will continue to erode, resulting in increased potential exposure of the delta to cyclones and sea level rise. The cumulative effect of all underlying dynamic processes was captured using remote sensing and GIS techniques to model these changes, reducing uncertainty when using intractable hydrodynamic parameters in sampling and modeling.

| 2 | 5 | WEBGIS FOR INVENTORY OF VIETNAM MARINE PROTECTED AREAS | Van Ngoc Truc Phuong | Marine protected areas (MPAs) has become a strategy for marine biodiversity conservation. Habitat inventories are useful assessments that inform balanced resource management, and conservation and restoration efforts in marine ecosystems. Recent advancement of GIS technologies have been enable MPAs' geospatial data inventiories. Particularly, operational dashboards have been used to create web maps that support interactive visualizations, and dynamically and spatially display statistics, including commercial applications/softwares such as ArcGIS Dashboard, Maps API, Eofactory AI, Tableau… For marine biodiversity inventories, webgis dashboards are lauched in some developed countries with ArcGIS. In Vietnam, MPAs system has being been established over the last two decades. The inventory, monitoring and reporting the status of MPAs' biodiversity are compulsory by law. Efforts have been made to build biodiversity database systems which support the need. The National biodiversity database system (NBDS) has been launched in 2015, via https://nbds.ceid.gov.vn/ and http://nbds.vea.gov.vn/. The system is mainly a nation-wide biodiversity database for decision makers, governmental officers, researchers and the public, without map. Meanwhile, at provincial level, a geodatabases of biodiversity in Bac Kan province were developed and published as a web map with no statistics were found. This paper is aiming to develop an open source webgis operational dashboard for inventory of Vietnam MPAs system. Based upon Vietnam biodiversity conservation policies and regulations, initial indicators for MPA's biodiversity inventory will be selected. Then, geodatabase of Vietnam MPA will be developed with QGIS. Available and free spatial data will be collected. As such, statistical data sourced from legal documents, journal articles, proceedings paper and official websites of MPAs. Next, webgis will be developed using GeoServer, JavaScript, PHP and SQL. Dashboards will aggregate data to provide indicators to facilitate decision making. Research results will be a webgis dashboard for Vietnam MPA inventory - a view of geographic information that show maps, charts, graphs, gauges, indicators, lists… that work together on a single screen. Beside interactive maps, statistical indicators will be presented on the dashboard to link interactive maps to infographics, charts, numbers… reporting the status of MPAs' issues and measurements… These elements can interact with each other. Changing a map view will results in the update of graphs, charts, numbers… to just show the statistics from the area shown on current map extent. The webgis will be refined through users' interviews. The webgis for can be futher applied for inventory of other types of VietNam protected areas. |
| 3 | 7 | THE METHOD OF RISK PREDICTION METHOD, LANDSLIDE IDENTIFICATION FOR THE RESETTLEMENT SITES OF THE SONLA HYDROPOWER PLANT | Phung Vinh An | Because of various reasons, the situation of landslides in the resettlement areas of the Son La hydropower plant has become more abnormal, causing great damage to people and infrastructure. Therefore, the study of risk prediction and identification of possible landslides for these resettlement areas, in order to have timely treatment and prevention solutions, is essential. This paper discusses the scientific basis of a method of the risk prediction method, landslide identification, and the process of performing landslide risk identification for the resettlement sites of the Son La hydropower plant. The prediction and identification of landslide risk for the resettlement site of the Son La hydropower plant are conducted based on a 3 step process. Step 1, identifying landslide characteristics. Step 2, using the identified factors of topography and geology in the criteria matrix. Step 3, making a decision to assess the possibility of landslides and identify possible landslide patterns. The above research results are also applied experimentally to the resettlement area of the Son La hydropower plant within the study area. |

| 4 | 8 | Mapping of Groundwater Potential Zones Using Logistics Model Trees Based Novel Ensemble Machine Learning Model | Tran Xuan Bien | In this work, the main aim is to map the groundwater potential zones in Central Highlands of Vietnam using novel ensemble machine learning model namely CG-LMT which is a combination of two advanced techniques namely Cascade Generalization (CG) and Logistics Model Trees (LMT). For this, a total of 501 wells data and a set of twelve affecting factors were collected and selected for generation of training and testing datasets used for training and validating the model. Validation of the model was implemented using various quantitative indicators including ROC curve. Results of this study showed that the novel ensemble model performed well for groundwater potential mapping and modeling, its performance is even better than a single LMT model. Thus, the CG-LMT is a promising tool in accurate prediction of groundwater potential areas in the study area. In addition, groundwater potential map generated from the CG-LMT model is a helpful tool in better water resource management of the study area. |
| 5 | 9 | Evaluation of Groundwater Loss from the Holocene Aquifer at the Coastal Sand Dune of An Hoa Hai Commune - Tuy An District – Phu Yen Province - Vietnam | Vu Dinh Hung | Groundwater loss refers to the reduction of groundwater due to outflow through the aquifer boundaries or loss through evaporation, and, it is one of the factors contributing to groundwater depletion. A study was carried out to evaluate groundwater loss from the Holocene aquifer at the coastal sand dune of An Hoa Hai commune, Tuy An district, Phu Yen province. The studied sand dune has an average width of approximately 600 m and a length of about 2,400 m running parallel to the shore/coastline. The exposed area of the sand dune is around 1.5 km2, with surface elevation varying from 1.0 to 8.0 m. The primary source of recharge for this aquifer is rainfall, and the groundwater depth is shallow and seasonally variable, ranging from 0.3 to 2.5 m during the rainy season and 1.1 to 4.0 m during the dry season. Due to the groundwater lying at higher levels than the rivers, sea, and marshes in the area, the freshwater in this aquifer tends to discharge out causing significant loss to the surrounding areas. The shallow depth of the groundwater makes it susceptible to substantial evaporation. So the loss is expected considerable high. Currently, the freshwater in the aquifer is being extracted for domestic water supply serving 2,003 households, as well as for irrigating more than 35.0 ha of rice fields. The total extraction volume is approximately 800,000 m3/year. The hydrogeological structure of the studied aquifer is established based on collected data and surveys. Groundwater levels were directly measured in monitoring wells from January 2022 to April 2023. Groundwater losses were monitored at three points corresponding to coastal boundary, river and marsh boundaries. The seepage meter method was employed with a frequency of five days per month throughout 2022. Groundwater evaporation was measured using lysimeters during four periods within 2022: from January 17 to January 31; from June 16 to June 30; from September 7 to September 21; and, from December 5 to December 19. Results obtained were summaried as follows: The characteristics of the Holocene formation: The predominant lithology composition of the aquifer is of fine- to medium-grained sand, with an average thickness of 11.5 m. The hydraulic conductivity (k) is 4.29 m/day, the specific yield (μ) is 0.12, and the transmissivity (a) is 421.40 m2/day. The groundwater level shows a synchronous response to rainfall with no lag, with the maximum water level (Hmax) of 2.78 m occurring on January 12, 2022, and the minimum water level (Hmin) of 0.35 m recorded on September 6, 2022. The groundwater loss to the coastal boundary ranges from 204.6 to 1,029.9 ml/h/m2. The groundwater loss to the river boundary and marsh boundary is the same magnitude of approximately 0.6 to 13.9 ml/h/m2, that is significantly smaller than the loss to the coastal boundary. The reason could be attributed to the presence of a thin layer of mud (5-10 cm thickness) on the river and marsh boundaries, which considerably reduces the permeability, whereas the coastal boundary consists of a uniform layer of sand. The average daily groundwater evaporation ranges from 0.47 to 1.53 mm/day, and the average annual groundwater evaporation is approximately 322 mm/year. The research findings on groundwater losses to the coastal, river, and marsh boundaries, as well as the |

| | | | | groundwater evaporation rates obtained in this study, provide essential information for proposing solutions to minimize the losses and enhance water storage in the coastal sand dunes. |

6	10	INFLUENCE OF A FEW DISADVANTAGE FACTORS ON LANDSLIDE OF FILL SLOPE IN THE RESETTLEMENT AREAS OF THE SON LA HYDROPOWER PLANT: A TYPICAL CASE STUDY IN TUA THANG COMMUNE, TUA CHUA DISTRICT, DIEN BIEN PROVINCE, VIETNAM	Phung Vinh An	This paper studies the influence of inclination slope, rainfall,... etc on landslide of fill slope in Tua Thang commune, Tua Chua district, Dien Bien province, Vietnam. This is one of the typical resettlement areas of Son La hydropower plant. In this area, fill slopes were created to expand the area for building infrastructure and houses for resettled people. Fill slopes are often builted basing on experience and without field survey or design drawings. Therefore, in recent years, in many resettlement areas of Son La hydropower plant, many incidents of landslides of fill slopes have occurred, especially in the rainy season, which causes a lot of damage to people and infrastructure. In order to explain the reason causing landslides in the resettlement zones during the rainy season, this studies the influence of fill slope and extreme rainfall by analyzing seepage changes according to the pore water pressure of a typical slope, then the impacts of these changes on the slope stability coefficient are determined. The rainfall used in the analysis was selected basing on typical rainfall which has caused many landslides in the previous periods. Calculation results show that when the total rainfall reaches q= 133.8 mm from the rain beginning, the slope is unstable. Thus, it can be discovered that the inclination of slope and rainfall are the direct factors that impact the stability of the fill slope of the resettlement area of Son La hydropower plant. When the side slopes are almost from 1:1 to 1:1.2 for most of the resettlement sites, the rainfall is the decisive factor affecting the slope safety factor value. Also, basing on above rainfall, mathematical model and real structure, it can be found that the fill slope is almost completely saturated at the time of unsafety. From the findings, in order to enhance the stability of these embankment surfaces, it is possible to increase the inclination of embankment or to drain water in the embankment. However, because the areas of the slopes were built houses and infrastructure, it is not easy to change their inclination of them. Therefore, the general solution to enhance the stability of fill slopes for resettlement sites of Son La hydropower plant is the drainage of slopes.
7	11	APPLICATION OF GIS IN LANDSLIDE RISK ASSESSMENT IN KRONG BONG DISTRICT, DAK LAK PROVINCE, VIETNAM	Anh	In the southeast of Dak Lak province, Krong Bong is a district where mountainous terrain is dominant. Area with slope of over 25o accounts for 42% of the total. In Dak Lak Province, this is considered one of the area most heavily affected by landslides in recent years. This study was carried out using a combination of GIS technology and remote sensing to assess landslide risk for early warning to limit the loss of life and property. The result is landslide risk maps, showing that very low risk area accounts for 308.54 km2 (24.54%), low risk area is 260.06 km2 (20.68%), average risk area is 309.22 km2 (24.59%), high risk area is 270,05 km2 (21.47%) and very high risk area is 109.62 km2 (8.72%). The main result of the study is the landslide risk map, which can provide useful information for building preventive and mitigation measures solutions to reduce damage caused by natural disasters.
8	12	EFFECTS OF THE STRONG EL NINO 2015-2016 ON THE SURFACE SALINITY OVER THE SOUTHERN VIETNAM AS OBSERVED BY REMOTE SENSING DATA	Thien Le	Observing and studying sea surface salinity (SSS) variability are important owing to its role in atmosphere-ocean systems. Recently, the technological innovation in satellite remote sensing has provided a new chance for ocean study and observation. The effects of the strong El Nino 2015-2016 on sea surface salinity (SSS) in the Southern Vietnam Sea are investigated using satellite observations. This strong El Niño event fully established in spring 2015, reached its peak strength during November-December 2015 and has been rapidly developing into one of the three strongest El Niño episodes in recorded history. We show that a wide salinification is observed over most of the Southern Vietnam Sea during the mature phase of El Nino. Our results show that the spatial and temporal variability of SSS is different between the southern Vietnam sea during 2015-2016. In the northern regions, SSS increases during the mature phase of El Nino. The SSS variability during the period from January 2015 to December 2016 is found to be almost in phase with Nino 3.4 index and surface water tends to be saltier during El Nino time. The maximum SSS occurred in months with strong El Nino.

9	13	FORECAST OF SUBMARINE LANDSLIDES RELATED TO THE REACTIVE PROBABILITY OF THE FAULT SYSTEM IN THE SOUTHEAST VIETNAM CONTINENTAL SHELF AND ADJACENT AREAS	Tran Tuan Duong	In this article, the fault's geometrical parameters in the Southeast Vietnam continental shelf and adjacent areas (such as the location, dip angle, and strike angle as well as depth, length…) are determined by gravity, seismic data, and regional stress fields. For the faults, due to their high internal frictional coefficient, they accumulate more energy under the impact of the regional stress field. Sometimes, when they accumulate enough energy, they can react and disrupt the local geological structures causing earthquakes, and can penetrate the upper layers of the Earth's crust, forming favorable surfaces for submarine landslides. The model of fault's reactive possibility is built based on analysis, overlayed integration of three informative layers determined, which are, the slip tendency of the fault system, and the relative vertical and horizontal displacement field of the Earth's crust. For fault's slip tendency and horizontal displacement, the classification of the fault's reactive possibility is based on their magnitude; For vertical displacement, where there is a large difference in amplitude, that, fault's reactive possibility is higher and vice versa. The reactive possibility of the fault system can be seen as a key factor in research on marine geological hazards such as earthquakes and submarine landslides in the Southeast Vietnam continental shelf and adjacent areas.
10	14	Impacts of human activities in the upstream area of the Black River in China on the flow to Vietnam using hydrological models and remote sensed data	Khuong Van Hai	Hydrological modeling plays a crucial role in comprehending the fundamental processes in river basins associated with the effects of climate variability and human activities on water resource availability. In this study, a high-resolution (0.05º, ~5 km) hydrological modeling for the Black River was developed based on the Variable Infiltration Capacity (VIC) model for the time period from January 1980 to December 2018. The results of this study show that the approach to studying the change of hydrological regime on the Black River under the impact of urbanization in the upstream area of China can be applied to areas being lack information and in-situ observations data. The study identifies human factors as the causes behind changes in the flow regime of the Black River in Vietnam. It quantifies the resulting alterations in water availability and hydrological processes, providing insights into the impacts of human activities on the basin.
11	15	Using Google Earth to identify karst polje, serving socio-economic development	Lecanhtuan	Karst poljes is a special landform, formed in the karst regions. This is a concentrated residential area and a key economic region. The characteristic of karst regions is that surface water is rare, but groundwater is abundant. In the karst poljes often occurs floods, water pollution, rock fall, collapse, erosion, Etc. Researching typical karst landforms, warning of adverse effects, and serving social economic development is the important task of specializing in karst geology. The authors present a method to determine karst poljes on Google Earth images, This research result has been our field test applications.
12	16	SURFACE DISPLACEMENT MONITORING UTILIZING SENTINEL-1 TIME SERIES IMAGES AND LEVELING SURVEY DATA IN HANOI'S INNER CITY	Le Minh Hang | Do Thi Hoai | Tran Van Anh | Bui Thi Hong Tham	Surface displacement is happening in many parts of the world, particularly in large urban areas like Hanoi. It is believed that the surface movement in Hanoi is due to the extraction of groundwater and the development of infrastructure. With the advancement of remote sensing techniques, the radar interference technique (InSAR-Interferometric Synthetic Aperture Radar) is being investigated and implemented in surface displacement monitoring. In addition, Setinel-1A multi-temporal microwave satellite imagery is publicly available as the primary data source for InSAR studies. The authors of the article used PSInSAR (Persistent Scatterer Interferometry) and Sentinel-1A time-series data to monitor surface displacement in the inner city of Hanoi. The authors utilized 37 Sentinel-1A VV-polarized images in the period 2018–2019 to calculate the surface displacement of the experiment area. The results of the experiment indicate that the surface displacement velocity ranges between -28.1mm/year and +17.2mm/year. 41 leveling survey sites were compared with the PS (Persistent Scatterer) points in the study area. The accuracy of the test results is determined based on the correlation between the values of the PS points and the field survey points. The correlation value reached 0.7750.

| 13 | 17 | Coregistration of PRISMA Hyperspectral Imagery for Accurate Land Cover Classification | Qiongji Xu \| Vasil Yordanov \| Xuan Truong Tran \| Xuan Quang Truong \| Ludovico Biagi \| Maria Antonia Brovelli | The precise and prompt categorization of land cover types holds significant importance in the domain of land resource planning and management, as well as in the risk reduction. Remote sensing and satellite optical images play a vital role in analyzing surface cover types and environmental changes. The utilization of hyperspectral satellite imagery further enhances and improves such studies and products by providing information in higher spectral sensitivity compared to the multispectral imagery. PRISMA is a hyperspectral satellite of the Italian Space Agency containing 240 total bands operating in VNIR and SWIR regions at a spatial resolution of 30m with a spectral interval of 400-2505 nm. Additional panchromatic band is available at a spatial resolution of 5m. Even though PRISMA products are distributed at preprocessing Level 2D (radiometrically and geometrically calibrated), the images have inherited registration errors in the range of few hundreds of meters. Therefore, before utilizing the PRISMA imagery for land cover classification, one of the crucial preprocessing step is a coregistration to ensure that corresponding features in the images are spatially aligned. This study utilized the GeFolki algorithm, a local coregistration method based on the optical flow estimation technique applied in a multiscale manner. In order to investigate in detail, the coregistration problem of the hyperspectral products we have used PRISMA images acquired for Yen Bai Province, Vietnam in the period 2020-2023. As reference images were employed datasets derived from ESA's Sentinel-2 and NASA's Landsat 8/9 missions, with known higher spatial accuracy. To apply the proposed approach, firstly, Sentinel-2 images were selected with the closest acquisition dates to the corresponding PRISMA. Then, different band-to-band coregistration combinations were tested, using Red, Green or SWIR bands. As Sentinel-2 Red band is actually covered by three PRISMA bands, also here different combinations (mean, max or their sum) were carried out. The effectiveness of the co-registration process was assessed by analysing the residuals which represent the difference between the calculated displacement from the PRISMA image to the reference image and its opposite. Visual verifications were also done. The evaluation results indicated that the SWIR band produced the best performance with the lowest residuals and the flow computation difference when the acquisition dates of the PRISMA image and the Sentinel-2 image used for the computation were within one week. As the time differences between acquisition dates increased, the computed differences increased significantly. In this case, Landsat 8-9 images were used to reduce the time gap. In this case, coregistration strategy using the panchromatic bands was adopted to facilitate the coregistration procedure. The coregistration outcome indicates that when the time difference between acquisitions is within 15 days, the difference between various computed flows can be effectively controlled at the decimal level. Moreover, when comparing the coregistration results of Landsat 8-9 and Sentinel-2 with the same PRISMA image, it is evident that the residual obtained from the coregistration using Landsat 8-9 is significantly smaller.
A careful selection of an appropriate reference image holds immense importance in the coregistration process, and the closer the acquisition time of the reference image is to the acquisition time of the image to be coregistered, the higher the quality of the coregistration results. When combined with state-of-the-art machine learning methods the proposed coregistration approach further enhances the usability and accuracy of PRISMA products for land cover classification and makes them a great information source when applied in land management or thematic hazard studies, such as floods and landslides. |

14	19	Design and Development of an Application for Remote Sensing the Water Quality of the INSUBRIC LAKES	Maria Antonia Brovelli | Lorenzo Amici | Ali Badr Eldin Ali Mohamed | Mohammed Abd alslam Mohammed Elkhalifa	This study focuses on monitoring water quality in subalpine lakes using remote sensing technology within the SIMILE Interreg project, aligning with the United Nations' 6th Sustainable Development Goal. The goal is to develop an application that utilizes Sentinel-3 OLCI and Landsat-8 TIRS images processed through the C2RCC processor to obtain Water Quality Parameters (WQP) including Chl-a (Chlorophyll-a), TSM (Total Suspended Matter), and water surface temperature. The application automates the processing workflow using Python programming and a Docker Python container, while incorporating a user-friendly graphical user interface. SIMILE, an integrated monitoring system for subalpine lakes and their ecosystems, enables efficient water quality monitoring, facilitating early pollution detection, resource allocation, and policy decision-making.
15	20	MONITORING URBAN EXPANSION OF HANOI AREA BASED ON MACHINE LEARNING ALGORITHMS AND MULTI-TEMPORAL SATELLITE IMAGE DATA SERIES	DangThanh Tung	Hanoi is a growing city and monitoring its expansion is essential for the Vietnamese government. This study monitors the urban expansion in the center of Hanoi using GIS and remote sensing techniques based on machine learning algorithms. The use of appropriate machine learning algorithms for classifying Land use Land covers, and extracting Built-up areas is very useful for urban state management. The results of this study showed that each period has an expansion of the Built-up area in different directions. Especially in the last 5 years period, the Built-up area expanded rapidly, continuously, and mainly to the east of the center of Hanoi, while in the previous period, it expanded much to the west. For the past 10 years, the Built-up area increased by about 11.56 square kilometers, of which the period 2013-2018 increased by 5.36 square kilometers, and the period 2018-2023 increased by 6.20 square kilometers. This result can effectively contribute to the work of urban planning and management.
16	21	Land Cover Classification from Remote Sensing Imagery: Machine Learning Approach	Hoa Thanh Thi Pham | Ngoc Quang Vu | Phuong Nam Thi Doan | Nghi Thanh Le	In recent times, with the rapid development of technology, the term Machine Learning (ML) has become familiar in many fields, for example, education, business, data mining, image processing and recognition, …There are a variety of ML methods that have brought high accuracy for image classification. Therefore, the study proposes approaches Random Forest (RF), Support Vector Machine (SVM) and Classification and Regression Tree (CART) for extracting land cover in Quang Binh province, Vietnam. Sentinel-2 SR (Surface Reflectance) was collected in Google Earth Engine platform. Images were acquired in August 2021 with cloud cover less than 30%. Samples were randomly distributed in entire study area and divided into 70% for training and 30% for validating. The results showed the ability to use Sentinel-2 and Machine Learning in determining the state of land cover.

17	22	Water surface temperature retrieval from Landsat data in Google Earth Engine: A case study at shrimp farms in Mong Cai City, Quang Ninh Province, Vietnam	Thuyet D. Bui	Temperature is a fundamental environmental element of all aquatic ecosystems since it not only directly affects the survival, growth, maturation and reproduction of all aquatic organisms but also regulates many physical, chemical, and biological processes in waters. Global warming, reaching 1.5°C in the near-term, and more frequent and intense extreme weather events (e.g., heat waves) has caused widespread adverse impacts across regions and sectors, including shrimp farming. However, the availability of in situ water temperature data typically only represent a small portion of shrimp farms' thermal profile, and this often leads to limitation in investigating impacts of global warming and climate change on shrimp farming. For this aim, satellite-derived water surface temperature (WST) at shrimp farms in Mong Cai City, Quang Ninh Province, Vietnam were investigated using Landsat data in Google Earth Engine. Results showed that satellite-derived WST at shrimp farms in Mong Cai City ranged from 9.9oC to 39.0oC, mainly concentrated at 19-33oC (around 82% retrieved WST from Landsat data acquired in 2000-2023). There was a seasonal variation of WST at shrimp farms, with monthly mean WST ranged from 18.5oC (January) to 29.7oC (September). Annual WST at shrimp farms in Mong Cai City showed an increasing trend from 2000 to 2022. A remarkable warming trend of WST was detected during shrimp farming season (often from April to October each year) and this may lead to high risk for shrimp farms there. Findings of this study indicate that greater awareness of shifts in WST regime at shrimp farms is required if this activity is to be sustainable in the climate change context.
18	23	COASTAL INUNDATION IN THE NORTH CENTRAL REGION OF VIETNAM: A STUDY BY SUWAT MODEL COMBINING OBSERVATIONS DATA OF SATELLITE IMAGERY AND WATER LEVEL AT STATION	Pham Van Tien	Coastal inundation is a common natural catastrophe of type in Vietnam which economic and life loss in the coastal area. Coastal inundation is mainly due to high tides and storm surges and is increasingly common in the context of rising sea levels, as a result of increased typhoon activity. This paper presents the study results of coastal inundation in the North Central region of Vietnam, the simulations done by the SuWAT model. The model results are verified with the observed data at the hydrological station and the observed flood data from satellite images
19	24	APPLYING MACHINE LEARNING ALGORITHMS TO CLASSIFY FOREST COVER TYPE FROM SENTINEL 2 MSI DATA	Trinh Le Hung	Forest cover plays a very important role in regulating water sources, limiting floods, soil degradation as well as preserving ecosystems. In recent years, the forest cover has changed drastically due to the impact of socio-economic development, population growth and effects of climate change. With outstanding advantages compared to traditional research methods, remote sensing data has been widely used in monitoring and evaluating changes in forest cover. This paper presents the results of forest cover classification in Dak Lak province from Sentinel 2 optical satellite image data using machine learning techniques. Sentinel 2 MSI images taken in November 2015 and December 2020 are used to classify forest cover objects, then evaluate forest cover changes in the period 2015 - 2020. The obtained results show that most of the forest cover objects in Dak Lak have a marked decrease in the period 2015-2020, especially evergreen forest, semi-evergreen forest and dipterocarp forest due to the conversion of natural forests to agricultural land, residential land, industrial crops such as rubber, coffee...

| 20 | 25 | RESEARCH AND APPLICATION OF REMOTE SENSING AND GIS TECHNOLOGY TO ASSESS AGRICULTURAL DROUGHT EVOLUTION OVER TIME AND SPACE IN DAK HA DISTRICT AND KON RAY DISTRICT, KON TUM PROVINCE | Tran Van Tinh \| Huynh Thi Lan Huong \| Nguyen Thi Bich Ngoc | Drought is one of the most damaging natural phenomenon. Since droughts cover large areas, it is difficult to monitor them using conventional systems. Drought can occur on a global scale, including Vietnam - The country is suffering from unusually severe droughts caused by climate change. Kon Tum is an important province in ensuring security and defense, socio-economic development in the Central Highlands region, Vietnam. In recent years, Kon Tum province has been experiencing severe droughts and water shortages in the dry season that cause significant damage to people's lives, socio-economic development and and especially agriculture of the province. Agriculture drought occurs primarily by low rainfall, hight surface temperature. Agricultural drought occurs when soil moisture is insufficient to maintain the average agricultural output. The fist consequences are affect the critical periods of crop growth and reducing crop yields. The most severe of the drought can lead to famine, epidemics, threaten food security etc. The traditional drought assessment and monitoring method usually calculate drought indices according to the observed data onto rain, temperature, evaporation, etc. at meteorological stations. However, this method was limited all of areas where have no data or insufficient number of monitoring stations. Currently, using remote sensing data is an effective method of drought monitoring. The application of thermal infrared remote sensing data in drought research and monitoring has successfully achieved important results and very necessary problem. Research and application of Remote sensing and GIS technology by using LANDSAT 8 remote sensing image with a resolution of 30 m to effectively assess agricultural drought evolution over time and space for 2 typical agro-forestry production districts Dak Ha and Kon Ray of Kon Tum province, Viet Nam. In remote sensing, the Normalized Difference Vegetation Index (NDVI) and land surface temperature (LST) can provide information about the humidity conditions at the surface of the mantle, thereby reflecting agricultural drought in the study area. This paper presented the method of using indexs NDVI and LST from band 4, band 5 và band 10 of LANDSAT 8 in exhausted period (from February to April) between 2014 - 2023 to calculate Water Supplying Vegetation Index (SWVI), Temperature Vegetation Dryness Index (TVDI). The remote sensing image processing and calculations were performed on a cloud based platform - Google Earth Engine (GEE) combined with ARC GIS software. GEE is designed to store and process huge remote sensing image data, it can compute and analyze data up to petabytes. The research results have shown that drought - prone areas correspond to regions with increased LST and decreased NDVI value. In addition, based on the scale of drought severity according to two SWVI and TVDI indicators have proved that most of the communes in the district are affected by drought. In which, Dak To Lung commune, Dak To Re commune, Dak Ruong commune of Kon Ray district are the 3 communes with the most severe degree of drought. Besides, the paper also built the agricultural drought map system of research area. They will an important scientific basis, visually displaying the distribution of agricultural drought serving the local agricultural production planning to cope with drought in the context of climate change. |

21	26	Solution of low-cost GNSS RTK network for realtime deformation monitoring	Duong thanh trung	Deformation monitoring is important for structure health monitoring and early warning of natural hazard such as landslide or tsunami. With the requirement accuracy of millimeter or centimeter level, a network of GNSS with static surveying have been widely applied in deformation monitoring. However, the limitation of static network is that it is commonly post-processed and complicated adjustment processing. On the other hand, GNSS RTK is enable to provide realtime data with centimeter level. However, realtime data transmission between base and rover stations is costly requirement. The limitation in distance from the base and rover is another issue to apply GNSS RTK in wide areas. In general, Deformation monitoring using GNSS at centimeter level accuracy is costly at current time. To overcome this problem, this study introduces a solution that using a low-cost GNSS RTK network for a wide range deformation monitoring. The experiment indicated that the proposed method is enable to provide deformation information at millimeter level for a range of hundred kilometers
22	27	Estimation of Land Surface Temperature and Vegetation Dryness Index (TVDI) in Bac Binh – Binh Thuan using remote sensing images	Linh Nguyen Thi Thuy | Minh Hoang Thi Nguyet | Linh Phung Thi	Nowadays, drought is regarded as one of the most destructive natural disasters which causes negative impacts on societies around the globe. Especially, in Binh Thuan province - Vietnam, the drought tends to increase in both scale and intensity but it is harder to be forecast. In recent years, with the development of remote sensing technology, its products have been used effectively in studying, monitoring and reacting to drought. Thus, in this study, we aim to determine the progress of drought through the years in Bac Binh district - Binh Thuan province by using remote sensing images. In details, we use images from Landsat 7 ETM+ (2002, 2005, 2010) and Landsat 8 OLI (2014 and 2017) to estimate dryness indices: temperature vegetation dryness index (TVDI) and improved temperature vegetation dryness index. These two dryness indices are based on normalized difference vegetation index (NDVI) and land surface temperature (LST) for TVDI and gradient of temperature (Ts-Ta) for iTVDI. The obtained results show that a significant proportion of Bac Binh's area is estimated as drought and severe drought, and its severe drought areas increased rapidly in 2014, 2017. The study also found that the improved dryness index tends to reduce the rate of dryness compared to TVDI.
23	28	Identification and delineation of flood hazard areas using the relative slope length data: A case study of the Ngan Sau, Ngan Pho river basin, Vietnam	Dang Tuyet Minh	Flood modeling offers helpful data to support in managing flood hazard and reducing the effects of flooding in the flood-prone areas. The current study used the Analytical Hierarchy Process (AHP) method and GIS technology to develop the flood hazard maps in the Ngan Sau, Ngan Pho river basin. The accuracy of flood simulation results is dependence on the factors that contributes to flooding. The aim was to monitor and evaluate the importance of relative slope length for delineation of flood hazard in the study area. A total of six physical geography and metrological factors were chose to calculate relative weights in AHP including rainfall, slope, soil, and land use, drainage density, relative slope length. When calculating the model, these factors are divided into two groups, group 1 includes five criteria excluding the relative slope length factor and group 2 includes all six factors. The results of flood hazard zoning were verified based on flood warning levels at hydrological stations in the study area during historical floods. The obtained findings revealed that map generated from the group of parameters including the relative slope length are more accurate than those prepared based on the remaining five variables.
24	29	Research the application of terrestrial laser scanning technology for mining management (a case study at Khe Cham mine site, Quang Ninh province)	Dang Tuyet Minh	The technology of Terrestrial Laser Scanning allows a quick scan of the terrain surface and creates a database in the form of a point cloud to generate a digital model of hard-to-reach areas such as underground mines, transport rail, mining pits where minerals have been exploited. The paper presents the application of Terrestrial Laser Scanning technology and takes a case study at a mining pit of the Khe Cham coal mine for building digital spatial data of the mining tunnel system, transportation, ventilation, calculation of excavation volume and mining output over time in mining pit of Khe Cham coal mine, cycle 0 is 4070.19 m3, cycle 1 is 13668.06 m3 to ensure the coal mining management and to minimize the access and presence of people in dangerous underground mining areas.

25	30	The water governance in the upper Mekong River from remotely sensed perspective and bio-optical analysis. A case study of the water incident in Ialy hydropower plant in February 2022.	Hung Quang Ha	In recent years, the economic growth has led to massive urban sprawl, intensive agricultural production, and environmental degradation and losses in Vietnam. In the upper Mekong region (i.e., a part of Central Highland of Vietnam), agricultural production, urban growth, unsustainable resources (water and soil) management, and industrial activities are the potential polluters to the regional environment. To regulate the human interferences on the environment, environmental taxes and fees based on the 'polluter pays principle' (PPP) are the key for environmental protection. But PPP's efficiencies are dependent on the ability to track the pollutants and polluters using spaceborne/airborne monitoring sensors, ground stations, and field samplings. In the rural and mountainous areas in Vietnam, the monitoring networks and data are scarce despite efforts to invest in the environmental monitoring system for years. In this research, we examined the use of bio-optical models (i.e., acolite and Case 2 Regional Coast Color (C2RCC) methods) and remotely sensed analyses (i.e., Landsat 8, 9 and Sentinel-2 data) for the case on the environmental incident in the Ialy hydropower dam, Chu Pa, Gia Lai, Vietnam in January to February 2022. The research's outputs emphasized the need to revise the approach for environmental monitoring and environmental protection in Vietnam.
26	31	Digital elevation models (DEM) generated from spaceborne and airborne radar remote sensing, a solution for timely land use planning and climate change in the Mekong delta.	Hung Quang Ha	The Vietnam's Mekong Delta (VMD), a biggest agricultural field in Vietnam, is facing with environmental challenges due to rapid sea level rise and land subsidence. Despite efforts have been made to capture the regional elevation, an official and public digital elevation model (DEM)product has yet to be released for the region. An efficient regional development plan should be based on an up-to-date DEM, which is not available for VMD. FABDEM, MERIT DEM, and TOPO DEM were the reliable DEMs at a global scale without a regularly updated component. Researchers have proven the high rate of land subsidence in VMD, which can alter the elevation by tens of centimeters per year. TOPO DEM, generated by the research team at Utrecht University, is created from a collection of tens of thousands of elevation points and the best-known DEM for the area. Given the high rate of changes in the land elevation, it is necessary to have a regularly updated and sufficiently reliable DEM to support the sustainable development of VMD. In this research, we examined the use of radar remote sensing technology (i.e., European Space Agency's Sentinel-1 satellite) for DEM creation for a case study of VMD and its ability in updating the surficial changes on a regular basis. These are technical review and demand testing for the use of LOTUSat 1, a soon-to-be available satellite for Vietnam.
27	32	Optimal Parameter Selection for SMRF Filtering of Lidar Point Cloud data in various terrains of Vietnam	Trung Anh Tran | Hong Hanh Tran | Hai Au Luu | Manh Tuan Quach	The LiDAR point cloud classification for obtaining the ground surface through SMRF (Simple MoRphological Filter) filtering is relatively simple to implement. However, choosing the optimal parameters for this filter is difficult. This article conducts research and testing on the appropriate input parameters for the SMRF filter using LiDAR point cloud data from Vietnam, with the primary objective of achieving the most accurate classification of land surfaces. The SMRF method utilizes five parameters: the cell size of the minimum surface grid, a percent slope value, an elevation difference threshold, a slope threshold, and a maximum window size. Various types of terrain exist, including areas with dense or sparse forests, different types of trees, regions with residential structures, areas with significant elevation variations, mixed terrains, and more. Experimenting with input parameters allows filtering SMRF in these terrain types and selecting the most suitable parameters for each specific type. Subsequently, the ground point cloud is continually detected, and noise and outlier points are removed to construct the most precise digital terrain model. This process is facilitated by the author's application software named ApLAS.

28	33	DETECTION OF LAND SURFACE TEMPERATURE CHANGE IN COAL MINING AREA USING REMOTE SENSING AND GIS TECHNIQUES - A CASE STUDY IN QUANG NINH PROVINCE, VIETNAM	Thi Thu Ha Le	This research explores Land Surface Temperature (LST), which represents the energy exchange between the land surface and the atmosphere, as well as with the biosphere. Variations in surface temperature can lead to the formation of heat islands, characterized by higher temperatures compared to surrounding areas. The study focuses on the application of Remote Sensing (RS) and Geographic Information Systems (GIS) to detect changes in LST in a coal mining area in Vietnam. Landsat images spanning from 1986 to 2022 were used to quantify these changes. The analysis revealed that the radiant temperature in 1986 ranged from 14.2ºC to 30.5ºC, whereas in 2022, it was significantly higher, ranging from 17.4ºC to 32.3ºC. A change map was created to visualize the temporal changes in land surface temperature distribution during the study period. The research employs scientific and efficient methodologies to investigate whether enhancing the ecological environment in coal-mining regions can help alleviate the conflict between human activities and nature, thus fostering sustainable development in these areas.
29	35	COLORIZATION OF BLACK-AND-WHITE AERIAL PHOTOGRAPHS USING DEEP LEARNING FOR OBJECT-BASED IMAGE ANALYSIS LAND USE CLASSIFICATION	Arunothai Waesonthea | Sarawut Ninsawat | Nitin Kumar Tripathi | Sanit Arunplod | Thantham Khamyai	The multispectral image comprising various spectral ranges is used to classify land use, and the first satellite multispectral image designed to study Earth started in the 1972s. Thailand has used historical black-and-white aerial photographs that began recording in 1954s to prove past land use for issuing land title deeds and verifying right ownership possession and use human visual interpretation techniques to inspect trace land use in the past. Moreover, the image that used interpretation for verifying the trace land use has only black-and-white images that difficultly interpreted more challenging to interpret than RGB images and usually is an unconfident rate of interpretation, as well as criteria in visual interpretation techniques, typically leading to an unbalanced workload because always cannot finish in the time required. From the problems, historical aerial photographs lack various spectral ranges because the information is mainly recorded in a panchromatic band or black-and-white color. This study uses the Pix2Pix model of a cGAN to predict color channels for an input black-and-white image. The goal is to find a suitable model for converting historical black-and-white photographs into multispectral color (RGB) images. The results indicate that the U-NET network within the Pix2Pix is entirely appropriate, with a PSNR of 33.025 and an SSIM of 0.961, indicating that the suitable model effectively learns images. To reduce the workload optimal time by adapted capability, this study also uses computer vision on colorized images for automatic land use classification. Thus, the OBIA techniques to classify land use on black-and-white and colorized images are improved from the colorization model. This process used aerial photographs in 1954 in Maha Sarakham province, Thailand. The suitable parameter set across all classes is a scale of 50, a shape of 0.3, and a compactness of 0.8 in the multiresolution segmentation process. As a result, land use classifications using the nearest neighbor algorithm on colorized images showed significant improvements over black-and-white photos at +5%. This study concludes that the colorized image improved with the colorization model is better than the black-and-white image for classifying land use. Mainly, vegetation groups are more accurate when enhanced images from the model are used. Therefore, this success can support the mission of investigating traces of land use in the past to consider the issuance of land title deeds and prove people of rightful ownership possession.

| 30 | 36 | Use of FER for the characterization of health and well-being using Deep learning | Vineet Singh | Facial emotion recognition is a fundamental task in computer vision and human-computer interaction, with applications ranging from social robotics to affective computing. In recent years, deep learning techniques have demonstrated remarkable success in this domain, outperforming traditional machine learning approaches. This paper presents a comprehensive review of facial emotion recognition using deep learning methodologies. The review begins by providing an overview of the challenges and importance of facial emotion recognition. It explores the role of facial expressions in conveying emotions and the significance of accurately recognizing and interpreting these expressions in various real-world scenarios. Next, the paper delves into the core concepts of deep learning, specifically convolutional neural networks (CNNs), recurrent neural networks (RNNs), and their variants, which have been extensively applied to facial emotion recognition. It discusses the architecture, training procedures, and model optimization techniques associated with these deep learning models. Furthermore, the review discusses the widely used benchmark datasets for facial emotion recognition and the evaluation metrics employed to assess the performance of deep learning models. It highlights the limitations and challenges faced in these datasets and proposes potential solutions and future directions to address these issues. The paper also provides an in-depth analysis of various techniques employed for feature extraction, including both handcrafted and learned features. It explores the advantages and limitations of different feature representations and discusses the integration of multiple modalities, such as facial landmarks, facial action units, and audio, for enhanced emotion recognition. Moreover, the review presents an overview of state-of-the-art deep learning models for facial emotion recognition, including convolutional neural networks (CNNs), recurrent neural networks (RNNs), and their combinations. It discusses recent advancements, such as attention mechanisms, transfer learning, and generative models, and their impact on improving recognition accuracy and robustness. Lastly, the review concludes by summarizing the key findings and identifying potential research directions to overcome the existing challenges in facial emotion recognition using deep learning. It emphasizes the need for larger and diverse datasets, improved generalization across different domains, and ethical considerations in designing and deploying facial emotion recognition systems. Overall, this comprehensive review provides researchers and practitioners with a valuable resource to understand the advancements, techniques, and future prospects of facial emotion recognition using deep learning techniques methodologies. |

| 31 | 37 | Estimating above ground biomass using Landsat 8 imagery: A case study of deciduous broadleaf forest in Dak Lak province, Vietnam | Duong Dang Khoi | Accurately quantifying the aboveground biomass (AGB) is essential for understanding the potential for carbon sequestration. Traditional field-based methods for estimating AGB are often time-consuming, expensive, and limited in their spatial coverage. Recent studies have revealed that using a universal regression model to estimate AGB at a regional or country scale is not feasible. Instead, it is necessary to create local regression models that can accurately estimate AGB in a local scale. However, spatial distribution of AGB in deciduous broadleaf forest in Dak Lak province is currently unknown. Therefore, this study aims to develop predictive models specifically for estimating the spatial distribution of AGB in the deciduous broadleaf forest in Dak Lak province. Multiple spectral bands and vegetation indices derived from Landsat 8 imagery were used as independent variables, while AGB measurements served as the dependent variable. The results indicate a strong correlation between vegetation indices and field-based AGB data, confirming the effectiveness of using Landsat 8 imagery for estimating AGB. The models show reasonably good performance, achieving R^2 values ranging from 0.61 to 0.62 and RMSE values ranging from 30.68 to 31.54. The estimated AGB in the forest averages 100.80 Mg/ha with a standard deviation of 44.27. The regression model-derived spatial distribution of AGB in Dak Lak reveals the variation in AGB across the forest area, highlighting areas with high and low AGB in the province. This map can serve as a baseline information for future AGB estimates in the area, contribute to carbon sequestration monitoring efforts, and support improved local forest management practices. |
| 32 | 38 | Integrate location, value and time on the map with VN2000 coordinate system for daily activities in Vietnam | Nguyen Tuan Anh | The integration of coordinates of locations with maps, time and attribute values at locations as well as their variation on digital platforms makes it useful for about 90% of activities including: infrastructure construction, transportation, environment, trade, services, production, and socio-economic development of each country. Therefore, in the context that hand-held smart mobile devices have become popular with every citizen and 4G and 5G wireless internet has covered most of Vietnam's territory, we need to take advantage of these advantages to build a very simple, convenient, easy-to-use system that all people can access and use to serve their specific daily needs in Vietnam in the VN2000 coordinate system. The article introduces such a system of ours, including Cloud Realtime Database services on servers and Android mobile applications to create an IoT infrastructure that connects users and acts as a virtual assistant to help citizens and businesses determine VN2000 coordinates and altitude simply, save locations with time information, altitude and attribute values at the correct point, and easily manage and save information. Support the management, maintenance, development and effective exploitation of network of coordinates and elevations nationwide. Find Landmarks according to the radius around a location, navigate all the way to the landmarks in the field. The latest Map and Satellite Image section allows measuring, locating land parcels and importing KML, PNG, JPG drawing files, looking up information on land use planning in all provinces of Vietnam. This system is also used in a variety of other activities such as management of BTS stations, management and monitoring of environmental pollution points, points of natural disasters, geological hazards, marking and defining maritime boundaries and marking and searching tasks related to the evolution of location, value and time on the map background. Currently, there are nearly 100 thousand users in all regions of Vietnam, with nearly 1000 positive feedbacks. The application can be downloaded for free on Android CHPlay at: https://play.google.com/store/apps/details?id=com.nta.dodacbando We hope to carry out a digital transformation in the field of survey and mapping in Vietnam, helping to the specific practical activities of each citizen. |

33	39	Introduction of open source Web-Map for marine socio-economic development in Vietnam	Nguyen Tuan Anh	In recent years, Vietnam has paid great attention to marine economic development, especially in the fields of renewable energy, mineral exploitation, aquaculture, and at the same time has also increased activities such as: environmental protection, monitoring of sea level rise disasters due to the effects of climate change, coastal erosion, natural disasters, floods, security and defense, etc. Therefore, there have been many different survey projects built on the sea. However, there is still a lack of an online mapping system to bring out the available data to provide people across the country to use for various purposes of socio-economic development. The article introduces the open source Web-Map system we built based on the Leaflet online map and our MogoDB real-time database on a VPS server located in Vietnam, allowing users to manage and upload unlimitedly marked positions, boundaries, specific regions and detailed maps established in different sea areas to the Web-Map for users to exploit. The database is designed to be open and the system automatically Scales according to the input data, all data is referenced in a consistent mathematical base, users can choose the working coordinate system VN2000 or WGS-84, and they also have their own data partitions to add their data to. In addition, the system also allows to select the sea area adjacent to the provinces, determine the depth of the selected location and measure the length, area, and circumference at sea. Trial version at: http://103.169.34.100/QLGiaoKVB/#/
34	41	Solutions to Enhance accuracy when using UAVs to Collect and Construct Spatial data for the Creation of extremely large-scale Maps in the Urban area	Tran Ngoc Huyen Trang | Le Van Trung	Ho Chi Minh City is the largest city in Vietnam that is interested in and pioneered by the government in becoming a smart city in the future. The application of solutions to support the collection, construction, and updating of spatial databases, creating the basis for urban management, becomes very necessary. Unmanned Aerial Vehicles (UAVs) are experiencing strong growth in many fields, especially spatial data collection. Problems arising when collecting and processing UAV images in urban areas include distortion in some areas on the orthomosaic, accuracy not suitable for creating extremely large scale maps (1/200, 1/500), the boundary between adjacent objects not being clear, etc. The authors have conducted flight test shooting with many flight altitudes, different shooting angles, and changing the number of Ground Control Points (GCPs) layouts, using and not using the UAV 's RTK receiver mode. From the experimental results, we propose the solutions to improve the accuracy of data collection and image processing by UAVs.
35	42	APPLICATION OF INTEROMETRIC SYNTHETIC APERTURE RADAR (INSAR) TECHNOLOGY (InSAR) IN THE STUDY OF TERRAIN CHANGES IN NINH BINH	Nguyen Mai Lan | Lai Hop Phong | Tran Trung Hieu | Nguyen Duc Anh	Through the method of Satellite Interferometric Synthetic Aperture Radar (InSAR), based on analyzing the phase difference of radar complex images recorded from two different positions simultaneously observing a terrain area where the signals have the same amplitude, frequency, wavelength but different phase, the deformation of the terrain surface in Ninh Binh province is analyzed and calculated. The preliminary results include the construction of a deformation map of the ground surface in the Ninh Binh province for the period 2020-2021, consisting of 78,077 points. The map shows areas that have been uplifted with values of 3-5 mm/year and >5 mm/year, particularly highlighting areas with significant subsidence velocities of <-10 mm/year (Kim Son and Yen Khanh districts), some areas with subsidence velocities ranging from -5 to -10 mm/year (Yen Nhan commune, Yen Mo district, Nam Binh ward, Ninh Phong district in Ninh Binh city), and subsidence values of 0 to -5 mm/year in the communes bordering between Nho Quan and Gia Vien districts. These results provide a basis for identifying the causes of terrain surface changes and proposing solutions to prevent and mitigate damages in Ninh Binh province in - depth studies continuing in future. Keyword: InSAR, terrain surface, uplifted, subsidence, Ninh Binh

36	43	Determination of the optimal density contrast in the seafloor depth inversion from gravity anomalies using the Gravity Geologic Method	Nguyen Van Sang	In the problem of indirectly determining seafloor depth from gravity anomalies using the Gravity Geologic Method, the density contrast between the seawater and the ocean bottom topographic mass needs to be determined. In this study, the iteration method was applied to determine the optimal density contrast. Firstly, a density contrast is given. Then, the seafloor depths are calculated and compared with the shipborne depths. In the next step, change the density contrast and repeat the calculation. Finally, the optimal density contrast is determined corresponding to the smallest deviation between the calculated depths and the shipborne depths. The experiment calculations were carried out on the central East Sea with eight density contrast values, which were varied from 1.10 g/cm3 to 3.0 g/cm3. The results show that the optimal density contrast on the study area is 1.40 g/cm3.
37	44	Identification of Upwelling in the Marine Regions of Southern Centre of Vietnam by Remote Sensing Data	Phan Minh-Thu | Ho Dinh Duan | Nguyen Van Hung | Le Thi Hai Nhu | Tran Thi Hoa | Tran Thanh Ha | Truong Thi Cat Tuong | Danh Mon	Upwelling is a fascinating oceanic phenomenon that involves the upward movement of nutrient-rich deep waters to the surface, playing a crucial role in marine ecosystems. This article delves into the investigation of upwelling events in the marine regions of the Southern center of Vietnam. The occurrence of upwelling in this area is primarily influenced by the complex interplay of seasonal Monsoon winds, ocean currents, and seabed topography. To explore and understand the spatial and temporal variability of upwelling events, the study utilizes Sea Surface Temperature (SST) data collected from satellite images and employs the Topographic Position Index (TPI) method. This comprehensive analysis reveals a distinctive pattern, with upwelling events predominantly observed from May to September, peaking between June and August. These summer months harbor the most favorable conditions for upwelling processes to occur, leading to the uplift of nutrient-rich waters from the depths of ocean to the surface layers, benefiting the local fishing industry and ecosystem health. Otherwise, the study also considers the influence of El Niño-Southern Oscillation (ENSO) and La Niña on variation of upwelling regions as well as local marine ecosystem's productivity and diversity. By unraveling the mechanisms behind upwelling events and their response to climatic oscillations, the research contributes to a deeper understanding of the marine ecosystem's resilience and vulnerability to environmental changes. Ultimately, this knowledge serves as a foundation for responsible and informed decision-making in marine resource management for policymakers and stakeholders, aiming to safeguard the region's marine biodiversity and fisheries for future generations.
38	45	MONITORING SURFACE WATER BODIES CHANGES FROM SENTINEL-2A IMAGERY WITH MODIFIED NORMALIZED DIFFERENCE WATER INDEX: APPLICATION IN DALAT, LAMDONG, VIETNAM	Nguyen Van Trung	Accurately monitoring open water bodies is a fundamental and crucial task in remote sensing. Numerous techniques for mapping water bodies have been devised to extract them from multispectral images. One of the most widely used techniques is the method relying on the spectral water index, particularly the Modified Normalized Difference Water Index (MDNWI), which is derived from the green and Shortwave-Infrared (SWIR) bands. The purpose of the study is to rapidly identify objects and locate surface water bodies using Sentinel-2 MSI (Multi Spectral Instrument), one of the latest types of remote sensing satellite data. The results of the research show that by using Sentinel-2 MSI imagery, MNDWI (Modified Normalized Water Index) is the appropriate parameter to detect surface water areas in the studied area, with the overall accuracy > 0.92 and kappa coefficient > 0.84. Additional research is required, specifically targeting diverse geographical conditions and exploring other regions within Vietnam.

| 39 | 46 | WebGL-based visualization tool for 3D geological structures in shallow subsurface in urban areas | Susumu NONOGAKI \| Tsutomu NAKAZAWA | Three-dimensional (3D) geological maps that represent shallow subsurface geological structures are essential for mitigation of earthquake-induced disasters such as amplification of ground motion and liquefaction/subsidence, development and management of infrastructures, and assessment of renewable energy potential like groundwater and geothermal energy. Recently, as part of the intellectual infrastructure development, we have been working on 3D geological mapping of urban plane areas in Japan using borehole data in tens of thousands created for public construction works and for stratigraphic studies, cooperating with local governments, and to date have completed 3D geological maps of northern area of Chiba Prefecture and central Tokyo. These 3D geological maps are available for free on the website "Urban Geological Map" by Geological Survey of Japan. In this study, to make it easy for everyone to understand the 3D distribution patterns of geological layers and geotechnical properties within the shallow subsurface, we have developed a visualization tool for 3D geological map that consists of shape data of geological boundary surface and 3D representations of borehole data. The developed viewer is JavaScript-based Web application with free and open-source libraries, designed to smoothly render large number of 3D objects on Web browser by Graphics Processing Unit (GPU) operations using WebGL technology. The viewer allows the users to modify the vertical-to-horizontal ratio of the 3D rendering space, toggle the visibility of individual geological boundary surfaces, alter the texture images of borehole representations, and adjust the position of the light source. When applied the developed viewer to the 3D geological map of central Tokyo, it was confirmed that the viewer can effectively demonstrate the distribution of key layer, which are closely related to earthquake-induced disasters, in both lowlands and uplands using simple mouse operations on a Web browser. The developed viewer is expected to not only enhance understanding of shallow subsurface geological structures but also facilitate the utilization of shallow subsurface geoinformation in urban areas. In this presentation, we will introduce details of the functions of the developed viewer and examples of its use on the 3D geological map of central Tokyo. |
| 40 | 47 | Building a webgis for management of aquatic resources protection zones Serepok river, Dak Lak province | Huy Anh Nguyen | WebGIS is a geographic information system used on the Internet environment, which can integrate, distribute and transmit geographic information, perform queries, and perform spatial analysis. Internet users can access and use GIS applications without installing GIS software. Databases through WebGIS technology have the advantage of allowing many people to access at the same time, managing data over time with large, unified capacity and without generating "versions" like traditional databases. Based on research findings, Webgis was developed to manage the aquatic resource protection zones of the Serepok River in the Dak Province. Its key features include an interactive map, search, the ability to add layers, display, query, and see real-time data. Local assistance for the management of natural resources and the environment is based on research findings. |

| 41 | 48 | Impacts of urbanization and population growth on land cover and coastline changes based on remote sensing and GIS technique for Vietnamese coastal regions | Le Thi Thu Hang \| Nguyen Hong Quang \| Vu Anh Tuan \| Nguyen Manh Hung \| Nguyen Thi Phuong Hao | Currently, urbanization and population increase rapidly in coastal areas. Various development projects are carried out along the coastal areas, putting great pressure on these areas, leading to many coastal hazards such as coastline erosion, seawater intrusion, affecting the quality of the seawater, etc. Continuous monitoring of urbanization in coastal areas is essential to monitor the loss of natural areas due to urban development, and to support planning activities, helping the local authorities to awere the importance of raising awareness about environmental protection and people's safety. These issues and concerns are the main focuses of this research. We look for the simple but effective approaches to exploit and study the urbanization process from optical remote sensing images to support rapid assessment of landscape changes for urban planning and decision making in coastal areas of Vietnam. This study applies two methods, which are to assess the effects of urbanization through land use change and coastline change in Rach Gia, one of the country's fastest growing cities in the past recent decades. The land use from Landsat images with medium resolution (30 m) and observed over many periods from 2010 to 2020 has been mapped. The advanced machine learning methods, the Support algorithm Vector Machine (SVM) to estimate land use area integrated with census data was applied. The result shows the urban land use ratio, urban land use density compared to population growth rate which is demontrating the impact of urbanization on land use status. Meanwhile, the study also focuses on detecting changes and fluctuations of the Rach Gia coastline by using the landat satellite image series where the technology of shoreline interpretation using the index calculation, image thresholding and shoreline analysis and evaluation methods. For doing that we ultilized the DSAS software provided by the United States Geological Survey (USGS) integrated in the ArcGIS environment. The shoreline change is assessed through the volatility index after a 5-year cycle including the erosion and accretion processes from 2010 to 2020. The shoreline variation index is quantified using 03 functional analysis variables in DSAS which are the evaluation of the endpoint ratio EPR, NSM shoreline displacement and LRR linear regression rate of change. These variables showed the variability of Rach Gia coastline during the study period clearly. The research results show the advantages and reliability of the research method, and the ability to support the assessment of changes due to urbanization for coastal areas effectively and in a timely manner. |
| 42 | 49 | SWASH MODEL APPROACH FOR ASSESSMENTS OF SEDIMENT TRANSPORTS DRIVEN BY LOW-FREQUENCY WAVES INSIDE WOODEN FENCE AREAS | Hoang Tung DAO | The Mekong deltaic coasts have been suffering from erosions and massive mangrove reduction for nearly a decade. As considered a natural base solution, wooden fences or permeable structures, have been applied for a number of mangrove restoration projects along the coasts. This green structure is often built in front of the mangrove belt to create a lively environment including low wave energy and high sedimentation for young mangroves. One of the most valuable functions is the wave reduction resulting from the significant reduction due to its resistance generated by densities and thicknesses. This function has also been studied by a number of sites in Vietnam, Thailand, and Indonesia. However, the study on the increase of sedimentation in front and behind the fence has been left out due to the complexity of sediment transports, especially for the permeable fences. In this study, the low-frequency wave, which is considered the main driven transport of sediments, is focused on assessing the possibility and potential sedimentation inside the wooden fence areas. This study applies the SWASH model developed by Delft University of Technology to validate and calibrate with experimental and field data obtained from previous studies. The simulation results show a good agreement with both experimental and field data. Moreover, the amplitudes of low-frequency waves at the upstream and downstream sites of the wooden fences emphasize the roles of these waves in sediment transport. |

| 43 | 50 | Landslide susceptibility assessment using hybrid machine learning models: A case study of Cau River Watershed in Thai Nguyen, Vietnam | Tran Thanh Thuong \| Nathaniel C. Bantayan \| Canesio D. Predo \| Cristino L. Tiburan Jr. \| Vladimir Y. Mariano | Landslides are a natural hazard frequently occurring in mountainous areas and have been responsible for numerous fatalities and injuries. They were considered the primary cause of natural disasters leading to loss of life in Asia. In Vietnam, landslides have become increasingly common in recent years, particularly in mountainous regions, posing a direct and significant threat to human life and property. To mitigate this risk, improve land-use planning, and establish early warning systems, landslide susceptibility maps are valuable tools, but they require continuous updating and further development with practical applications to address the complexity of landslide events. Given the importance of landslide susceptibility maps, this study aimed to assess landslide susceptibility using novel hybrid machine learning (ML) techniques. Three ML models have been developed for landslide susceptibility prediction, including KNNSVM, KNNRF, and KNNRFMLP. These models have been constructed based on K-nearest neighbours (KNN), support vector machine (SVM), random forest (RF), and multilayer perceptron (MLP) algorithms. To develop the models, the study has collected nine conditioning factors (slope, elevation, relief degree of land surface, drainage density, lithology, soil, land use land cover, rainfall, normalized difference vegetation index) that have been based on the correlation between historical landslide occurrences and specific geo-environmental conditions in the study area. The relative importance of these factors has been determined by excluding that factor and then calculating the overall accuracy of the model. The difference in overall accuracy between the models with and without the conditioning factor indicates the quantitative importance of the factor. The performance of the models has been assessed using different statistical measures, including accuracy, sensitivity, specificity, and the area under the receiver operating characteristic (ROC) curve (AUC). Typically, higher values of ACC, SEN, SPE, and AUC indicate better performance of the models. The results have shown that the KNNRFMLP model has been the most appropriate model with the best performance, with an accuracy of 85.33%, sensitivity of 85.71%, and specificity of 83.33%. Additionally, the KNNRFMLP model has achieved the highest AUC value (86%.), indicating that it has been the most effective model for predicting landslide susceptibility. Based on the results, the KNNRFMLP model has been used to produce a landslide susceptibility map for the study area. The final results represented 41,973 ha (14.94%) in very high-susceptibility areas, 14,258 ha (5.08%) in high-susceptibility areas, 22.159 ha (7.89%) in moderate-susceptibility areas, 48,334 ha (17.21%) in low-susceptibility areas and 154,129 ha (54.88%) in very low-susceptibility areas. This landslide susceptibility map is a valuable tool for analyzing and evaluating landslide risk at the study site, and it provides practical information for land-use planning and early warning systems. This study has provided a feasible approach for assessing landslide susceptibility using hybrid ML models. The results have demonstrated the effectiveness of the KNNRFMLP model and suggest that it has practical implications for evaluating landslide risk in other mountainous regions with similar geo-environmental conditions. Continuously updating and improving landslide susceptibility maps using advanced ML techniques is necessary to mitigate the risk of landslides and protect human life and property in areas susceptible to this natural hazard. |

44	51	Assessment of the forest change pattern in the northwestern of Vietnam using remote sensing and the landscape metric	Pham Minh Hai | Pham Hong Tinh | Bui Quang Thanh | Pham Manh Ha | Vu Ngoc Phan	Land-cover change, particularly habitat loss and fragmentation, poses significant threats to ecosystem services and biodiversity conservation. In the context of northwestern Vietnam, major land-cover changes occurred in the late 20th century, but their impacts on forests have not been quantified comprehensively. This study aimed to address this gap by selecting an appropriate landscape metric index for monitoring forest fragmentation and characterizing forest transitions over time, focusing on the case study in Muong La district, Son La Province, from 1990 to 2018. The study utilized satellite images and an aggregation metric at the class level to detect land-cover change and examine forest distribution patterns over the specified period. The results revealed a significant decrease in forested areas in Muong La, with forest cover declining from 77% to 64%. The main drivers of forest loss were identified as the expansion of agricultural land and the construction of the Son La Dam water reservoir. The analysis of forest transitions indicated that forest areas in Muong La became more isolated and less compact from 1990 to 2008. However, by 2018, there was a trend towards increased aggregation of forested areas. These findings provide valuable insights into the dynamics of forest fragmentation and highlight the importance of monitoring and understanding such changes over time. The study contributed a potential technique for identifying the most threatened forested areas and informing prioritization efforts for natural conservation and land-use planning by the local government. By utilizing the selected landscape metric index and analyzing forest transitions, this study provides a technique for assessing the extent and location of forest threats, supporting targeted conservation efforts and sustainable land management practices.
45	52	Web 3D map from UAV images in Dalat city, Lam Dong province	Tran Ngoc Huyen Trang | Le Van Trung	Big cities are completing the establishment of Spatial Data Infrastructure (SDI) to create an important foundation to improve their capacity to provide necessary information related to digital economic development and meet all the requirements of smart city management. With the advantages of high accuracy, low cost, and flexibility in 3D data creation, UAV (Unmanned Aerial Vehicle) images have been researched and applied. This article aims to describe the new opportunities of using UAVs in 3D mapping and then sharing 3D map data through the WebGIS platform. After collecting the UAV images, they will be processed to create orthomosaics, point clouds, and Digital Surface Model (DSM). Conduct a classification of ground points to create a Digital Terrain Model (DTM). Combine DSM and DTM to form a calibrated surface numerical model (Canopy Height Model, CHM). Digitize the image map, combined with the object height extracted from the CHM model, and assign attribute data to each object. We edit the map and share it on the web. ArcGIS Online allows you to share information widely, targeting multiple users, reducing the cost of GIS software investment in building thematic classes for urban management.
46	53	A GIS techniques Application for Assessing the Spatial Variation of Groundwater Recharge: A case study in The Transboundary Cambodia-Mekong River Delta Aquifer	Anh Thi Kieu Ninh	Groundwater is considered to be a crucial element of the hydrological cycle that is formed by surface water entering the geological system through the soil surface or through lakes, rivers, streams. There are many types of surface recharge sources to groundwater include: rainwater, surface runoff, lakes, rivers, streams and artificial replenishment. This study was conducted with the aim to evaluate the spatial and temporal distribution of recharge rate in the Transboundary Cambodia-Mekong Delta Aquifer. Firstly, Arc GIS software was used to intergrate layers of topographical slope, land use classification and soil types of the modeling region to develop a classification of different recharge zones. Next, a quasi-two-dimensional hydrologic model HELP3 was used to evaluate the regional recharge rate assuming precipitation is the main component that contributes to total recharge amount. It was studied that there is a spatial and temporal variation in the recharge distribution, the recharge rate varies from 1.87% to 15.73% of annual rainfall. Recharge from rainfall to groundwater seems to be higher in high terrain area in Cambodia (Recharge domain). Meanwhile, the aquifer system in the Delta region in Vietnam receives less amount of recharge due to the hydrogeological structure with thicker impervious aquitard layers which isolate the deeper aquifers from the surface water system.

47	54	Drought monitoring using MODIS data and the Google Earth Engine platform, case study in Dak Lak province, Vietnam	Nguyen Ngoc Anh | Nguyen Ngoc Anh	The study was conducted to monitor drought conditions in Dak Lak province using satellite data and the GEE platform. Various drought indicators, such as the Vegetation Health Index (VHI) and the Normalized Differential Drought Index (NDDI), were obtained from multi-time MODIS satellite data and used to analyze the spatial and temporal distribution of dry conditions in Dak Lak province during the period from 2001 to 2020. The results of the calculation of drought indicators obtained from satellites were compared with the results of calculating the Standardized Precipitation Index (SPI) from data observed at meteorological stations in the study area and drought events recorded in the past. This study demonstrates the potential application of GEE computing technology, which gives users access to geospatial big data, not only in drought monitoring but also in other environmental monitoring applications.
48	55	APPLICATION OF GIS TECHNOLOGY IN BUILDING LAND PRICE DATABASE FOR LOCAL LAND PRICE MANAGEMENT. EXPERIMENT IN GIA NGHIA CITY - DAK NONG PROVINCE	VU Le Ha | BUI Thi Cam Ngoc1	In recent years, many land price database systems have been established to serve local management and support information exploitation for related parties. A land price database provides accurate and reliable information about land prices in different areas, serving as a crucial resource for government agencies and real estate businesses to have an overview of the market, aiding in making strategic decisions and development plans. For management purposes, the land price database enhances transparency in real estate transactions and reduces the risk of corruption. For investors and real estate businesses, the database offers vital information to make intelligent investment decisions, identify potential markets, and forecast future land price trends. Building a land price database is the most appropriate direction, especially in the context of the 4.0 technology revolution and in alignment with the Government's digital transformation objectives. The proven strength of GIS technology lies in its powerful capabilities to optimize the processes of data collection, management, and analysis of land prices. By integrating geographical data from various sources, GIS creates visual and realistic maps, which allows experts and real estate market managers to have a comprehensive overview of the land price situation in specific areas. Integrating data from different sources into a unified database helps reduce data errors and ensures the information is up-to-date and complete. Additionally, by integrating mobile and online technologies, users can easily update and access land price information from anywhere, streamlining work processes and saving time. This research proposes a six-step process for building a land price database in 8 wards and communes of Gia Nghia City, Dak Nong Province: (1) Setting research objectives and tasks, (2) Designing the database model, (3) Conducting data survey and collection, (4) Analyzing, processing, and standardizing data, (5) Inputting data into the database management system, (6) Evaluating the results. The land price database in Gia Nghia City includes various objects such as land parcels, houses, administrative boundaries of communes, water systems, transportation, and various tables of land prices, including official pricing, reference prices, specific land prices, auctioned land prices, and market transfer prices. Upon completing the construction of the land price database in Gia Nghia City, it will facilitate easy, quick, and accurate updating and exploitation of land price data. This will greatly support the process of determining land valuations in line with market transactions and enhance transparency in the local real estate market.

| 49 | 56 | Impact of urbanization on sea water quality in Quang Ninh province | Nguyen Tran Dinh \| Le Thanh Son \| Nguyen Tran Dien \| Vu Anh Tuan \| Nguyen Hong Quang | Quang Ninh province is located in the northeast of Vietnam. With an area of 6,100 km², Quang Ninh has great strengths and potential to develop marine economic sectors, with the longest coastline of 250 km with 2,077 islands, accounting for two-thirds of the country's islands, It has a large fishing ground of over 6,100 km², which is home to countless rare marine species. From 2020 to 2023, this province has an urbanization rate of about 37.5% in 2020, up from 30.8% in 2010. However, urbanization growth also poses many challenges for Quang Ninh province, including traffic overload, environmental pollution, and the need to enhance infrastructure and public services to meet the growing needs of urban dwellers. Faced with that situation, The research team built a network of water quality monitoring points in industrial zones, clusters, aquaculture zones, tourist and service areas, coastal estuaries, etc., using GIS (Geographic Information Systems) software to assess the impact of urbanization on sea water quality in Quang Ninh province. This network of monitoring points is based on the database of the Current status of fishery industry development in the period of 2018 – 2023 and additional monitoring and analysis, the Current status of fishery industry development in the period of 2018 – 2023 and additional monitoring and analysis. The research team took samples and divided them into two seasons: the rainy season and the dry season to have a complete set of data through which to assess the overall sea water quality of Quang Ninh province. Collected seawater samples were analyzed in a laboratory with full Vimcert certificates (Vimcert 079, Vimcert 032, Vimcert 120); and Vilas (Vilas 386, Vilas 450, Vilas 366) conforming to the recognized international standard ISO/IEC 17025:2005 and a system of modern analytical equipment equipped by the JICA project of Japan and Korea's KOICA. The analysis parameters of coastal seawater samples comply with QCVN 10-MT:2015/BTNMT (National regulation on coastal water quality b, in which 25 indicators are evaluated: pH, DO, TSS, N-NH4+, P-PO43-, F-, CN-, As, Pb, Cd, Cr6+, total Cr, Cu, Zn, Mn, Fe, Hg, Aldrin, BHC, Dieldrin, DDTs, Heptachlor & heptachlorepoxide, total phenol, total mineral grease, Coliform. From those results, the authors conducted research, using indicators to assess the level of water pollution, such as chemical and microbial pollution, and measuring the impact of urban factors such as population growth, wastewater discharge, and water consumption. From the above evidence, the authors have made an overview of the impact of urbanization on seawater quality in Quang Ninh province. Thereby pointing out the causes and effective solutions to minimize the impact of urbanization on sea water quality and protect the water resources of this area. Ha Long Bay is an area of special importance for Vietnam's marine economy, this sea often appears cold water blade phenomenon when there is northeast monsoon and southwest wind. Survey results of sea water quality in two seasons, rainy season and dry season, there is a difference in some specific hydrological indicators such as Coliform exceeding the allowable threshold in the dry season, iron and ammonium content tend to increase. high in the rainy season due to disturbance of the water layer, upwelling water, and submerged water, the rest of the other indicators are within the allowable limits according to QCVN 10-MT:2015/BTNMT. It is necessary to have an effective treatment plan to minimize the impact of urbanization on sea water quality and protect water resources in Quang Ninh province. |

| 50 | 57 | Presenting of the Military Terrain Analysis between Thailand and Myanmar's Historical Battlefield, over 200 Years (the 9-Armies War) with Geo-Informatics Techniques. | Kittitouch Naksri, Chaiwiwat Vansarochana* | OCOKA is a battle concept. This study applies OCOKA's principles to remote sensing and GIS techniques by applying the combat situation of Thailand and Burma. About two hundred years ago, during the year 1785 AD., known as the War of the Nine Armies, It was a war in the western border area of Thailand and was used as an issue of study. OCOKA had its essence: O = Observation and Fields of Fire, C = Cover, and Concealment, O = Obstacles (man-made and natural), K = Key or Decisive Terrain, and A = Avenues of Approach We have taken spatial and topographic data from Google Earth, Google Maps, GIS, and historical battle data. Let's analyze the integration together. The results show that the OCOKA concept can be well applied to geo-informatics technology. Especially, the online data extraction of Google Earth is very useful for analyzing military terrain for combat purposes. This study can be used as an example of historical data to be integrated with online geospatial to provide a more visual representation of past spatial studies. The full study results can be presented in the article below. |
| 51 | 58 | Proposed solutions for the restoration of salinization in groundwater exploitation works within water-scarce regions of the Southern plain, Vietnam | Pham Quy Nhan \| Ta Thi Thoang \| Tran Thanh Le \| Pham Thi Thu | Presently, in the context of climate change and socio-economic development, water scarcity and the escalating salinization of groundwater in water-scarce regions of Vietnam are significant concerns. As a response, the Prime Minister has sanctioned a program aimed at investigating and exploring groundwater sources to meet domestic water demands in these regions, with plans to broaden its scope of implementation. Among the areas heavily impacted and confronted with these challenges is the Southern Plain. Globally and within the country, diverse solutions have been proposed and tested in research settings to address these issues. However, some of these solutions prove costly, technically intricate, or incompatible with local customs, leading to resource wastage. Consequently, the primary objective of this study is to propose appropriate and sustainable solutions for mitigating salinization in groundwater exploitation within water-scarce regions of the Southern Plain, Vietnam. The research methodology encompasses comprehensive data collection and supplementary surveys to assess the current status and underlying causes of groundwater salinization in water-scarce regions. Based on the results of data collection and field survey, solutions for mitigating salinization were proposed and experiment site was selected. Geographic Information System (GIS) was applied to construct potential area maps for implement mitigation groundwater salinization and sustainable groundwater abstraction solution for Southern plain of Vietnam basing on the experimental results and a thorough consideration of influencing factors. Experimental implementations of the proposed solutions have been conducted in Long An and Tra Vinh provinces utilizing conventional technical methods. For instance, one of the solutions involves optimizing the groundwater extraction rate in Ca Na village, Vinh Hưng district, Long An province. Through this optimization, sustainable extraction rates have been determined and applied to groundwater wells, ensuring the prevention of groundwater salinization during the extraction process. The monitoring process has been diligently maintained for the abstraction wells in the study area. Furthermore, a supplementary solution known as Managed Aquifer Recharge (MAR) has been tested at the household scale in My Chanh village, Chau Thanh district, Tra Vinh province. This method involves recharging water from widespread coastal sand dunes of Holocene aquifer (qh), which are abundant during the rainy season but scarce during the dry season, into extraction wells. Subsequently, the water will be extracted during the dry season from the underlying Upper Pleistocene aquifer (qp3). The outcomes derived from monitoring and modeling of experimented sites showed that the changings in quantity and quality of the groundwater system based on scenarios are promising. Maps of potential areas for application of these solutions have been delineated using GIS overlay mapping techniques could help managers and policymaker in planning and investment for sustainable groundwater resources abstraction solutions in water-scarce regions like South plain, Vietnam. |

| 52 | 59 | MONITORING THE AREA AND WATER LEVEL OF THE RESERVOIR BY REMOTE SENSING AND GIS TECHNOLOGY. CASE STUDY IN VU GIA – THU BON RIVER BASIN | TRINH Thi Hoai Thu \| BUI Thi Hong Tham | Managing and efficiently using water resources is a top concern worldwide. Due to drought and increasing water demand, many places have constructed reservoirs on rivers. Although these reservoirs only cover a small part of the Earth's surface, they play a significant role in human health, biodiversity, and watershed ecosystems. Storing water in reservoirs is essential for human livelihoods, agricultural irrigation, and economic development, especially in densely populated and arid regions. However, apart from their positive effects, the construction of reservoirs also leads to water scarcity, causing conflicts over water allocation from upstream to downstream. Additionally, excess water from reservoirs can lead to flooding, threatening human populations. As a result, many areas sharing the same water source are designing and implementing agreements to share water resources in the watershed. To build appropriate and sustainable agreements for integrated water resource management, monitoring water sources, in general, and monitoring water levels in reservoirs, in particular, are essential. Monitoring water sources in reservoirs means keeping track of the water level in the reservoirs. This can be achieved by establishing a relationship between the water level and the reservoir's surface area. In this study, the A Vuong River, Dak Mi 4 River, and Tranh River, part of the Vu Gia - Thu Bon River basin - an area with conflicts and tensions over water usage - were selected for investigation. The water level in the reservoirs was determined through a linear relationship with the surface area of the water from Landsat 8 data for 15 dates points between 2016 and 2020. These values were compared with measured water levels. The results indicated that the measured water levels and the water levels derived from remote sensing and GIS data showed a linear relationship. |

| 53 | 60 | The role of groundwater recharge sources in groundwater exploitation in the red river delta plain, Vietnam | Le Viet Hung \| Pham Quy Nhan \| Dang Tran Trung | The Red River Delta Plain, the second largest delta in Vietnam, covers an area of 14,860 km² and is home to over 22.5 million inhabitants. Groundwater, predominantly extracted from Quaternary sedimentary aquifers, amounts to a total discharge of approximately 3 million m3/day. However, some regions, such as Hanoi and Nam Dinh, have shown signs of over-exploitation, leading to potential issues of depletion, subsidence, saltwater intrusion, and water pollution. While several studies have attempted to estimate groundwater recharge in the study area, uncertainties and fragmented information still persist, hindering a comprehensive understanding of groundwater recharge sources. Therefore, this study aims to provide clarity on groundwater recharge sources and their roles in groundwater exploitation. By examining complementary groundwater recharge sources from the Red River system and the delta's edge, we conducted a thorough review and comparison of previous studies. In this research, we identified an important groundwater recharge source from rain, irrigation water, and even wastewater, referred to as "groundwater recharge from surface". We utilized various satellite images and interpreted different thematic layers to assess the groundwater recharge potential. Geographic Information System (GIS) was employed for zonation analysis and thematic layer integration. Field trips and water sampling, including chemical and radioactive 3H analysis, were also carried out. Groundwater recharge potential was verified using ground recharge rates estimated through isotope analysis, resulting in the division of the Red River Delta Plain into three zones with low, moderate, and high groundwater recharge potential (77, 280, and 440 mm/year, respectively). To evaluate the role of groundwater recharge sources in the current groundwater extraction, we employed MODFLOW software. Based on calibrated and validated flow and solute transport models, we used the "Zone Budget" module to determine the contribution of groundwater recharge sources to Quaternary sedimentary aquifers. The results indicate that surface groundwater recharge occurs throughout the year, with the highest contribution during the rainy season (85%) and a lower contribution during the dry season (14.20%). Recharge from the Red River system is predominant during the rainy season, accounting for 12.05% to 20.71% of the total recharge. Conversely, groundwater recharge from the bedrock at the edge of the plain and the water discharge to the sea from Quaternary sedimentary aquifers occur throughout the year but in smaller quantities. This study provides valuable insights into the groundwater recharge sources in the Red River Delta Plain and their significance in sustaining groundwater extraction in the region. The findings can aid in the development of sustainable groundwater management strategies to mitigate potential adverse effects of over-exploitation. |

54	61	Urban residential land valuation using machine learning: A case study of Hanoi City, Vietnam	Bui Ngoc Tu | Tran Quoc Binh | Bui Thi Cam Ngoc	The strong development of the Fourth Industrial Revolution has led to the proliferation of artificial intelligence (AI) and, more specifically, machine learning (ML) techniques, in many socio-economic sectors, including the real estate market. With the rapid urbanization and under impact of the digital transformation process, land-related data are growing significantly in volume and being standardized better than before, thereby enhancing the applicability of machine learning in real estate market. As the market continues to expand, the demand for rapid and accurate land price valuation under specific market conditions becomes a prominent and socially relevant topic. Among several approaches to land valuation, machine learning has gained attention as a new method that many researchers propose to include into recent drafts of Land Law. This research utilized three simple machine learning algorithms: Decision Tree Regression, Linear Regression, and Random Forest Regression, to construct models for urban residential land valuation. The training and testing datasets comprised 1082 observations across 12 districts in Hanoi City, encompassing 20 variables such as: area, frontage length, location, road type, business potential, distance to the city center, distance to recreational facilities, etc. Experimental results revealed that the Random Forest algorithm outperformed the other two, exhibiting an estimated land price error of approximately 10%. Furthermore, the Random Forest algorithm has a side effect to allow for computation of importance of factors on land price. For the collected datasets, the research demonstrated that location, road width, distance to the city center, and road type were the most influential factors on urban residential land price in Hanoi. Conversely, factors pertaining to availability of communication infrastructure and the security environment exhibit relatively minor effects on land price. The research findings contribute to affirming the potential of application of machine learning in urban residential land valuation, particularly when an adequate volume of training dataset is available.
55	62	RESEARCH COMBINATION OF GIS TECHNOLOGY AND REMOTE SENSING ON A GOOGLE EARTH ENGINE PLATFORM TO ASSESSMENT IMPACT LEVEL OF AGRICULTURAL IN BEN TRE PROVINCE	Le Thi Thuong	Ben Tre is one of the provinces in the Mekong Delta that is strongly affected by saline intrusion, especially for agricultural production. This paper research using integrated GIS technology and Sentinel-1 remote sensing image processed on the Google Earth Engine platform to monitor and assess the salinity level in Ben Tre Province through combination with salinity monitoring data with a Machine Learning algorithm to determine the impact of salinity intrusion on agricultural production. Research results show that most of the Thach Phu district is affected by high salinity. Saltwater intrusion in the Ba Tri district in two directions from the sea is about 6 km with salinity from 9-15‰ and the direction of the Ba Lai River to the mainland is 1-2 km, the Binh Dai district is affected by salinity from Dai and Ba Lai estuary inland about 15-20 km. The impact of this has been significant on agricultural production in Ben Tre province. The results of the article are to assess the level of soil salinity in agricultural production, as a basis for proposing solutions to minimize the impact of saline intrusion on agricultural production in Ben Tre province.
56	63	Application of Terrestrial Laser Scanning Technology to Build 3D Products of Tangible Cultural Heritage Objects	Hanh Hong Tran	Terrestrial Laser Scanning (TLS) technology is a revolution in field data collection for 3D applications. TLS 3D technology allows all aspects in life such as environment, people, landscape, equipment and machinery, civil works, traffic and others to be captured and represented by true three-dimensional images. The aims of the paper are to propose the technological process and to build several 3D products of the tangible cultural heritage objects. The steps taken include field survey, project planning, data collection, field-work checking, office-work processing, and final outputs building. The results of the study involve the proposed technological process, various 3D products of tangible cultural heritage objects such as point cloud models and solid models. The accuracy meets the requirements when they are compared with the direct measurement. The research will contribute to enhance the efficiency of local data management and uses.

57	64	REMOTE SENSING AND GIS APPLICATION TO MAP THE SURFACE TEMPERATURE OF PHU THO PROVINCE	Tran Thi Ngoan	In recent years, the phenomenon of global warming has become more and more pronounced, causing great concern in global climate research. There is a lot of research done to extract information about surface temperature to study temperature changes. Along with the development of remote sensing technology and GIS, the extraction of temperature information at a time is done easily and quickly. Phu Tho is the gateway, the economic center of the northern inter-province, located in the Hanoi urban area, the Kunming - Hanoi - Hai Phong economic corridor, so it has many advantages for economic development. The development of the economy entails an increase in construction, converting agricultural and forestry land into residential or industrial land. This is what causes the temperature to rise. This study uses remote sensing and GIS technology to create a temperature map of Phu Tho province. The study uses Landsat 8 satellite image data in 2022 to extract research temperature information. Digital data on administrative boundaries, traffic, water systems are taken according to national data. The research result is the temperature map of Phu Tho province in 2022.
58	65	Spatio-temporal Patterns of the Spread of a SARS-CoV-2 Variant through Vietnam	Tien-Thanh Nguyen	The global outbreak of the COVID-19 pandemic has spread worldwide, affecting almost all countries and territories. This study aimed to analyze the spatio-temporal patterns of the spread of the SARS-CoV-2 in Vietnam using spatial auto-correlation analysis. The spatial clustering including spatial clusters (high-high and low-low), spatial outliers (low-high and high-low), and hotspots of the COVID-19 pandemic were explored using the local Moran's I and Getis-Ord's statistics. The local Moran's I and Moran scatterplot were first employed to identify spatial clusters and spatial outliers of COVID-19. The Getis-Ord's statistic was then used to detect hotspots of COVID-19. A case study of locally transmitted cases confirmed in four COVID-19 waves in Vietnam indicated that the locations of high-high clusters and low-high outliers and hotspots of the COVID-19 had rapidly changed. The findings of this study provide important insights into how to apply spatial statistics to better understand the spatio-temporal patterns of the spread of SARS-CoV-2.
59	66	Relationship between Remoted Sensed-derived Aerosol Optical Depth and Vegetation Density in Hanoi, Vietnam	Tien-Thanh Nguyen	Vegetation cover and density play important potential roles in reducing dust emissions. This study investigates the relationship between Aerosol Optical Depth (AOD) variation and vegetation density in Hanoi city, Vietnam. Vegetation density was first derived from Landsat 9 images through NDVI index, whereas AOD is obtained from MODIS images. The relationship between AOD and NDVI index is assessed using statistical methods (correlation analysis and scatter plots). The statistical parameters for the AOD variation in each NDVI range were summarized and compared. It was found that there existed a close relationship between the AOD variation and vegetation density. The findings of this study provide important insights into how to investigating the impacts of vegetation density on the AOD variation in urban areas.

| 60 | 67 | Urban Climate Resilience: Making Informed Decisions through Spatial Planning | Kapil Chaudhery | Vietnam has been facing increasing challenges and pressures to its economic growth from climate change related impacts. In the urban settings, the loss of economic activity, impact to livelihood, damage to living environment, and the increasing risks of flood damage have disrupted the urban growth paradigm. Investments (and loans) in addressing flooding impacts take away from what could alternatively be resources allocated towards urban economic growth. Drawing upon examples and experience through ODA financed projects, we have the clear understanding that simple acts of making urban development masterplans that follow natural landform, surficial hydrology, ecological footprints, are logical inputs in making a more resilient urban development plan. Further, understanding the cause-effect relationship between increasing impervious areas and increasing rainfall events is an avoidable circumstance, which is not adequately appreciated in the business of planning. Using GIS-based spatial analysis, demonstratively though collaborative working of governmental and consultant agencies, brings the use of this "spatial decision" process into the normative working and potentially into the understanding of the use of nature-based solutions and blue-green infrastructure. This demonstrative and iterative working/ analytical process provide the opportunity to move from theory into practice, drawing upon geospatial technologies (in the web-based environment) to create climate responsive spatial development plans. |
| 61 | 68 | Developing Voxel-based 3D GIS for GHG Emission Inventories | Kapil Chaudhery | Green House Gas emissions are of critical concern under the international and national agreements on reduction of the same. Critical to this notion is the ability to establish a clear and defensible baseline of urban GHG emissions, especially from stationary source of the built urban environment, which theoretically embodies about 35% of these emissions. The estimation, quantification, and documentation of these GHG emissions is a difficult and complex process. Recent works with building energy and building design surveys have provided insight into how data generalization models can be built to cover a large urban extent using GIS-based interpolation methods to create a representative baseline of GHG emissions across an urban landscape. Further, using cartographic modeling techniques, the layering and additionality of GHG emissions from increasing urbanization and reduction of the same through mitigative measures can provide a more authoritative documentation of baseline and changing emission inventory to demonstrate achievement of declared emission reduction goals. The tactile understanding and cognitive acceptance/ agreement on the baseline GHG emissions, the changes (increase and decrease), represented as 3D raster grid voxels, with thematic renderings of each attribute set, provides a effective visualization and assessment tool, providing necessary factual basis for decision making, through this visually-interactive 3-dimensional representation model. The modeling and visualization works are still currently in process however it is expected that the progress-to-date should be an effective platform for dialogue and further development. |

| 62 | 69 | A combination of ALOS-2, Sentinel-1 imagery for rapid deforestation detection in Vietnam | Ngo Duc Anh | In recent years, the socio-economic development in Ha Long City has caused deforestation happen more often and more complicatedly, from clearing forests for vacant land for construction to burning forests for timber and many other purposes to serve human needs. The use of optical remote sensing data has low efficiency in regular forest monitoring due to the influence of tropical climate conditions and cloud cover. To address the need for timely information on lost forest areas, the improvement on monitoring frequency, and the combination of multiple types of SAR (Synthetic Aperture Radar) radar images, bring about more effectiveness than using a single sensor. The radar wavelength determines the ability to penetrate the coating object, leads different scattering mechanisms, thereby obtaining different information about the coating. The longer the wavelength, the better the penetration ability. With the object being the forest cover, the C-band wavelength (~5cm) receives signals about the canopy and some small branches, generating mass scattering inside the canopy, while the L-band wavelength (~23cm) acquires information about the tree branches. This paper focuses on combining two different wavelength SAR data types (C-band and L-band), included HV, and HH polarizations to detect clear-cut and forest fires. The author uses the method of comparing the backscatter values before and after deforestation to detect forest loss, with the Sentinel-1 time series data using the RCR (Radar Change Ratio) method, while the three ALOS-2 image scenes use the RGB composite method. The results show that the C-band SAR (Sentinel-1) data can detect deforestation due to clear-cutting in Ha Long with monthly frequency, however it is less effective in finding forest fire areas, while the L-band (ALOS-2) can detect more types of deforestation, including clear-cutting and forest fires. With the C-band (Sentinel-1), HV polarization gives better results than HH, while the L-band (ALOS-2) gives similar results when HV or HH polarization is used. Combining the results from two sets of C-band and L-band SAR data helps to provide more information about the deforested areas, thereby improving the accuracy of the backscatter detection method. |

| 63 | 70 | Tsunami Evacuation Simulation Using Multi-Agent System: A Case Study of Wajima City, Ishikawa Prefecture, Japan | Tatsuya NEMOTO \| Aoi SATO \| Venkatesh RAGHAVAN | Many natural disasters have occurred in Japan. The tsunami generated by the 2011 off the Pacific coast of Tohoku Earthquake caused extensive damage. Recently, Tsunami damage caused by the Nankai megathrust earthquake is predicted. Many simulations have been conducted to clarify problems related to tsunami evacuation (Saito and Kagami, 2005; Kosaka et al., 2017). In this study, we have created a tsunami evacuation simulation model using a multi-agent system (MAS), referring to Kosaka et al. (2017). A virtual experiment using multiple agents is called a multi-agent simulation. Agents act autonomously according to the situation under certain rules. In tsunami evacuation simulation, agents are evacuees, and evacuees move on a road network consisting of intersections (nodes) and roads (lines). Artisoc4 developed by Kozo Keikaku Engineering Inc. was used to generate the simulation model in this study. This is a simulation platform specialized for MAS. It is possible to define the types of agents using GUI and to create action rules using Visual Basic. In this study, 12 evacuation sites were set as destinations for agents in the port area of Wajima City, Ishikawa Prefecture, Japan (4 km x 4 km). Based on Kosaka et al. (2017), the attributes of the agent are male, female, and tourist, and the evacuation speeds are set to 1.30 m/s, 1.25 m/s, and 1.14 m/s, respectively. Assuming evacuation during the daytime on weekdays, the total number of agents was set at 12,456 based on the population of Wajima City and the number of tourists. Agents were placed considering the area and number of buildings in each town. The attributes, speed, and number of agents can be easily added or changed. Under the condition that the agent knows the position of the evacuation site, the agent moves the shortest route to the evacuation site. The Dijkstra method was used to calculate the shortest path. In this study, road network data was created from OpenStreetMap. As a result of the simulation, all agents completed evacuation after 2,028 seconds. The number of people who completed evacuation after 300 seconds, 600 seconds, and 900 seconds was 6,976, 11,153, and 11,760, respectively, and 90 % completed evacuation in about 600 seconds. In this study, the attributes of agents were simply classified by gender and whether they are residents or tourists, but it is necessary to subdivide them by age and so on. In addition, it is necessary to consider the occurrence of congestion from road width information, and to reflect walking speed difference due to weather conditions and road gradients. |
| 64 | 71 | Mangrove degradation assessment using WorldView-2 imagery for Mekong Delta, Vietnam | Pham Hong Tinh \| Tran Dang Hung \| Truong Van Vinh \| Mai Huong Lam \| Nguyen Thi Hong Hanh \| Richard A. MacKenzie | Mangrove forests have been widely acknowledged for their significant roles in protecting coastal areas from soil erosion, storms, and strong waves, as well as providing seafood, aiding in land reclamation, and sequestering carbon. Vietnam boasts a considerable expanse of mangrove forests, spanning approximately 170,000 hectares along its 3,260 km coastline, with the majority, three-quarters of the total, concentrated in the provinces of the Mekong Delta. An examination of time-series WorldView images reveals that between 2015 and 2020, the Vietnamese Mekong Delta experienced a loss of around 16,200 hectares of mangroves, accounting for approximately 20.3% of its total mangrove area. However, during the same period, there were efforts to restore mangrove forests, leading to a gain of approximately 27,200 hectares. In terms of quality, Vietnamese Mekong Delta has about 6,900 hectares of degraded mangrove forest (equivalent to about 7.6% of the total mangrove area) where tree density, structure or species composition were decreased. Degraded mangrove forests were mainly in the districts: Ngoc Hien, Dam Dơi, Nam Can (Ca Mau province) and An Minh (Kien Giang province). Anthropogenic factors, particularly the conversion of mangroves to aquaculture and agriculture, emerged as the primary driver of mangrove loss. Additionally, soil erosion played a crucial role in the decline of mangrove areas. The degradation of mangrove forests could be attributed to the impact of storms, strong winds, pests, fishing activities, sand influx, sediment depletion, altered hydrology due to the construction of dikes, roads, and other structures, among other contributing factors. |

| 65 | 72 | The Role of Orographic Effects on Heavy Rainfall Event over Central Vietnam in October 2021 | Nguyen Binh Phong | In this study, the WRF model is used to investigate the role of Central Vietnam terrain on occurrence of the heavy rainfall event in October 2021 over Central Vietnam. Two model experiments including with and without terrainwere performed to examimine the orographic blocking effects during the event. In the terrain experiment, the results from a three-day simulation show that the model reasonably wellcaptured northeast monsoon circulation, tropical cyclones and the occurrence of heavy rainfall in Central Vietnam. The topography causes a high pressure anomaly intensifying northeast monsoon. When the terrain is removed, the three-day accumulated accumulated rainfall decreased approximately 75% in comparison with that in the terrain experiment. The terrainblocking and lifting effects in strong wind and moisture laden conditions combined with convergence circulation over open ocean are the main factors for occurence of the heavy rainfall event. |
| 66 | 73 | Assessment of the dynamic impact of debris flow on structure safety: A case study of check dam in Viet Nam | Nguyen Chi Thanh \| Vu Quoc Cong \| Vu Le Minh \| Do Van Chinh \| Tran Thi Nga \| Luyen Le Dieu Linh | Debris flow is one of the climate-driven natural disasters that has an arising risk of property and life loss. The phenomenon is a combination of high flow velocity, large impact forces in a sudden event of poor temporal predictability. Vulnerable areas to debris flow are mountainous areas with growing population such as Northwest region of Viet Nam. Improving the check dams' resistence to debris flow is therefore an important task nowadays. Debris flow has been worldwide studied, in which calculating the impact forces of the debris flow on barriers is the core issue. Estimating this impact needs to cover not only the factors of common flood flow, which are the static debris flow pressure pst, and surcharge from a debris flow moving process, but also other dynamic impacts. The dynamic impact factors are the impact and collision of individual components, hits of the debris flow and dynamic debris flow pressure. Current design and construction procedures applied for check dam in Vietnam follows the national standards of hydraulic dams, which are the TCVN 9137:2012 for concrete dams, TCVN 10777:2015 for local material dams , and TCVN 9147:2012 about hydraulic calculation for spillways . In these standards, design loads of the flow are considered as static loads, which are the hyraulic pressure values at differents water level. Dynamic impact of the debris flow and the impact force of boulders are not taken into account. In addition, climate change has cause extreme weather conditions including extreme heavy rainfalls. In combination with the typical terrain of the Northwest region, the water level under current circumstain is clearly higher than the design level at the time of the check dam design. As a result, check dams in northwest region of the country are incapacable to deal with debris flow nowadays. In other countries which suffer the high risk of this phenomena, debris flow mitigation has been well developed. Sabo system in Japan is well known for this problem. Debris flow calculation and mitigation are also standardized in Japan, Austria and some other European countries , and their standardization is spreading to other countries. The core of the calculation is the model of debris flow and how to evaluate impact of the flow on checkdam. Those approaches have been well studied and applied over the world, so they can be valuable tools for Vietnam to study and applied to our current circumstances and improve the capability of check dams to deal with debris flow. For this purpose, this paper will examine the stability of a typical check dam in the Northwest region with and without the impact of debris flow in the design loads. In this paper, stability of a checkdam located in Vietnam is re-evaluated in two regimes of the debris flow impact: (i) static impacts as conventional flood flow, and (ii) dynamic impacts adopting Huebl's approach. The results help to analyze shortcomings of the current design procedure applied for check dam in particular and hydraulic structures in general. When renovating current check dams or design new ones, this analysis shows the importance of updating the dynamic impacts of debris flow in the standardize design. In order to upgrade the resistence capactity of the current check dam systems against debris flow, taking those dynamic impacts into consideration is crucial. |

67	74	Flash Flood Hazard Mapping Based on AHP and Ranking Method with Remote Sensing and GIS Techniques on Ca River Basin	Nguyen Tien Quang	Flash flood is one of the most severe natural disasters causing significant loss of life, property and environmental destruction, thereby, as a basis for proposing solutions to respond to and minimize the impact of flash floods. The Ca river basin is the typical study basin. Research using data from some remote sensing satellite images – Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM), Landsat 8 Operational Land Imager (OLI), and Tropical Rainfall Measuring Mission (TRMM) and flash flood thematic classes such as topography, geomorphology, hydrometeorological conditions, ... were prepared, and combined through a GIS-based analytic hierarchy process (AHP) and ranking method (RM) to build flash flood hazard areas in the basin. The two final flash flood hazard maps were validated with the map of the location where flash floods occurred in the Ca river basin. The research results showed the appropriateness of the methods and the integration of remote sensing and GIS techniques showing important flash flood areas in the Ca river basin.
68	75	MONITORING AND ASSESSMENT OF REMOTE SENSING ECOLOGICAL INDEX CHANGES IN CAN THO CITY, VIETNAM	Nguyen Thi Hong Diep	Nguyen Trong Nguyen	Duong Co Hieu	Nguyen Thi Thanh Huong	Remote Sensing Ecological Index (RSEI) is one of the widely used indices for the evaluation of eco-environmental quality. In this study, the Remote Sensing Ecological Index (RSEI) was an calculation on four ecological elements including greenness (NDVI), wetness (WET), heat (LST) and dryness (NDBSI) based on remote sensing data taking Landsat 8 OLI period from 2015 to 2020. Next, the study normalizes the values of the ecological elements and estimates the RSEI formula according to Principal Component Analysis (PCA) methods. The estimated results of RSEI in 2015 and 2020 reached the average value of 3.66 and 3.60, respectively. In which, the ecological quality (EQ) was decreasing from 88.78% in 2015 to 84.75% in 2020 with the qualification range from good to very good and an increasing from 1.97% in 2015 to 3.49% in 2020 from very poor to poor. The average RSEI decreasing and the ecological level proportios changing indicated the ecological environment quality has a reducing trend in the city in the period 2015 - 2020. The results of RSEI effectively reveal the ecological benefits of surrounding environments in the cities which lead to more accurate and comprehensive basis for the implementation of environmental protection policies and development towards local sustainability.
69	76	APPLICATION REMOTE SENSING TECHNIQUE USING GOOGLE EARTH ENGINE PLATFORM TO ASSESS CROP BURN AREAS AFTER WINTER-SPRING RICE HAVERSTS IN MEKONG RIVER DELTA	Tran Van Dung	Lam Dao Nguyen	Hoang Phi Phung	Dang Pham Bao Nghi	Pham Thy Mai Thy	Crop burning in the Mekong Delta has been going on for many years. Rice farmers have the habit of burning straw to free up paddy field space, kill some insects and pathogens before sowing/planting new crop. This not only causes the reduce soil fertility and air pollution, harm to human health, but also increases the risk of widespread fires. The main objective of this study is to apply remote sensing technique using Google Earth Engine platform to identify and map crop burning areas, thereby helping managers have an overall view and make future reduction plans. The study used FIRMS data (The Fire Information for Resource Management System) extracted from MODIS satellite data using band 21 (MOD14 – Terra and MYD14 - Aqua) for winter-spring rice crops in the Mekong Delta. It has capability to provide near-real-time fire locations. In addition, the rice-age maps are also used to compare and evaluate the reliability of crop burning maps.

70	77	Investigate SAR Intensity and optical images to rapidly detect small and medium landslides in Mu Cang Chai district Yen Bai Province	Xuan Quang Truong	Van Anh Tran	Thi Thanh Thuy Pham	Hong Hai Pham	Manh Dat Truong	Chi Cong Nguyen	Van Anh Truong	Vasil Yordanov	Synthetic Aperture RADAR (SAR) imagery remains unaffected by weather conditions and enables day-and-night observations, making it particularly suitable for studying landslides, especially in regions with cloud cover, such as tropical climates like Vietnam. On the other hand, optical images can be utilized to create land cover/use maps and monitor changes over time. This paper presents a combination of methods to determine changes in SAR intensity between two time periods and track land use/coverage changes before and after landslides, aiding in the rapid detection of small and medium landslide points in the mountainous areas of northeastern Vietnam. In the study, Sentinel-1 Radar images and Sentinel-2 images from the period before and after July 2022 were utilized. The research leveraged the Google Earth Engine (GEE) cloud computing platform as the primary tool, enabling efficient and rapid mining of image data. The findings from this study can contribute to the improvement of the landslide inventory dataset and the swift identification of potential landslide points during landslide disasters. The study area is located in Mu Cang Chai district, Yen Bai province, known as one of Vietnam's landslide hotspots.
71	78	INTEGRATED GIS AND MODELLING APPROACHES FOR DEVELOPING A FLOOD FORECAST INFORMATION SYSTEM IN THE SMALL RIVER BASIN IN VIETNAM	Truong Van Anh, Truong Xuan Quang, Bui Thi Bich Ngoc, Hoang Thi Nguyet Minh	Flood forecasts play an important role in accelerating an early warning system that inturn help to reduce the lost and damage of the exposed society and economy. In the small river basin, where the time concentration is very short compared with the flood-leading time, it requires a new approach to make an effective forecast system. This study suggests an integrated GIS and modeling approach to developing a flood forecast information system, which was tested on two small river basins in Vietnam: Nam La and Nam Pan river. Data-driven flood forecast models have been used to reduce computation time and effort. The outputs of this model provides information to the text creation module to produce an automatic warning message at control locations, which is in turn displayed on a GIS-based interface. The result show that the leading time increases and therefore the time preparation for the hazard's response also increase. In the consequences, this system helps to shorten the gap between the forecast agency and the end users, who should take relevant actions based on forecast information to reduce their losses and damage.
72	79	Geospatial approach for assessment of high conservation value forest carbon stocks in tropical regions: A case study in Bac Kan province, Vietnam	Thi-Nhung Do	Thu-Ha Nguyen	Lam-Phuong Do Dang	Diem-My Thi Nguyen	Quang-Thanh Bui	Van Manh Pham	The world is focusing on the connection between carbon density, forest biodiversity, and their significance in mitigating and adapting to climate change in the context of emissions from land-use changes, which now exceed half of the emissions to the atmosphere from all terrestrial ecosystems. Although studies globally provide estimates on the role of natural climate solutions for carbon storage and their benefits to biodiversity, regional analyses with spatial information are needed to achieve better resolution at the right scale and provide specific information to support decision-making. Furthermore, we discover that preserving high-priority forests helps to safeguard both the habitats of animals and plants in order to slow the loss of biodiversity and preserve the carbon stocks and accumulations of ecosystems that help to mitigate climate change. This study monitors forest conservation based on spatial data integration and spatial data analysis tools to identify forest areas and prioritize forestland conservation using spatial measures of carbon stocks in the ecological zone of Bac Kan province. According to the findings, implementing a long-term forest conservation strategy will aid in reducing climate change, preserving biodiversity, and maintaining significant carbon sinks, such as the forest ecosystems in the Bac Kan province region.

| 73 | 80 | Utilization of Borehole Data for Correlation System of Strata - A Case Study of Hanoi, Vietnam. | Kenichi SAKURAI \| Go YONEZAWA \| Luan Xuan Truong \| Tatsuya NEMOTO \| Shinji MASUMOTO | In order to build cities that are resilient to natural disasters and man-made disasters, urban planning using a variety of subsurface data is essential, such as identifying weak ground and providing land improvements, and considering groundwater utilization based on groundwater flow and level increase/decrease. In general, such subsurface data in urban areas can be obtained by borehole survey to determine and accurately record the geological structure, N-values, groundwater levels and flows. However, a borehole survey at a single location provides only a mere piece of information at that point and cannot be used for urban planning, no matter how accurately it is recorded. In order to use the data for urban planning, borehole survey should be conducted at as many points as possible within a city, and the data should be correlated so that the underground structure, groundwater level and flow in the area can be sufficiently understood. However, the problem that arises here is that the process of correlating the data is very time-consuming and labor-intensive. Recently, investigation techniques utilizing AI and machine learning technologies have been considered, but operations by human are still required to verify and correct the results. In order to improve the efficiency of the entire process, there is a need to develop a new system that can correlate data in a way that is easily perceived visually.   In Japan, the data obtained from borehole survey is currently formatted as XML files. The author has developed a system for visualization and stratigraphic comparison of borehole data using a Web browser by simply importing borehole data in this format to a server. The main functions of the system are as follows:
The borehole data can be displayed on the Web-GIS screen.
The 3D display of borehole data can be zoomed in, out, rotated, moved, etc., using the mouse.
Display of geologic log view. Detailed core information can be displayed by overlapping the mouse.
In addition, a function to compare strata on the geologic log map screen while referring to the displayed data is also implemented. The system works not only with PCs running web browsers, but also with tablet computers such as iPads. Therefore, it is possible to immediately visualize the borehole information at that location as long as the device is connected to the Internet. An API service was created by authors to visualize borehole data and to compare geologic formations. The API service consists of a database server that stores borehole data and an API server. By sending requests to the API server, it responds to the client with the necessary data in GeoJSON format based on the information sent. This means that on the front-end side, the system can be developed freely on many operating systems and development languages that support Http socket communication, in addition to Web browsers. In this research, the actual data of the investigation where the system was put into practice in order to estimate the subsurface structure of an area of approximately 7 km in length and 7 km in width in the city of Hanoi using 275 borehole data, will be provided. In the stratigraphic comparison, the names of the Vietnamese soil types correspond to the Japanese soil types. The results were output as data necessary for 3D geological modeling, and finally visualized as a 3D geological model. |

| 74 | 81 | Characterization of Landslide-induced Topographic Changes Using LiDAR Data | Mitunori UEDA \| Tatsuya NEMOTO \| Mitunori UEDA | Landslide is a phenomenon in which sediments and rocks on the surface layer of a slope slide down along a boundary. It has an enormous impact on human lives and social infrastructure. After landslides occur, Landslide Distribution Maps are generated to determine the extent of damage. Landslide Distribution Maps are generated by visual interpretation using aerial photographs. However, this method has problems of time, labor and objectivity. In recent years, it has become possible to generate detailed terrain models using LiDAR data and detailed topographical data are obtained for multiple time periods at the same location. Thus, this has made it possible to quantitatively investigate of minor changes in topography. We focused on the changes in LiDAR before and after the landslide to capture changes in the morphological of landforms. The purpose of this study is to characterize of landform changes caused by landslides for automatic identification of landslides. The data used were terrain models and the actual landslide distribution map. The terrain models are generated 1-meter resolution DEM from LiDAR data acquired by airborne survey before and after the landslide occurred. Slope angle, landform classification (Geomorphon) and convergence index were calculated from each DEM. first, we grasped the change of the terrain shape of Geomorphon from the data before and after the landslide occurred. After that, the change vector of each topography was calculated using the Change Vector Analysis method. Change Vector Analysis is a technique for detecting changes in spatial data. This method captures the characteristics of change by determining the slope and intensity of the change vector for the two time periods. Result of comparing before and after terrain shape in landslides, it was found that the terrain has been changed to an irregular concave and convex terrain with continuous slopes and hollows. In addition, a crown was formed on the former slope, which was changed from a slope to a hollow, and the downstream part was changed to a valley. Change Vector Analysis result, the location of the landslide site and the vector magnitude of the landslide coincided with each other, and we were able to capture the changes. Similar changes also existed along the stream where the sediment flowed down. The direction of the vectors shows that changes in the same direction are concentrated in the areas where landslides have occurred. In this study, the morphological changes of landforms were investigated and characterized the changing in landform caused by the landslide in from topographic data before and after landslide occurrence. This can be used for machine learning and applicable to automatic identification of landslides by investigating in detail the features of terrain morphology that change due to landslides and the magnitude and direction of the change vectors in terrain information. However, landslide distribution maps often disclose only information on location and scale. In the future, it is a challenge to develop a method to quickly generate landslide distribution maps that add the shape, form, and direction of landslides based on data before and after the occurrence of landslides. |
| 75 | 82 | Application of AHP model to establish a landslide probability zoning map in A Luoi district, Thua Thien Hue province, Vietnam | Nguyen Thi Thuy Hanh | A Luoi is a mountainous district, in Thua Thien Hue province, Vietnam, with rugged terrain, steep slopes and many valleys. Every year, A Luoi district bears many risks of natural disasters such as storms, floods, droughts and especially landslides. This study applied the AHP (Analytical Hierarchy Process) model with GIS tool on the input database of Sentinel-2B Image, DEM and geographic background data to evaluate the influence of 5 factors: slope, elevation, aspect, land cover and vegetation to generate a landslide hazard zoning map, scale 1:50,000. The results show that the sites with high risk of landslides are concentrated mainly in the communes of Hong Kim, Hong Ha, Son Thuy, Hong Thuong, Phu Vinh, and Huong Nguyen. There by, provide guidance to help people avoid and minimize vunerabilities caused by landslides. Keywords: Landslides. AHP. GIS. Vietnam. Sentinel. |

76	83	Mangrove forest types mapping using radar and optical data integration with the Random Forest (RF) algorithm for Ca Mau province, Vietnam.	Tran Dang Hung | Pham Hong Tinh | Pham Minh Hai | Nguyen Thanh Bang | Giang Hoang Hiep | Pham Quang Hiep	Mangrove forests with their unique root structures play a crucial role in soil retention and coastal protection against erosion and wave impacts. Additionally, they provide a range of ecosystem services, mitigate the effects of climate change, and maintain water quality. Remote sensing technology has been widely demonstrated as an excellent tool for mapping mangrove ecosystems. However, accurately classifying different types of mangrove forests using remote sensing imagery remains a challenge. Clouds can easily affect optical data, while radar data is often difficult to interpret. Combining both datasets for mangrove classification has the potential to significantly improve the accuracy of the classification results. The purpose of this study is to develop a classification method using Google Earth Engine (GEE) that simultaneously utilizes ALOS-2 radar satellite data and optical Sentinel-2 data with medium spatial resolution to map different types of mangrove forests in Ca Mau province using the Random Forest (RF) algorithm. The classification results indicate that dominant types of mangrove forests in the province, such as Avicennia and Rhizophora, can be classified quite accurately, along with aquaculture, residential areas, and agriculture classes, resulting in an overall accuracy of 88%. The classification becomes less reliable for mixed mangrove forests or locations with limited survey data.
77	85	Distribution, Fate and Ecological toxicity of some Heavy Metals in Sediments: A case study from Day River Downstream, Viet Nam	Nguyen Khanh Linh	According to the statistics of management agencies, the Nhue - Day river basin system is experiencing an increase in the number of polluted sources and waste water flow from production and living activities. The accumulation of persistent organic substances, heavy metals, etc., in sediments affects the quality of river water and the aquatic living system. In this study, the 50 surface sediment samples were collected along Day River downstream on July 2018 and January 2019 (25 sampling sites) to clarify the status, movement, and potential risk of some heavy metals (Cr, Pb, Cu, Cd, and Hg). The receptor model of PCA-MLR was applied to track the source types of these metals. The results show that the trace metal contents in sediment were below the limited values suggested by the National Technical Regulation on Sediment Quality (QCVN 43:2017/BTNMT). However, some of those were between the threshold effect level (TEL) and probable effect level (PEL), indicating the heavy metals have been able to cause negative effects on the water organism. The order of potential ecological risk factors (Er) for each metal in the sediment arranged as follows: Hg > Cd > Pb > Cu > Cr. This research area overall suffered from a "low-to-moderate" pollution status. The elements Hg and Cd were a major concern for the ecosystem's health because of its high toxicity. Sedimentation of materials at Day estuary are affected by hydrodynamic factors, and the distribution of heavy metals can be well correlated to the sedimentary dynamic environment. Human activities and hydrodynamic conditions are therefore important factors that influence the distribution of heavy metals in this study area. Metal source apportionment would control the metal input into the river and estuary and can inform sediment quality management.
78	86	Quantitative Correlation of Fracture Orientation Distribution and Their Relationship with Tectonic Characteristics in Nam Du Archipelago Area, Kien Hai District, Kien Giang Province, Vietnam	Phi Truong Thanh	This paper presents the analytical results of the quantitative correlation of the fracture orientation distribution of 3016 fractures at 102 survey sites on three islands of Hon Lon, Hon Ngang and Hon Mau in the area of Kien Hai district, Kien Giang province, Vietnam. The obtained analytical results show that the smallest correlation value among survey sites on Hon Lon island is 0.71% and their highest correlation value is 0.98%; between Hon Lon island and Hon Ngang island is 0.60%; between Hon Ngang island and Hon Mau island is 0.67%. The analytical results of the quantitative correlation of fracture orientation distribution between survey sites on Hon Lon island and among these islands clearly reflect the tectonic stress field caused rock damage according to the compression directions: NE-SW, NW-SE, sub-longitude and sub-latitude, suitable to regional tectonic conditions.

79	87	Application of Multi-Criteria Analysis and GIS in Centralized Solid Waste Disposal Sites Selection in HaNoi	Thi Thanh Thuy PHAM	Selecting a waste disposal site is a crucial issue in urban planning processes as it has significant impacts on the economy, the ecological environment, and especially the health of residents in the area. Hanoi is the capital of Vietnam, a city with a large area and a dense population. However, currently, there are only two waste disposal sites: Nam Son landfill and Xuan Son landfill. As a result, the amount of waste dumped into these two landfills is excessively high, leading to an overload situation. To address this issue, the Hanoi city government plans to construct 17 solid waste treatment areas covering an area of 430 hectares. However, there are conflicting opinions about the proposed locations for waste treatment areas as some believe that those sites are not yet optimal. To determine the most suitable location for the solid waste landfill in Hanoi, the study combined Geographic Information System (GIS) technology for spatial analysis and Multi-Criteria Analysis (MCA) method for assessing the importance level of each criterion for the location selection. The research results indicated that the Nam Son waste treatment area was evaluated as the optimal location. Among the remaining 16 locations proposed by the city's authorities in the planning document, 6 locations were deemed suitable, while 10 locations were considered less suitable according to the evaluation.
80	88	Diffusion of exhaust gases from waste-to-energy plant: Model and field monitoring	Trinh Thi Tham	Municipal solid waste (MSW) incinerators generating electricity are one of the effective solutions to solve the problem of solid waste treatment in urban areas of Vietnam. However, the gas exhausted from the waste-to-energy plant might affect the ambient air quality and the public health of the residents. This study was conducted to test the well-established ability of air quality models given sufficient input data, and all so to evaluate emissions from a waste incineration plant. In this study, we used the AERMOD model to estimate the environmental pollutants emitted from the Soc Son MSW incineration plant's chimney during the period of the trial operation. Besides, the air samples were collected at 06 locations from 200 to 2500m from the plant's chimney in four different directions to measure Total Solid particle (TSP), NO_2, CO, and SO_2 levels. The concentrations of TSP, NO_2, CO, and SO_2 extracted from the model were well correlated with those collected from the field measurements in July 2022 and January 2023. Correlation coefficient values for all pollutants were above 0.80 revealing that modeling is appropriate for conducting point sources in the waste-to-energy plant. The concentrations of the TSP and gases were highest at a distance of 200 - 300m from the plant's stack which were higher than the national and international standards. Besides, the diffuse pollution of the gases was mapped with the scenario as the maximum operating capacity of the plant. The assessment of the human health risk using the estimated concentration from the model provided a scientific basis for air quality management and public health. The low health risk of pollutants at a distance of 1000m from the factory chimney indicates that the plant's exhaust gas treatment system was operating efficiently.
81	89	Effects of constructions on submerged reefs on wave characteristics	Ho Duc Dat	Nguyen Quang Tao	Nguyen Trung Dung	Nguyen Van Bau	Dao Hoang Tung	Dinh Quang Cuong	Submerged reef is one of the most unique wave reduction environment in the world because of its special function to create high bed drag forces. However, the constructions built on offshore coral reefs, such as seadikes or sea walls, that protect national sovereignty and economic development has recently changed the wave characteristics on the submerged reefs. This study presents the change of wave characteristics on the coral reef before and after the presenses of the dike. In this study, 24 experimental scenarios, including 12 scenarios with a dike and 12 scenarios without one are tested in a wave flume in ThuyLoi University, HaNoi. The results show a significant raise in wave heights due to the appearance of a dike on the reef. Wave heights tend to increase by 10% to 30% because of structure obstacles and effect of relative shallowness. In addition, the study has also given an empirical formula to determine the incoming wave height to serve the design of construction works on the submerged reef.

| 82 | 90 | ESTIMATING ABOVEGROUND MANGROVE BIOMASS OF THE NHA PHU LAGOON USING MACHINE LEARNING AND UAV IMAGERY | Nguyen Hoang Thai Khang \| Do Lan Phuong \| Tran Thi Quynh Thi | This study estimates the aboveground biomass of mangroves in Nha Phu Lagoon using Unmanned Aerial Vehicles (UAVs) and a machine learning approach with a random forest regressor model. Indicators such as vegetation index, canopy height, texture index, and cloud index were used to measure biomass. The main species in the mangrove community are Rhizophora apiculata and Rhizophora mucronata, with average heights of 10.56 m and 3.45 m, respectively. The developed random forest model accurately estimates aboveground biomass with an R-squared value of 0.8321 and a root-mean-square error of 23.8645 Mg/ha. Estimated aboveground biomass ranges from 37.26 to 181.82 Mg/ha, with an average value of 94.35 Mg/ha. The study highlights a trend in biomass distribution within the Nha Phu Lagoon, with levels higher of biomass in the northern region gradually decreasing towards the southern part. The technologies of UAVs and machine learning combination provides valuable insights into the biomass variations of the dominant mangrove species, contributing significantly to our understanding of ecosystem dynamics and aiding conservation efforts. |
| 83 | 91 | DEM generation and topographic changes of central Hanoi, Vietnam | Go Yonezawa \| Tatsuya Nemoto \| Xuan Luan Truong \| Susumu Nonogaki \| Do Thi Hang \| Muneki Mitamura \| Venkatesh Raghavan | In recent years, urban flooding caused by localized heavy rains has become more frequent in Japan and Vietnam. To solve this problem, it is important to understand the characteristics of the terrain, as well as to improve the drainage function in urban areas. Analyzing the relief of terrain and the micro-topography of Hanoi can play an important role in explaining its urban transformation. Yonezawa(2009) generated a detailed Digital Elevation Model (DEM) of the central Hanoi of Vietnam from about 15,000 points of elevation data. The elevation data is from the topographic maps published by the Department of Survey and Mapping of Vietnam, Ministry of Natural Resources and Environment in 2005, and was provided by Hanoi University of Mining and Geology. The DEM based on the surface estimation method. The topographical surface is estimated from (x, y, z) based on the surface estimation method (we call it BS-Horizon) using the Cubic B-Spline Function (Nonogaki et al. 2008). BS-Horizon is one of the surface estimation programs for geologic boundary surfaces and geomorphic surfaces. The DEM is generated at 2-meter resolution and the contour interval is 0.5 meter. The very subtle elevation gaps which can not be distinguished on the satellite image are significantly recognizable on this DEM. In this study, a DEM is generated using elevation data from a newly published topographic map in 2018. By comparing the two patterns of DEM for 2005 and 2018, the areas of urban transformation can be clarified. These high resolution DEMs are useful not only for analyzing the urban transformation of Central Hanoi, but also for the urban sustainable development, as in improvement of urban infrastructure and disaster prevention. |

| 84 | 92 | Automatic Extraction of Linear Features from Digital Elevation Model Using Edge Extraction and Hough Transformation | Venkatesh RAGHAVAN \| Tatsuya NEMOTO \| Shinji Masumoto | Linear geomorphic features such as valleys and ridges tend to represent geologic lineaments and contribute important information in targeting natural resources, evaluating hazard risk and elucidate surface deformation caused by tectonic forces. Several algorithms have been proposed for automatically extracting lineaments from digital satellite images and Digital Elevation Model (DEM). The limited use automated linear feature extraction, despite the advantages offered, can be, at least, partially, ascribed to implementation of algorithms as standalone implementation using proprietary software ecosystems. As a result, the feature extraction workflow remains to validated with disparate datasets and in diverse geographical condition. Further, refinement of algorithms and optimization of parameter selection remains to be resolved. The focus of this research was to investigate the process of extracting lineaments from digital images (e.g., satellite images and DEM). The basic steps are carried out in three stage processing involving, demarcation of linear geomorphic features, edge extraction and vector line extraction from edge maps or any raster image. The entire workflow was implemented and tested using the Free and Open Source GRASS GIS framework using existing functions and addons. As a preliminary step, DEM was used to calculates terrain forms and associated geometry using the GRASS r.geomorphon function. The r.geomorphon function categorizes the DEM into 10 terrain forms, namely, flat, peak, ridge, shoulder, spur, slope, hollow, footslope, valley and pits. Linear footslopes, ridges and valleys define features of interest in this research. Such terrain form can be represented as binary images by reclassifying the output raster generated by r.geomorphon. Terrain form using recognition r.geomorphon is sensitive to search radius and flatness threshold. Additionally, skip radius is used to eliminate impact of small irregularities and flatness distance eliminates the impact of longer distance of search radius. The selection of parameter for r.geomorphon is subjective and requires trail and error approach based on visual inspection of the output generated. As an alternative approach to overcome subjectivity in parameter selection to identify the terrain forms, a simpler (fewer parameters) using the Convergence Index was also attempted. Convergence Index depicts the structure of the relief as a set of convergent areas (channels) and divergent areas (ridges). Convergence Index is very useful for detection of lineaments especially represented by ridges or channel systems. In the present experiment, binary image representing valley systems were generated as input for the second step of data processing workflow. The test data covering parts of the Rokko mountain range in southeastern Hyōgo Prefecture, Japan was mainly characterized by linear valley systems potentially representing active faults. Therefore, in the second step, the Canny edge detector algorithm implemented as i.edge module in GRASS GIS was applied to the reclassified terrain form and Convergence Index images representing only valley systems. An edge is considered as a change in gradient which is computed from digital values defining the image. Two main differences characterize the Canny filter from other edge detectors. First, others edge detection algorithm generally produces broad edges, while Canny filter generates one-pixel-wide line(s) representing the most probable edge position. Secondly, the Canny filter combines several steps while other algorithms generate edges in a single step that may require some pre- or post-processing to achieve the desired results. The Canny edge detection algorithm consists of multiple steps. Firstly, the noise is reduced by a Gaussian filter to obtain a smoothed image. Secondly, two orthogonal gradient images are computed. These images are combined, to generate final gradient defining both angle and magnitude of the edge. Subsequently, non-maximum suppression is applied to preserve only pixels with magnitude higher than magnitude of other pixels in the direction (and the opposite direction) of gradient. Finally, significant edges are retained by thresholding with hysteresis. The Canny edge detector produces an edge map and an angle map as output which is used in the final step of data processing. In the final step, the Hough Transform algorithm is applied to the Canny edge map and angle map as input. Hough transformation and extracts line segments and is implemented as r.houghtransform function in GRASS GIS. |

To extract significant lines from Hough image, r.houghtransform module uses an identify and remove method. Lines obtained by identify and remove Hough transform method are further processed to get the actual line segments from the original image. The subsequent step of line segment extraction involves elimination the outlying pixels. The method needs should show tolerance to smaller gaps because some line segments can, be interrupted, for example by local terrain form. On the other hand, such gaps cannot be too frequent because many interruptions would indicate line segments which are probably not part of the target feature. The Hough transform is optimized by providing directions of edges as input. These angles are used to search only pixels which are in the direction of a particular line. The results using the data processing workflow were verified for a test site in the Rokko mountain range and their efficacy for automatic lineament extraction techniques were successfully demonstrated. Further, the algorithm was also tested on multi-direction relief shades that highlight terrain features which would not in terrain form or Convergence Index maps alone. As a future work, optimizing parameter selection using machine learning will minimize subjectivity in linear feature extraction. The paper will highlight on advantages of the approach to extract and validate "geologic" lineaments and demonstrate results obtained using high-resolution DEM.

| 85 | 94 | APPLICATION OF GIS TECHNOLOGY TO COMPARISON OF ORDINARY LEAST SQUARES AND GEOGRAPHYCALLY WEIGHTED REGRESSION MODEL IN THE ASSESSMENT OF THE MARKET | LE HUU NGOC THANH | The objective of this paper is to compare the application of GIS technology to compare ordinary least squares (OLS) and Geographycally Weighted Regression (GWR) regression models in determining market land prices in Thuy Van ward. Research results show that both models identify the same variables affecting land prices in the market, including the following factors: Area of the land, Width of road attached to the land plot, distance to hospital, ability to generate cash flow, planning information with different equation coefficients. However, the level of R2 interpretation of both models is quite similar to the GWR model, which is 76% lower than 78% of the OLS model. Besides, the difference between the market land price and the estimated land price from the two models is quite similar when about 75% of the difference is below about 3 million VND/m2. Thus, both models are easy to apply and have high accuracy in valuing residential land in series, contributing to improving the efficiency of land valuation. |

		RESIDENCE LAND IN THUY VAN WARD, HUE CITY		
86	95	Geospatial overview of the vegetation environment suggested by community level place names in the area of northeastern Thailand and northern Cambodia	Nagata, Yoshikatsu	Place names often use words that describe the topography, vegetation, and other environmental conditions. They contain important key words related to the history and culture of the community. In order to compile a historical database of community level place names, the author has collected old place names mainly from the northeastern Thailand but also from adjacent areas in Cambodia, Laos, and some areas of Vietnam. Northeastern Thailand and northern Cambodia face each other across the Dangrek Mountains. On the northern side of the Dangrek Mountains, on the side of northeastern Thailand, not a few community level place names use words whose meanings cannot be understood in Thai. In order to find out what these Thai-written place names mean, similar Khmer words were searched for in pronunciation on the northern side of Cambodia, the south of the Dangrek Mountains. Thus, the possibility of understanding the meaning of such place names on the Thai side by linking them by pronunciation, although the Thai and Khmer scripts have different notations, was discussed [1]. Since the report in [1] on the characteristics of place names in the area of the Dangrek Mountains, about 2,500 community level place names with location have been collected not only in the vicinity of the Dangrek Mountains but also in the wider northern part of Cambodia. The major source material used to collect the place names was the 1:50,000 topographic maps published by the AMS in the 1950s, which are described in both Khmer and Roman characters. The collected place names include many words describing geographical features and vegetation. The author also has data on about 29,000 village names in northeastern Thailand and can extract words describing geographical features and vegetation. Examples of words for edible fruit trees that appear frequently in place names in northern Cambodia include tamarind, fig, banana, gooseberry, Jambolan plum, and mango. Mango, 'svay' in Khmer and 'muang' in Thai, in particular, is very popular not only in northern Cambodia but also in northeastern Thailand. Timber trees such as Ceylon oak, teak and yellow teak, are also commonly used in place names. Many of these vegetation-related words are also used in place names in northeastern Thailand. For example, place names that include the name of the same tree species, 'samraong' in northern Cambodia and 'samrong' in northeastern Thailand, are widely distributed in both regions. This example suggests that there were similarities in the original landscape in the early days of community formation. On the other hand, although the word for bamboo, or 'russei' in Khmer, is widely used in northern Cambodia such as 27 places or almost 1 percent of villages, but only 2 out of almost 30,000 places are found in northeastern Thailand. This report outlines the frequency and distribution of place names containing these vegetation-derived words. Some examples are used to discuss how the analysis of the meaning and spatial distribution of place names, especially older ones, can provide important clues about the vegetation environment and the historical background of communities in these regions. [1] Yoshikatsu Nagata, "A Spatio-Temporal Study on the Community Level Place Names of around the Dangrek Mountains Area", Proceedings of the 2022 Pacific Neighborhood Consortium Annual Conference and Joint Meetings, pp.27-32, 2022

| 87 | 96 | APPLICATION OF MACHINE LEARNING TECHNIQUES IN ASSESSING THE IMPORTANCE OF SALINITY INDICATORS EXTRACTED FROM LANDSAT-8 OLI IMAGERY | Bui Duy Quynh | Background: Salinity prediction maps often provide valuable information about the spatial distribution and variability of salinity levels in a specific area. Thus, they play an essential role in various fields, including agriculture, environmental management, water resource planning, and ecosystem conservation. Nowadays, Landsat 8 satellite image data allows to extract of salinity indicators more variously and fully, however, not all these indicators are necessary for salinity prediction studies. There are 30 indicators extracted from Landsat 8 satellite image data, including the Coastal Aerosol band, Blue band, Green band, Red band, Near-Infrared band, Principal Component Analyses of bands 1, 2, 3, 4, 5, Normal Difference Vegetation Index (NDVI), Normalized Difference Salinity Index (NDSI), Normalized Difference Water Index (NDWI), Normalized Difference 47 (ND47), Combined Spectral Response Index (COSRI), Canopy Response Salinity Index (CRSI), Moisture Stress Index (MSI), Enhanced Vegetation Index (EVI), Vegetation Soil Salinity Index (VSSI), and the Salinity Index (SI). Algorithms that use machine learning can handle complicated and routine jobs, which saves time and work. They can find patterns and insights that may be difficult or impossible for people to discern manually. Machine learning techniques enable the analysis of multiple indicators simultaneously and determine indicators that contribute the most relevant information and offer insights into their relative importance. Therefore machine learning algorithms have been used extensively in many natural hazard prediction studies and recently in several salinity hazard studies. However the majority of these research often omit the step of establishing the significance of the input indicators in the salinity evaluation. Meanwhile, how well the evaluation's input indicators are chosen significantly impacts how well the forecasting models perform in terms of accuracy. - Context: The Mekong Delta is one of the most significant regions in Vietnam and plays a vital role in the economy, agriculture, and ecosystem of the whole region. Nowadays, salinity has significantly impacted the living environment, livelihoods, and productive activities in Mekong Delta. One of the main factors influencing salinity in the Mekong Delta is the tidal intrusion from the East Sea. - Approach: Start the above-mentioned reasons, this study utilizes machine learning techniques including Bayesian Model Averaging (BMA), Information Gain (IG), and Random Forest (RF) in assessing the importance of salinity indicators extracted from Landsat 8 satellite images. - Results and conclusion: The results of this research are to establish a theoretical framework that aids in the selection of suitable indicators, thereby enhancing the precision and reliability of salinity prediction maps in the future. - Contribution: This study aims to contribute to selecting suitable input indicators to enhance the accuracy and precision of salinity prediction studies in the future. - Development: By identifying the most influential indicators, the next studies have only focused on monitoring specific aspects of salinity phenome rather than collecting and analyzing excessive amounts of input indicators. This proper approach can lead to cost savings and increased efficiency in salinity monitoring and prediction efforts. |

| 88 | 97 | Digital Quantification of Environmental Change along Hanoi's First Urban Railway | Nguyen Dinh Minh \| Nguyen Viet Huong | Background: Urban railways are crucial in solving public transport problems in densely populated urban areas. However, their impacts on humans and the environment must be assessed and managed effectively using different methods for sustainable development. In recent years, several urban railway development projects have been carried out in the two largest cities in Vietnam, namely Hanoi and Ho Chi Minh city. In Hanoi, the capital of Vietnam, the first urban railway completed and entered into operation in 2021 is called Metro Cat Linh-Ha Dong. It passes through the center of Hanoi and is anticipated to enhance public transportation in the wards and districts of the city with the highest population densities. For sustainable development, the environmental change caused by this railway's construction and operation must be quantified and managed with modern methods. Aim: The digital quantification of environmental change along Hanoi's first urban railway aims to map, measure and monitor the environmental impacts of the construction and operation of the railway using digital data, tools and techniques such as satellite remote sensing and geographic information systems (GIS). Concepts: Environmental change along an urban railway can be defined as the alterations to the environment brought on by the construction and use of an urban railway. These changes could be physical, biological, or chemical, and affect environmental components, including the air, water, soil, and ecosystems. To mitigate environmental harm and enhance sustainable development, it is essential to comprehend these changes and their implications. Digital quantification of environmental change is the measurement and analysis of environmental changes through time using digital tools and techniques such remote sensing, GIS, computer modeling, and monitoring devices. Approach: The approach to digital quantification of environmental change along Hanoi's first urban railway is data-driven and focuses on the acquisition of multispectral, multitempotal digital satellite imagery, using digital image processing and GIS techniques to map, measure and monitor the environmental impacts of the railway . Results: The use of digital tools for the analysis of optical and thermal satellite imagery such as Landsat, ASTER, and Sentinel help to compute the changes in normalized diference vegetation index (NDVI), normalized difference water index (NDWI), and land surface temperature along Metro Cat Linh-Ha Dong before, during and after its construction and operation. Conclusion: The digital quantification of environmental change along Hanoi's first urban railway is an effective approach to understanding the environmental impacts of urban infrastructure development projects. The use of digital satellite imagery, tools and techniques, such as digital image processing and GIS allows for a quantitative assessment of the impacts of the railway on the environment, and can inform the development of targeted mitigation strategies. Contribution: The digital quantification of environmental change along Hanoi's first urban railway is an important contribution to sustainable urban development, providing valuable insights into the environmental impacts of infrastructure projects and informing decision-making for long-term sustainability. The study enriches the literature on the environmental applications of satellite remote sensing and GIS for sustainable development in the age of digital transformation. |

| 89 | 98 | AUTOMATIC DETECTION AND DELINEATION OF SURFACE WATER BODIES USING OPTICAL AND RADAR IMAGES | Le Thi Phuong Hong | The requirement to improve accuracy in operation and management of reservoir including asking for regularly and continuously updated data, and water surface of reservoirs is one of the important data that needs to be observed and monitored daily. Nowadays, remote sensing image interpretation has been used to determine the surface area of water, thanks to its advantages in terms of wide coverage, high revisit frequency, good historical data, with low cost and sometimes free access. Methods for automatic detection and delineation of water surface from remote sensing images can be divided into two categories: Threshold segmentation and Image classification. While threshold segmentation is mainly based on the spectral knowledge to construct various classification models and water body indices to extract water bodies, the image classification synthesizes the spectrum, texture, and spatial characteristics of the image and makes full use of the spectrum, shape, structure, and texture of the ground features to extract water body information. Remote sensing images are divided into two types: optical images and radar images. Regarding to the threshold segmentation method, many methods have been developed to detect and delineate water bodies from optical remote sensing images by adopting water indices such as NDWI, MNDWI, AWEI,... The evaluation of the most suitable thresholds for water surface determination is based on the principle that the reflectivity of water is lower than that of other soils in the infrared channels. For satellite radar images, the threshold value is usually determined by analyzing the SAR (Synthetic Aperture Radar) intensity histogram and estimating the probability distributions of the water and not water pixels. Google's Google Earth Engine (GEE) is one of the widely used geographic information and remote sensing data storage and calculation platform allowing to use, calculate and export data for the study area from the satellite image database stored on the server system. This study aims to develop a toolkit for automatic detection and delineation of reservoir's surface water bodies using both optical and radar images based on Google Earth Engine platform which is used to automatically collect low cloudiness images, compute proposed indices and then water body of reservoir using different threshold values. The accuracy of the extraction results is assessed by calculating the Overal Accuracy (OA) and the Kappa coefficient (kappa) by comparing the delineated water bodies with the ones determined from surveyed bathymetry or observed water level and topography map. In this research, Am Chua reservoir in Khanh Hoa province with the storage volume of 4.7 mil m3 corresponding with the normal water level of 11.6m has been selected to verify the accuracy of the proposed method as well as the automatic and flexible of the toolkit. The results reveal that optional thresholds for delineating water body of Am Chua reservoir are: (i) -0.15 and -0.1 with NDWI and mNDWI indicates respectively for optical images and (ii) -20 ÷ -19 dB for radar images. The values of OA and Kappa greater than 0.9 and 0.85 show the satisfaction of extracted results. Remote sensing data such as Sentinel 1, Sentinel 2 and Landsat 8 are all free of charge, combine with the automatic GEE platform provided a rapid and friendly toolkit which can support relevant agencies in managing and operating the reservoir more efficiency and economical. |

| 90 | 99 | A NOVEL APPROACH OF NEURAL NETWORKS AND USLE IN SMART SOIL EROSION MODELING, CASE STUDY IN SOUTHERN COASTAL REGION OF VIETNAM | Hoa Thi Tran \| Ha Tran Thanh \| Thu Minh Phan \| Hung Van Nguyen | Soil erosion is a critical environmental issue with far-reaching consequences. To tackle this challenge effectively, innovative approaches are required for accurate prediction, monitoring, and mitigation. Smart soil erosion modeling often involves the integration of remote sensing data and geographic information systems (GIS). In recent years, the application of machine learning techniques in smart soil erosion modeling has gained significant attention due to its ability to learn complex patterns from data without explicit programming. Several supervised machine learning techniques commonly applied in this domain are Gradient Boosting Machines (GBM), Support Vector Machines (SVM), and Artificial Neural Networks. These algorithms are leveraged soil erosion data and associated influencing factors. This paper adopted one of neural networks – the Long Short-Term Memory (LSTM) to analyzed temporal variations in erosion patterns over time, aiding in understanding erosion dynamics. Furthermore, another common soil erosion – the Universal Soil Loss Equation (USLE) was investigated for predict annual soil loss. Our data were extracted from remote sensed data (DEM – Digital Elevation Model and MODIS) and vector data of the study area. Our case study is located in the Southern coastal areas of Vietnam where the possibility of annual soil loss is relatively high due to the conditions of steep terrain and heavy seasonal rainfall. Our prelim results showed that the soil erosion process is unevenly distributed over the entire study area: the northern region is the most highly affected area than the others. The accuracy of current soil erosion state map and soil erosion potentially map is above 0.9 within the area showing a satisfactory performance. This model provides valuable insights for implementing efficient soil conservation strategies and adaptive management practices, crucial for mitigating erosion's adverse effects on the environment and agricultural productivity. The integration of LSTM with USLE and remote sensing data opens new avenues for sustainable soil management and environmental conservation. However, challenges related to data availability and interpretability of black-box models warrant further investigation for the continued advancement of smart soil erosion modeling. |
| 91 | 100 | Drought hazard analysis using Gis-based Analytical Hierarchy Process in Cai-Phan Rang River Basin, South-Central Coast of Vietnam. | Hoang Le Huong | Drought is a naturally occurring event associated with a significant decrease in water availability over a region. Changes in hydrological conditions in the area, such as climatic changes, especially rainfall, can lead to droughts and floods, which have many negative impacts on life and nature. Adaptation to natural disasters, such as drought, can be effective through improved understanding of disasters. Understanding their effects are of widespread concern and a great challenge to researchers and policymakers. Further understanding of disasters is only possible with a comprehensive hazard analysis. Drought hazards depend on many factors, such as precipitation, temperature, flow and water balance, soil structure, land cover, etc. A holistic drought hazards analysis considering all these factors will provide a more effective disaster risk management. In the Cai - Phan Rang River basin, South Central Coast of Vietnam, the changes in water availability are significant concerns since it often leads to drought, forest fires, reduced agricultural productivity, poverty, and food insecurity. This study uses the analytical hierarchy method, multi-parameter modelling, to assess drought hazard analysis in the Cai - Phan Rang river basin. The drought hazard zoning map was made based on the weight of the selected indicator using GIS (geographic information system). The results show that, in general, the southern regions are at high hazard of drought due to low rainfall and high temperature; in which due to topographical characteristics, the narrow delta area in the central valley of the basin is the area with the highest hazard, although it is located in the vicinity of low-elevation streams and relatively densely populated areas. |

92	101	Landslide susceptibility prediction based on slope-unit mapping and ensemble machine learning models	Khuc Thanh Dong	Landslides are natural hazards that cause significant damage to infrastructure and human livelihoods. Machine learning and geospatial data approaches are believed to yield robust results in landslide prediction. This study employs an integrated method by considering multiple factors based on slope-units in Van Yen district, Yen Bai province, Vietnam. Thirteen factors are used to assess their relationships with landslides, including Elevation, Slope, Aspect, Plan Curvature, Profile Curvature, Lithology, Landcover, Distance to Road, Distance to River, Distance to faults, Topographic Wetness Index, Flow Accumulation, and Rainfall. Four ensemble machine learning models, namely Random Forest (RF), Bagging-based Support Vector Machines (BSVM), Gradient Boosting (GB), and Adaboost (AB), are utilized to analyze landslide susceptibility. Performance evaluation metrics such as sensitivity, specificity, and Receiver Operating Characteristic (ROC) curve are employed to compare the performance of these models. Based on the comparison of Area Under the Curve (AUC) values, the results indicate that all four models are suitable for mapping landslide susceptibility by slope-units in the study area, with the random forest model yielding the best performance.
93	102	Spatial prediction of rainfall-induced landslides using fast decision tree learner by Reduced Error Pruning (REP) for the mountainous area of Nguyen Binh County, Cao Bang Province, Vietnam	Nguyen Quoc Phi	Decision tree learning is one of the most successful learning algorithms in data mining approaches, due to its various attractive features such as simplicity, comprehensibility, no parameters, and being able to handle mixed-type data. Among decision tree algorithms, a fast tree-growing algorithm without substantial decrease in accuracy and substantial increase in space complexity as in landsliding studies. The fast decision tree learner by Reduced Error Pruning (REP) was used for landslide susceptibility mapping in the Nguyen Binh County of Cao Bang province. In the database, 306 landslides were plotted and classified into training (70%, 214 landslides) and testing (30%, 92 landslides) subsets randomly to train and validate the models. A total of 12 landslides conditioning factors were considered as model inputs, and the results of each model were categorised under four susceptibility classes. The receiver operating characteristics (ROC) curve and five statistical measures were used to evaluate the model's performance. Experiments show that the REP tree performs competitively with C4.5 in accuracy with 92.38% corrected prediction and the area under the curve of 0.935 and the running time is significantly faster than C4.5. Indeed, it is as fast as naive Bayes but outperforms naive Bayes in accuracy according to the landslide database in study area. The research shows that REP could be a practical decision tree algorithm used in natural hazard studies with large amount of data, and the result is useful in decision making process of land use planning.
94	103	Geological Lineament Extraction using Satellite Image and deep learning technique	Xuan Luan Truong | Do thi Hang | Van ANh Tran | Xuan Quang Truong	Geological lineaments are an important factor for studying formation of minerals such as gold. This study aims to detect lineament from remote sensing data using both traditional method and deep learning technique. The study area is located in Thanh Hoa Province where gold mineral is found. Optical and SAR satellite images such as Sentinel-1, and Sentinel-2 are employed to extract lineament. The result is evaluated by comparing to geological fault map of the study area.

| 95 | 104 | Rock deterioration risk assessment for limestone geosites at Dam Thuy area of Non Nuoc Cao Bang geopark, Vietnam using TOPSIS approach | Nguyen Quoc Phi | The geosites at Dam Thuy area of Non Nuoc Cao Bang geopark are valuable natural heritage for not only their scientific values but also their landscape contexts. However, the risk of rock deterioration at those limestone geosites has not been studied. The geosites (caves, waterfall and natural monuments) in the area are located along the limestone slopes, often highly fractured and exposed to the intense activity of aggressive exogenous agents, occur mainly with the detachment and fall of blocks extremely variable in sizes. The rock mass generally shows a high degree of fracturing and evidence of previous blocks falls is also visible all over the study area. Several blocks of different sizes appear to be in conditions of high instability and in proximity of falling. This study aims to evaluate the performance of widely used multi-criteria decision-making (MCDM) model of Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) to produce rock deterioration risk map in the Dam Thuy area of Non Nuoc Cao Bang geopark, Vietnam. Nine causal layers including slope angle, slope aspect, lithology, bedding plane, weathering rate, fracture density, distance to faults, rainfall and land use were used to produce the rock deterioration map. The weights of the causal factors were also calculated using the TOPSIS method and the final risk map plays an important role in integrated geopark management, especially in the field of preserving of geosites in hazard-prone areas. |
| 96 | 105 | Application of Random Forest Algorithm and Google Colab for land cover classification | Hoa Thanh Thi Pham \| Ngoc Quang Vu \| Name Phuong Nam Thi Doan \| Nghi Thanh Le | Land cover is important information for the management and monitoring environment including disaster assessment in terms of flood, erosion, forest fire, landslide, and so on. Nowadays, many machine learning methods have been used to map land cover. Scientists assessed Random Forest (RF) to have more advantages than other image classification methods in its accuracy, its flexibility, and it is an easy-to-use algorithm. Especially, the appearance of Google Colab has brought the potential for RF in land cover classification. Google Colab allows researchers to run Python code through the browser, which not only requires no installation to use or upgrade computer hardware but also provides access free of charge to computing resources. Therefore the research is to provide the approach RF with Google Colab environment for classifying land cover in Quang Binh province, Vietnam using sentinel - 2 image in August 2021. The results have indicated the ability of this research direction with an overall accuracy above 80%. |

| 97 | 106 | Geodiversity, Geoheritage and GIS | Natraj Vaddadi | Natural diversity encompasses two main components: biodiversity and Geodiversity. The term Geodiversity is a shortened version of the phrase 'geological and geomorphological diversity and has been defined as 'the natural range (diversity) of geological (rocks, minerals, fossils), geomorphological (landform, processes) and soil features. It includes their assemblages, relationships, properties, interpretations, and systems. This concept is comparable to biodiversity, which focuses on the variety of living organisms on Earth. Geodiversity is important, as the various Earth's material, their forms and the various processes that act on them are an integral part of Nature. Earth's material and form are crucial for the sustenance of ecosystems. Earth's diversity, with its landforms and dynamic processes, provides the substrate for habitat development. The wide array of landforms and ongoing dynamic processes contribute to the creation of suitable habitats for various life forms. Therefore, understanding and preserving Geodiversity is essential for our planet's overall conservation and ecological balance. Similar to the concept of geodiversity, are the frequently used terms such as Geosites and Geomorphosites (geomorphological features). Geosites are specific geological locations that possess unique attributes, offering aesthetic, scientific, and educational value. Both Geosites and Geomorphosites hold immense importance for scientific research, educational purposes, and tourism. The study and recognition of Geosites and Geoheritage date back to as early as 1949 and significant efforts have been made at the national and regional levels to identify and conserve them. Many countries have now designated certain areas as UNESCO Geoparks, signifying their geological and cultural significance. Geosites play a crucial role in enhancing our understanding of Earth's history, natural processes, and cultural heritage. They may also serve as valuable resources for research, education, and reference while holding cultural and economic significance for local communities. In recent years, Geographic Information Systems (GIS) technology has proven itself as a highly valuable tool for spatial analysis, transcending its common use in navigation. Professionals in the fields of heritage management, conservation, restoration, architecture, archaeology, and cultural heritage have embraced GIS to support and enhance their work. GIS has also emerged as a key tool for Geoheritage conservation. Through GIS, detailed maps, and visual representations of geoheritage sites and geodiversity can be created, aiding in the identification, and understanding of crucial geological features. This is instrumental in prioritizing conservation efforts and formulating effective management plans for the preservation of these natural assets. Additionally, GIS contributes significantly to Geotourism which focuses on promoting sustainable tourism by showcasing geological features and processes. By establishing tourism routes and providing interactive maps and location-based services, GIS enhances visitors' experiences at significant sites, enriching their understanding and connection with the geological wonders. Much of this work is on a large scale and focuses on a macro perspective. The intrinsic value of smaller-scale sites of geological significance is often overlooked and not recorded. Such sites provide valuable insights into Earth's evolution and scientific history. Serving as important resources for research, reference, and holding cultural significance for local communities, they also serve as valuable educational tools for students of Earth Sciences, fostering a deeper appreciation of the Earth's geological heritage. Keeping the above in mind, The Centre of Education and Research in Geosciences (CERG) has launched "Geotrails", an outreach program. Geotrails are field traverses that use GIS and Geospatial maps with attribute information as a base. Each Geotrail, documents not only the navigational information but also key attributes and geological/geomorphological/cultural information at a micro-level of interesting sites along the trail. Two such popular "Geotrails" in Pune and Ahmednagar districts in the state of Maharashtra, India are detailed in the paper. The Geotrail maps offer detailed route guidance to the public, allowing them to explore the area from various perspectives. Alongside highlighting geological features, these maps also draw attention to nearby ancient heritage sites, both historical and archaeological, found near the field outcrop or along the |

				field traverse. This approach establishes a meaningful connection between the local geology, architecture, and history, promoting essential awareness of Earth Sciences and its significant contributions to the well-being of society.
98	107	Three-dimensional Building Model Using Drone Point Clouds	Phaisarn Jeefoo	The traditional Total Station approach cannot be used to produce a photo-realistic 3D model of an object. This study primarily outlines the theory of high-resolution aerial mapping for 3D construction using drone point clouds of the Provincial Hall in Chiang Rai Province, in northern Thailand. The use of geographic information systems (GIS) to support and convey information to environmental managers and the general public is excellent for presenting data obtained from ongoing location monitoring. The building photos were processed using the Photogrammetry module of Agisoft Photoscan Professional software. The study progressed through several processing stages with Agisoft Photoscan Professional, including Align Photos, Build Dense Cloud, Build Mesh, Build Texture, Build Tiled Model, Build DEM, and Build Orthomosaic, respectively. High-quality aerial photographs with a resolution of 2.73 cm were used to create the base map of the building. Moreover, the outcome displayed the 3D texture of the hall.

99	108	MAPPING AQUCULTURE REGIONS WITH SPOT6 IMAGES IN COASTAL WATER OF BA RIA – VUNG TAU, VIETNAM	Phan Minh-Thu1, Nguyen Van Hung2, Le Thi Hai Nhu3, Ho Dinh Duan4, Nguyen Van Hoang5, Nguyen Minh Giam6	The increasing demand for aquatic food sources is a driving force to stimulate the development of aquaculture rapidly, not only inland, but also coastal areas and open seas. As a result, some regions have not been able to manage aquaculture properly, leading to instability in economic development and disruption of regional planning. Therefore, mapping the aquaculture areas can contribute to strengthening socio-economic management in the region. This article used SPOT6 images combining with ground-truthing survey data to determine the distribution of aquaculture regions in the coastal areas of Ba Ria - Vung Tau province, Vietnam. The analysis results have determined that the total area of aquaculture in the study area is 6636.45 ha, of which the marine aquaculture is 115.43 ha, aquaculture in the river is 609.57 ha and the inland pond culture is 5911.45 ha. In addition, the analysis results also show that other land use has changed over time. The multi-temporal, wide coverage and high spatial resolution of remote sensing data is a reliable source to determine the fluctuations of land use objects more accurately, contributing an effective part in the state management of aquaculture, socio-economic activities and environmental pollution monitoring.
100	109	Development of an AIoT prototype system for analyzing and assessing flood risk situations in the form 3D Simulator Using Geoinformatics and Spatial data science	Natima Udon and Sittichai Choosumrong*	Flooding is regarded as a serious issue that significantly affects people's life. Resources and national assets given Thailand's geography, position, and natural diversity. Thailand thus deals with flooding on a constant basis when planning for environmental restoration, particularly threats brought on by flood problems, etc. Using geoinformatics and spatial data science techniques, a prototype AIoT system for analyzing and evaluating flood risk scenarios in 3D simulation will be investigated and created in this study. we choose to look into and develop a prototype system in the Chi River basin of Mahasarakham province. The scientific method of spatial data will be used to develop the prototype of the AIoT system, starting with the development of measuring tools for collecting the volume of water in the Chi River basin, then manage the data on the cloud, analysis of the data, calculation, and modeling of the display model using machine learning techniques, and finally the process of using the data to create a Web GIS Dashboard in 3D model for relevant agencies to use to help make decisions and view analytics data in real time. The prototype of the AIoT system is designed to 1) develop IoT devices together with big data analysis using spatial data science and machine learning, and 2) to develop a simulation system for disaster analysis and forecasting by applying virtual models of physical objects (Digital Twins) that can be displayed in Web GIS. As a result of this research, departments, and management teams in Mahasarakham province will be able to use this model for planning flood management and prevention in the future.

101	110	Optimizing broiler house management to reduce costs and reduce losses with internet of things technology and wireless sensor network	Sittichai Choosumrong1*, Rhutairat Hataitara1, Tossaporn Incharoen1, Venkatesh Raghavan2, Thanwamas Phasinam3 and Khongdet Phasinam3	Effective broiler house management is imperative for sustainable and profitable poultry farming. To optimize broiler house operations, this research examines the combination of Internet of Things (IoT) technologies, Closed-Circuit Television (CCTV) powered by artificial intelligence (AI), and wireless sensor networks. The primary objectives encompass cost reduction, loss mitigation, and performance evaluation of feeding and watering devices. Wireless sensors, equipped with IoT capabilities, continuously monitor essential parameters such as temperature, humidity, and environmental conditions. Simultaneously, AI-powered CCTV cameras analyze bird behavior, detecting signs of stress, disease, or anomalies. This combined data provides comprehensive insights into the well-being of the flock. An integral component of the study involves comparing feeding and watering devices. Performance evaluation considers factors like feed consumption rates, water availability, and operational efficiency. By leveraging data from IoT sensors and AI-driven CCTV, the study offers informed recommendations for optimal device selection. Remote monitoring through IoT technology empowers farmers to access real-time data, facilitating timely adjustments to environmental conditions. Automated controls further ensure precise management, contributing to broiler growth and well-being. The integration of AI-powered CCTV extends beyond health monitoring. It detects aberrant behaviors, enabling early intervention and disease prevention. This proactive approach significantly reduces potential losses. Furthermore, the research evaluates cost implications. IoT technology's ability to regulate variables like feed utilization and energy consumption aids cost reduction. The study's findings offer practical insights for efficient resource allocation. In conclusion, the combination of IoT, AI-powered CCTV, and wireless sensor networks presents a multifaceted solution for holistic broiler house management. The real-time data, predictive insights, and automated controls collectively contribute to cost reduction, loss mitigation, and informed decision-making. By concurrently evaluating feeding and watering devices, the study enhances farm efficiency and bird welfare.
102	111	Thailand COVID-19 Case Fatality Spatial Cluster & Direction Analysis	1Athitaya Sakunmungmee, 2Tanyaluck Chansombat, and 3Pathana Rachavong	The global situation has been dominated by COVID-19 for 4 years. As of 12 August 2023, there were 4,755,443 confirmed cases and 34,437 deaths, equivalent to 491 per million population. The fatality rate was 0.724 percent. This study analyzes CFR: Case Fatality Rate using the COVID-19 death toll data together with the number of confirmed cases, the regional monthly change percentage & average monthly change percentage were analyzed. The results of the study are found to have seen regional changes. Areas with extremely dense and sparse deaths are analyzed using Getis Ord Gi* and spatial direction analysis to demonstrate the direction of COVID-19 deaths distribution from the center.
103	112	Regional post-earthquake damage estimation and prediction using Gaussian geostatistical simulation	1Sunanthacha Polkerd, 2 Pathana Rachavong, and 3 Tanyaluck Chansombat	From the inexplicably case of an earthquake of magnitude 4.5 at a depth of 5 kilometers, with the epicenter occurring in the area of Phai Lom Subdistrict, Bang Krathum District, Phitsanulok Province at approximately 00.17 pm on June 29, 2023, Thai officials assumed that it was caused by a sliding fault hidden underground (Hidden Fault), which is outside the area of 16 active fault lines in Thailand that have never experienced an earthquake in the past 100 years. This was a very shallow earthquake. The tremor from this earthquake made people in Phitsanulok, Phichit, Kamphaeng Phet, Phetchabun, Nakhon Sawan and Loei provinces able to feel the tremors in general. From a preliminary survey, it was found that the walls of houses and churches in the area of Ban Ratchachangkwan, Paktang Subdistrict, Muang District, Phichit Province were slightly cracked, which was perceived to be within the magnitude 4 to 5 earthquake on the Mercalli scale. The purpose of this study is to use Gaussian geostatistical simulations to integrate available inspection data with existing seismic risk models to dynamically update regional post-earthquake damage estimates and thereby organize to support recovery. Results show that the proposed method reduces the number of building inspections required to generate reliable and accurate damage predictions.

| 104 | 113 | SPATIAL - TEMPORAL ANALYSIS OF NO2 CONCENTRATION IN BINH DUONG PROVINCE, VIETNAM | Nguyen Thi Bich Ngoc, Pham Thi Mai Thy, Nguyen Le Tan Dat, Tran Thi An | This study aims at using Sentinel-5P satellite data for analyzing of NO_2 concentrations in Binh Duong province, Vietnam. Google Earth Engine which is a cloud-based geospatial analysis platform has been used to collect satellite data and extract information on NO_2 concentrations in Binh Duong in the period from 2018 to 2023. Based on the analysis over time, NO_2 dispersion is dependent on seasonal variation and spatially. The average NO_2 density is ranging from 17.2 to 41.86 $\mu mol/m_2$ in the period from 2018 to 2023. The average NO_2 concentration in the areas with high density of industrial factories is higher than other regions in Binh Duong province. Based on the spatial analysis of NO_2 concentration in Binh Duong, NO_2 index is highest in Di An City and lowest in Phu Giao district. Results from this study is valuable for air pollution monitoring in Binh Duong as well as other industrial provinces in Viet Nam. |