AGSE 2025

Applied Geoinformatics for Society and Environment

13th International Summer School and Conference, Bogotá, Colombia, 8. – 12. September 2025

The Challenge of Climate Change & Geoinformation Solutions

Programme and Abstracts

Stuttgart Active Alumni Group

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Preface

Applied Geoinformatics for Society and Environment (AGSE) series of conferences and summer workshops started in 2008 in Trivandrum, initiated by the initiatives of alumni and lecturers of the international Master's Degree Programme in Photogrammetry and Geoinformatics of the University of Applied Sciences, Stuttgart, Germany. After the successful follow-up conferences in Stuttgart (Germany, 2009), Arequipa (Peru, 2010), Nairobi (Kenya, 2011), Johor Bahru (Malaysia 2012), Ahmedabad (India, 2013), again Stuttgart (2014), on Kish Island (Iran, 2017), Windhoek (Namibia 2018), Stuttgart (2019), as hybrid conference in Kathmandu and Stuttgart (Nepal, Germany, 2021 and again Trivandrum (India, 2022). The conference is closely related to the Master's Programme in Photogrammetry and Geoinformatics which started with the first batch 26 years ago, meanwhile there is a global network of about 600 alumni graduated from the programme. Since its beginning, the course is supported by the German Academic Exchange Service (DAAD) in its program for Development-Related Postgraduate Courses (EPOS).

Also, AGSE 2025 is incorporated into the DAAD supported alumni work of the University of Applied Sciences Stuttgart. Therefore, participants from many countries worldwide contribute with experiences from their home countries.

As in previous years, the conference will address current topics in the field of geographic information (GI) science. With the broad theme of 'The Challenge of Climate Change and Geoinformation Solutions', the conference will focus on contributions from Earth Observation relating to environmental monitoring, natural hazards, and risk assessment in the context of climate change. Additionally, the conference will address new concepts and methods related to machine learning and deep learning for GeoAI applications. Finally, data sharing, which is one of the prerequisites for setting up these applications, will also be discussed.

The concept includes invited talks by invited international experts in combination with presentations and workshops by participants and lecturers on topics related to technological developments and recent data provision by Earth Observation Systems. Through a webinar also participants from counties worldwide who are not able to participate in person will be included in the networking activities.

The objective of the conference is to 'take the benefits of geographic information technologies to a wide canvas of applicable areas'. Since 2008 we – scientists, practitioners, students and alumni – continue this path to empower one another in a participative way.

We wish this event a successful exchange of knowledge crossing borders and disciplines.

Prof. Dr. Paul Rawiel Prof. Dr. Dietrich Schröder Prof. Dr. Franz-Josef Behr

Welcome

Dear participants and colleagues,

Greetings from Bogotá, Colombia.

On behalf of Universidad Distrital Francisco José de Caldas, it is an honor and a true pleasure to welcome you to the AGSE 2025 Conference, held from September 8 to 12, 2025, in our vibrant capital city. This international gathering, co-organized with the Hochschule für Technik Stuttgart (HFT), continues the rich legacy of the Applied Geoinformatics for Society and Environment (AGSE) initiative, bringing together professionals, researchers, and students from across the globe.

Under the timely theme **"The Challenge of Climate Change & Geoinformation Solutions,"** this year's conference aims to foster dialogue, innovation, and collaboration among the global geospatial community. Throughout five dynamic days, participants will engage in keynote lectures, technical sessions, hands-on workshops, and a field excursion — all addressing the critical role of geoinformation in confronting global challenges.

This compilation of abstracts reflects the diversity and richness of contributions to AGSE 2025. Each presentation and paper offer unique insights and perspectives, and we are proud to host such a breadth of expertise and experience in Bogotá.

We hope that, beyond the academic exchange, you will enjoy the spirit of our country, people, flavors, and rhythms. Colombia welcomes you with warmth and enthusiasm. At AGSE 2025, we will also have the opportunity to celebrate together with touches of traditional Colombian music and the joy that defines our culture.

We extend our deepest gratitude to all organizing institutions, contributors, volunteers, and participants who made this conference possible. May this event be not only a space for knowledge sharing, but also a seedbed for future collaboration and long-lasting friendships in the geoinformatics community.

Welcome to AGSE 2025. Welcome to Bogotá.

Let this be a memorable and inspiring experience for all.
Warm regards,

William Benigno Barragán Zaque, PhD
Full Professor
Topographic Engineering
Faculty of Environment and Natural Resources
Universidad Distrital Francisco José de Caldas

Programme

Monday, September 8	
07:30 – 08:30	*Registration*
08:30 – 09:30	**Welcome Addresses** Moderation: Mónica Alejandra Acosta Vega ***Dr. Paul Rawiel*** *Professor, Stuttgart University of Applied Sciences* ***William Benigno Barragán Zaque, PhD*** *Professor, Universidad Distrital Francisco José de Caldas* ***Wilmar Darío Fernández Gómez, PhD*** *Professor, Universidad Distrital Francisco José de Caldas*
09:30-- 09:50	**Presentation of Sponsors**
09:50- 10:20	*Coffee Break*
10:20- 11:05	**Keynote** Chair: William Barragán Zaque *Wilmar Dario Fernández Gómez* **Advancing Geoinformation Sciences in Colombia: A Review of Two Years of Research Agenda Formulation**

11:05-12:30	**Technical Session: „Geoinformation Worldwide - Disaster and Environmental Monitoring“** Chair: Ángela Blanco-Vogt *Charles Gaya and Christopher Oning* **Determination of Optimal Sites for Rain Water Harvesting (RWH) Structures in Kajiado Central, Kenya Using Long Short-Term Memory (LSTM) Networks** *Sanjeev Kumar Raut:* **Landslide Susceptibility Mapping of Sindhupalchok District, Nepal** *Luisa Fernanda Garzón Díaz, William Benigno Barragán Zaque, Juan David Méndez Niño, Jhon Fredy López and Emily Dayana Núñez Eguis* **Cartographic Assessment of Hurricane Iota Damage in Providencia Using Photogrammetry and Spatial Analysis**
12:30-14:00	*Lunch*
14:00 – 15:30	**Technical Session: „Geoinformation Worldwide - Disaster and Environmental Monitoring” cont’d** Chair: Paul Rawiel *Metzi Aguilar* **Urban Sprawl Detection and Land-Use Conflict Assessment in Santa Tecla Using Spectral Indices and Hybrid Machine Learning Classification of Sentinel-2A Data** *Emerson Javier Martinez Garcia* **Drought Monitoring in Coastal Agricultural Zones of Tola, Nicaragua Using Open-Source Satellite Data** *Hector Mora-Paez, Carlos Franco-Prieto and Jose-Fernando Mejia-Correa* **GNSS Space Geodesy and its Contribution to Society and the Understanding of Earth Dynamics in Colombia: Achievements and Challenges**
15:30-16:00	*Coffee break*
16:00-17:15	**Technical Session: „Geoinformation Worldwide - Disaster and Environmental Monitoring” cont’d** *Chair: Edilberto Suárez-Torres* *Paola Andrea Suarez Jaimes, Edilberto Suárez Torres and José Luis Herrera Escorcia* **Multitemporal Monitoring of Subsidence in Bogotá D.C. Using PS-InSAR Techniques: Geoinformatics Integration for Sustainable Urban Management**

	Md Zahid Hasan Siddiquee **Dealing Dengue Fever with Drone Technology** *Paula Campos and William Benigno Barragán Zaque* **Multi-Criteria Proposal Model for Forest Fire Prediction Based on the Use of Information Processed in AI and the Role of Quantum Sensors in Colombia**
17:45- 20:15	*Come Together and Icebreaker Party*

Tuesday, September 9

08:15 – 09:00	**Keynote** *Miguel Vallejo* **Climate Change Monitoring through Remote Sensing Imagery and Processing** *Chair: Franz-Josef Behr*
09:00 – 10:10	**Technical Session: "Climate Change Monitoring through Remote Sensing Imagery and Processing"** *Chair: Dietrich Schröder* *Karuppasamy Sudalaimuthu and Karthik Karunakaran* **Thermal Dynamics in Agriculture: An In-depth Analysis of Land Surface Temperature and Its Impact on Crop Yield at Thanjavur, Tamil Nadu, India** *Neyit Peña* **Estimation of Tropospheric Water Vapor from GNSS Signals: Applications and Benefits of CORS Stations in Environmental Management and Sustainable Development** *Jose Luis Gutierrez Ossio* **Geoproccesing WorldClim maps using Python**
10:10-10:30	**Presentation of Sponsors**
10:30 – 11:00	*Coffee break*
11:00 – 12:30	**Technical Session: "Climate Change Monitoring through Remote Sensing Imagery and Processing" cont'd** *Chair: Kwame Obeng* *Michael Mutale* **Gender-Responsive Spatial Analysis of Climate Change - Impacts on Land Access and Use in Namibian Urban Areas** *Vithanage Primali Anuruddhika Weerasinghe and M.K.G.A.N. Senavirathne* **Assessing Long-Term Trends in Land Surface Temperature and Normalized Vegetation Index in Coastal Ecosystems: A Case Study of Kalpitiya Peninsula (1994–2024)** *Kaleb Gizaw Negussie, Daniel Wyss and Martin Kappas* **Modeling Future Streamflow under Climate and Land Use Scenarios in the Lower Okavango River Basin** *Naa Dedei Tagoe and Edward Martey* **Tracking Climate Variability for Rainfed Agriculture in Ghana Using Google Earth Engine: A Multi-Year Analysis (2015–2025)**

12:30 – 14:00	*Lunch*
14:00-15:30	**Workshop** *Paul Rawiel* **Assessing smartphone sensors for mobile data capturing and mapping** **Workshop** *Cindy Ferrucho y Martha Valbuena* **Subiendo la escalera espectral: un desafío geoespacial**
15:30-16:00	*Coffee break*
16:00-17:15	**Workshop cont'd** *Paul Rawiel* **Assessing smartphone sensors for mobile data capturing and mapping** **Workshop cont'd** *Cindy Ferrucho y Martha Valbuena* **Subiendo la escalera espectral: un desafío geoespacial**
18:00-20:00	**Alumni Session** • *Experiences after graduation abroad* • *Recommendations*

Wednesday, September 10	
08:15 – 09:00	**Keynote** *Dietrich Schröder* **Does AI plus Geoinformatics equal GeoAI ?** *Chair: William Barragán Zaque*
09:00 – 10:10	**Technical Session: "Geoinformation and Artificial Intelligence – current trends and applications"** *Chair: Miguel Vallejo* *Martha Patricia Valbuena Gaona, David Doncel Ballen and Rodrigo Alexander Hernandez Vargas* **Fuzzy Logic and Deep Learning for susceptibility zonification related to volcanic eruptions** *Gamage Sanka Nirodha Perera and Hetti Arachchige Nalani* **Enhancing Vertical Accuracy of readymade DEMs in Hilly Terrain Using LiDAR-Derived GCPs and Random Forest Regression** *Wagner Holguin* **MapBiomas Ecuador: Applying Machine Learning to Monitor Land Cover and Land Use Changes from 1985 to the Present**
10:10-10:30	**Presentation of Sponsors**
10:30-11:00	*Coffee break*
11:00 – 12:30	**Technical Session: "Geoinformation and Artificial Intelligence – current trends and applications"** *Chair: Michael Mutale* *Hetti Arachchige Nalani* **AI-Enhanced 3D Landcover Classification Using Fused LiDAR and UAV Images** *Kaleb Gizaw Negussie, Bisrat Haile Gebrekidan, Daniel Wyss and Martin Kappas* **Assessing land suitability for leguminous crops in the Okavango River basin: A multicriteria and machine learning approach** *Jorge Alberto Valero-Fandiño and Josue Medellin-Azuara* **Integrated Analysis of Groundwater Responses to Climate Change and Agricultural Water Demand Using AI and Geographic Modeling**

	Technical Session: "Application of Geoinformation" *Rafael Rebolledo Wueffer* **Remote sensing applied to spectral, soil and morphological characterization for archaeological prospecting purposes. A comparative study about Cerro Tusa and Morro de Tulcán, Colombia**
12:30-14:00	*Lunch*
14:00 – 15:30	**Technical Session: "Application of Geoinformation" cont'd** Chair: Primali Weerasinghe *Gillie Cheelo* **Approaches for measuring the accuracy of landscape metrics derived from remote sensed data in small scale agricultural areas of sub-Sahara Africa** *Muhtasimul Islam Rushdi, Angela Blanco-Vogt and Sourav Karmaker* **Interpreting ENVI-met Simulated Microclimate Data with Measured Observations in HFT Stuttgart** *Edwin Cortes* **Analysis Tool for Sustainable Land Resource Management Case Study: Municipality of Palmira, Valle del Cauca** *Hetti Arachchige Nalani and Gamage Sanka Nirodha Perera* **Multiscale Monitoring of Urban Green Space Dynamics and Heat Stress Using UAV and Satellite Data**
15:30-16:00	*Coffee break*
16:00-17:15	**Webinar** Chair: Franz-Josef Behr *Nicolas Luna and Joaquin Huerta* **From Blueprints to Digital Twin – A GIS-Based Smart Campus** *Amina Said* **Harnessing Deep Learning and Remote Sensing for Water Segmentation** *Elia Vani, Daniela Dalmonach, Elisa Clocolo, Gina Marano, Leonardo Bianchini, Paulina Puchi, Elisa Grieco, Alessandro Cescatti, Andrea Colantoni, Gherardo Chirici, Alessio Collati* **Stand age diversity (and more than climate change) affects forests' resilience and stability, although unevenly**
17:15-17:30	*Break*

17:30-19:00	*Fatemeh Rafiei, Angela Blanco-Vogt and Robert Hecht* **AI-based Enrichment of Building Data by Predicting Demographic Data** *Rupert Allan* **Mapping Climate Memory: Climate Justice, Indigenous Counter-Mapping, and OpenSource Empowerment in Arabic and Welsh Multi-Ethnic Language Outsider Communities** *Shahid Parvez* **ML Insights for Climate Change and Snow-melt Dynamics in Pakistan** *Nabila Abd El Hamed and Ali Aldosari* **Temporal Monitoring to Track the Health of Olive Trees and Increase Productivity Under Global Climate Change for the Assessment of Biophysical Parameters and Soil and Water Properties in the Tabarjal/Al-Bassita (Al-Jouf Region - SA) Using Sentinel-1& 2**

Thursday, September 11	
08:15 – 09:00	**Keynote** *Kwame Obeng* **Assessment of Land Degradation in Ghana's Densu River Basin using Residual Trend Analysis from 1991 to 2020** *Chair: Paul Rawiel*
9:00-9:45	**Keynote** *Chair: Paul Rawiel* *Siddhant Rohit Ullal and Ángela Blanco-Vogt* **Challenges and prospects for the sharing of geospatial information: A Case Study in Flood Risk Management**

09:45 – 10:30	**Technical Session „Data sharing and Collaborative Geoinformation Portals"** *Chair: Ángela Blanco-Vogt* *Franz-Josef Behr* **From Technocracy to Data Sovereignty, Open Data and Use of Open Source Geospatial Technologies** *Winhard Tampubolon* **The role of Geospatial Information Infrastructure for Large Scale Topographic Mapping Acceleration in Indonesia**
10:30 – 11:00	*Coffee Break*
11:00 – 12:30	**Technical Session „Climate Change Monitoring through Remote Sensing Imagery and Processing " cont'd** *Chair:* Karuppasamy Sudalaimuthu *Monica Alejandra Acosta Vega* **Multitemporal monitoring of cloud forest ecological restoration using remote sensing: evidence for local climate change adaptation** *Diana Catalina Blanco Figueroa and Neira Yolima Figueroa Galvis* **GeoASG - A SaaS Solution for Geo Data-Driven Sustainability Management** *Sooraj Nediya Parambath, Aleesha Fathima S L, Jaishanker R, Gopakumar V, Sajeev C Rajan and Vishnu M.* **Geospatial Approaches to Plant Invasion Risk under Climate Change: A Synthesis of Recent Advances (2020–2025)**
12:30-14:00	*Lunch*
14:00-15:30	**Workshop** *Hamidreza Ostadabbas* **Digital data acquisition using QField Cloud and QGIS**
15:30-16:00	*Coffee Break*
16:00-17:15	**Workshop cont'd** *Hamidreza Ostadabbas* **Digital data acquisition using QField Cloud and QGIS**
17:30-19:00	**Informal Gathering and Farewell** • *Commitments* • *Thanksgiving*

Friday, September 12

Excursion (optional)

Lake Guatavita

Lake Guatavita, nestled in the mountains near Bogotá, is a mystical and natural wonder steeped in ancient legend. Famous for inspiring the legend of El Dorado, it was a sacred site for the Muisca people, who offered gold to their gods in its waters. Its stunning scenery, rich cultural history, and spiritual significance make it a must-visit destination for travelers seeking nature, heritage, and mystery. Visiting Guatavita is a magical experience that blends breathtaking landscapes with the ancestral legacy of Colombia.

Salt Cathedral

The Catedral de Sal (Salt Cathedral) is a Catholic church located in a mine tunnel and tourist attraction in the salt mine of Zipaquirá, in the province of Cundinamarca, Colombia. It is the result of an architectural competition and features rich artistic decoration, particularly sculptures made of salt and marble. It is one of Colombia's outstanding architectural and artistic structures and has been awarded the title “Jewel of Modern Architecture” (Joya Arquitectónica de la Modernidad).

Keynotes

Advancing Geoinformation Sciences in Colombia: A Review of Two Years of Research Agenda Formulation

Wilmar Dario Fernández Gómez

After *Peace Agreement 2016,* new challenges in Land Administration and Land Tenure take relevance in Colombia. This document presents new perspectives on the challenges around land tenure in Colombia. We did three activities a SWOT analysis, a workshop on the research subject, and a literature review about the topics studied by the researchers. As a result, we found the internal and external relationships between Universidad Distrital, different actors, and trends in geoinformation science and land administration. For an efficient and reliable Land Administration System in the mid-term, Colombia needs articulation among different entities responsible for the different parts of the process. In that way, it is necessary to have an infrastructure for implementing multipurpose cadastre, tertiary roads, irrigation, electricity and connectivity, and areas of interest for conservation, which in Colombia are fundamental elements of the peace agreement for the comprehensive rural reform. After some efforts, there is a lack in the implementation due to allocation founding for diverse programs. In This way, it is necessary to provide the country with knowledge and information that integrates technical concepts, geospatial technologies, and data sources.

Climate Change Monitoring through Remote Sensing Imagery and Processing

Miguel Vallejo
Instituto Pirenaico de Ecología - Spanish National Research Council (CSIC)

Accurate and timely data are essential for developing strategies to mitigate and adapt to global climate change. Geospatial data, along with key satellite missions and platforms such as the European Space Agency's (ESA) Sentinel, NASA's Landsat, and commercial providers (i.e., Planet and Maxar), are indispensable for monitoring climate-related variables across large spatial and temporal scales. Advanced processing techniques, such as time-series analysis, change detection, and machine learning, enable remote sensing applications to monitor various climate change indicators and proxies, including vegetation health, land surface temperature, sea level, and glacier coverage. However, the field still faces significant challenges, including technological asymmetries, the balance between data resolution and coverage, the limited availability of ground truth datasets, and high computational requirements. Future developments highlight the importance of scientific diplomacy, data standardization, citizen science, and cloud-based analytics. Overcoming these limitations and innovating AI and Earth observation platforms could enable geospatial technologies to enhance climate resilience, promoting global and local responses to climate risks.

Does AI plus Geoinformatics equal GeoAI ?

Dietrich Schröder
University of Applied Sciences, Stuttgart, Germany

The concept of artificial intelligence can be traced back to our ancestors thousands of years ago. As with other cultures, the ancient Greeks introduced the concept of autonomous, human-like robots in their mythology. It was a long way from those ancient times to autonomous, AI-supported robots like the robot dog. Nowadays, AI applications are state of the art in the geoinformatics domain too – but can we really call it GeoAI?

This talk will first provide a brief overview of the key milestones in the development of AI and introduce the main concepts. Geoinformatics encompasses non-machine learning AI concepts such as cellular automata and agent-based models, particularly for simulation and prediction. Shallow machine learning concepts, such as ensemble decision trees (e.g. random forest) and boosting concepts (e.g. XGBoost), are also widely used for classification. For feature extraction and object detection in remote sensing, concepts of deep learning, such as Convolution Neural Networks (particularly as pre-trained models for standard tasks such as land cover classification or tree detection), are widely used. Geographic information systems (GIS), such as Esri's ArcGIS Pro or open-source GIS, such as QGIS, have integrated, user-friendly tools for preparing data for machine learning and accessing these models. However, the additional installation of Python-based libraries such as PyTorch, Fast.ai, TensorFlow, Torchvision or Keras is still required, and as each GIS version requires specific deep learning library versions, installation remains challenging.

But do the models actually utilise spatial concepts? In machine learning, in particular, incorporating the well-known characteristics of geographic phenomena — autocorrelation, heterogeneity, and similarity — remains challenging. While non-machine learning AI concepts make extensive use of neighbourhoods, which play a crucial role in cellular automata and agent-based models, machine learning models only make implicit use of them by using spatial data as input.

Machine learning concepts in geoinformatics also pose other challenges, such as hardware and GPU requirements, processing times and the need for large training data sets. Natural phenomena are often poorly defined and biased training data sets can result in features being overlooked or machine learning results being inexplicable.

General "Geo Foundation Models" or "Large Geo Models" similar to those in other fields are not at the horizon.

Assessment of Land Degradation in Ghana's Densu River Basin using Residual Trend Analysis from 1991 to 2020

Kwame Obeng
Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

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Land degradation is an activity that has a global effect on the environment and humanity. Sustainable Development Goal 15 of the 2030 Agenda focuses on the relationship between sustainable management of natural resources and social and economic development which further seeks good land management and its importance in assessing desertification, drought and land degradation. The need to ensure good land management necessitated this study. This study examined the effect of human activities and climatic variables (soil moisture and rainfall) on degradation using Residual Trend (RESTREND) Analysis and Ordinary Least Square (OLS) Regression model respectively in the Densu River Basin of Ghana from 1991 to 2020. From the OLS regression analysis, the impact of rainfall on degradation was located at the Northern to middle part covering about 35% of the study area with soil moisture having an effect throughout the basin. RESTREND based on rainfall and soil moisture both showed a negative trend predominantly at the Southern part of the study area indicating the presence of anthropogenic activities which was also confirmed from ground truthing. Both positive and negative trends are significant covering about 87% of the study area. The research will be useful to the various local government assemblies, environmental protection agencies and other stakeholders to monitor and preserve the natural resource base in the basin.

Challenges and prospects for the sharing of geospatial information: A Case Study in Flood Risk Management

Siddhant Rohit Ullal and Ángela Blanco-Vogt
University of Applied Sciences Stuttgart, Germany

The effective sharing of geospatial data is critical for modern governance, urban planning, and disaster resilience, particularly in the era of smart cities, AI, and IoT. However, systemic barriers like fragmented regulations, institutional silos, and incompatible data standards continue to hinder seamless data exchange. While technological advancements like digital twins and real-time sensor networks offer transformative potential, their benefits remain constrained by a lack of interoperability.

This study examines these challenges through a literature review, a case study of flood risk management (FRM) in Regensburg, Germany, as well as a prototype for analysing data flow interoperability. The study reveals how disjointed governance and outdated data practices impede effective decision-making. Despite decades of available technical solutions, flood response efforts remain hampered by proprietary systems, inconsistent data formats, and short-term fixes. The root cause is not a lack of technology, but rather a failure in governance. To address this, the paper presents an integrated FRM framework comprising five interlocking pillars and open standards.

Determination of Optimal Sites for Rain Water Harvesting (RWH) Structures in Kajiado Central, Kenya Using Long Short-Term Memory (LSTM) Networks

Charles Gaya and Christopher Oning
Jomo Kenyatta University of Agriculture and Technology

Kajiado County in Kenya is classified as semi-arid, experiencing high rainfall variability and frequent droughts that limit water availability. This study aimed to estimate rainfall-runoff relationships and identify suitable locations for rainwater harvesting systems in the Kajiado Central Subcounty using geospatial techniques. A Long Short-Term Memory (LSTM) neural network model was implemented to simulate daily discharge over 22 years (2000-2021) based on precipitation, and temperature, together with other meteorological parameters and catchment properties. The tuned LSTM achieved high performance with an R2 of 0.82 on test data. This demonstrates the capability of LSTM modelling for complex hydrologic processes. The LSTM can readily incorporate climate and land use change scenarios. A GIS-based multi-criteria evaluation integrated hydrological, infrastructure, land use, and terrain factors to determine rainwater harvesting suitability. Using weighted overlay analysis, 55% of the subcounty was classified as highly suitable, with appropriate slopes, clayey soils, and proximity to roads. However, about 15% was restricted by factors like steep slopes and sandy soils. The suitability mapping provides vital spatial guidance for rainwater infrastructure investments in this water scarce region. This integrated methodology, combining location intelligence and geospatial analysis, demonstrates a transferable framework to support water management in data-scarce regions. The LSTM reliably simulated catchment dynamics while the multicriteria GIS delineated priority zones balancing water yields and operational viability. This provides an objective foundation for planning that can incorporate stakeholder input and participation. The techniques quantitatively evaluate complex interconnections between climate, landscape, infrastructure, hydrology, and human needs, supporting sustainable and equitable water systems.

Keywords*: Climate Change, Water Resource Management, Rainwater Harvesting, LSTM Networks, Machine Learning, GIS*

Landslide Susceptibility Mapping of Sindhupalchok District, Nepal

Sanjeev Kumar Raut
Land Management Training Center, Ministry of Land Management, Co-operatives and Poverty Alleviations, Nepal

The district of Sindhupalchok in Nepal is characterized by complex topography and a history of devastating landslides, making it crucial to understand and mitigate landslide risks. This study focuses on landslide susceptibility mapping in Sindhupalchok using advanced geospatial techniques to provide valuable insights for risk assessment and management. Remote sensing data, including high resolution satellite imagery and digital elevation models, are utilized to extract relevant terrain parameters such as slope, aspect, curvature, and land cover. Geographic Information System (GIS tools are employed to integrate these parameters with historical landslide data and other influencing factors, including geological and hydrological characteristics. Validation model is performed using independent landslide inventories and statistical measures such as area under curve (AUC). The resulting landslide susceptibility map provides a spatial representation of areas at high, moderate, and low risk, aiding in the identification of vulnerable zones and supporting informed decision-making for land-use planning and disaster preparedness. This research contributes to the understanding of landslide dynamics in Sindhupalchok and serves as a valuable tool for local authorities, land planners, and emergency responders. The findings are essential for developing proactive measures to reduce the impact of landslides on communities and infrastructure in the region, ultimately enhancing resilience and sustainable development.

Keywords*: Geographic Information System, Landslide Hazard, Susceptibility, Weights*

Cartographic Assessment of Hurricane Iota Damage in Providencia Using Photogrammetry and Spatial Analysis

Luisa Fernanda Garzón Díaz, William Benigno Barragán Zaque, Juan David Méndez Niño, Jhon Fredy López and Emily Dayana Núñez Eguis

Universidad Distrital Francisco José de Caldas

During Hurricane Iota in November 2020, the islands of San Andrés and, especially, Providencia suffered severe damage to their infrastructure, homes, and natural ecosystems, such as mangroves. To document and analyze the impact of the event, a photogrammetric survey was conducted using a WingtraOne drone equipped with a 43-megapixel full-frame camera and a multispectral camera. This equipment provided high-resolution aerial images that demonstrate the magnitude of the destruction in both urban and sensitive natural areas.

The presented work describes the processing of this information to generate precise cartography using three-dimensional stereoscopic models. This technique made it possible to observe the structural collapse of the homes in detail, as well as visually and metrically quantify the deposited materials, such as construction debris and solid waste. Environmental damage was also characterized, particularly in mangrove areas, which play a crucial role in local climate regulation and coastal protection.

It is suggested that the alteration of these ecosystems, coupled with the deposition of debris and waste in sensitive areas, could have significant implications for the region's environmental and climatic conditions, affecting the resilience of coastal ecosystems to future extreme events.

The final stage of the study focused on developing a detailed map of the inhabited area of Providencia Island. This map served as the basis for implementing an automatic damage quantification process using spatial analysis and computer vision techniques, achieving an accurate and efficient estimate of the degree of impact. The results obtained contribute significantly to reconstruction planning, risk management, and post-disaster environmental monitoring efforts.

Keywords: *Hurricane Iota, Providencia Island, Disaster impact assessment, High-resolution imagery, Unmanned aerial vehicles (UAVs), Coastal ecosystems, Mangrove degradation*

Urban Sprawl Detection and Land-Use Conflict Assessment in Santa Tecla Using Spectral Indices and Hybrid Machine Learning Classification of Sentinel-2A Data

Metzi Aguilar

Universidad Centroamericana José Simeón Cañas, El Salvador

This study evaluates the effectiveness of combining spectral indices to accurately delineate urban sprawl and identify land use conflicts in the municipality of Santa Tecla in El Salvador using remote sensing and machine learning techniques. Sentinel-2A satellite imagery was used to calculate the Normalized Difference Vegetation Index (NDVI) and the Normalized Difference Built-up Index (NDBI), which were then integrated into a hybrid classification approach combining unsupervised and supervised classification methods. This methodology enables precise mapping of urban expansion and facilitates the detection of inconsistencies between observed land use and existing regulatory planning instruments. The results indicate that the combined use of these indices significantly improves the identification of urban areas and associated land use conflicts, while reducing the need for extensive manual inspection. Moreover, the study identified land use conflicts, which are consistent with previous research highlighting a lack of planning largely due to the flexibility of regulatory planning instruments, thereby increasing socio-spatial vulnerabilities. Since the study was conducted using open source and free (libre) tools, it can be readily replicated, providing the basis for developing a generic methodology to monitor the spatio-temporal process of urbanization in the municipalities of the metropolitan area of San Salvador using open satellite images and current regulatory planning instruments as reference.

Keywords: Remote sensing, Machine learning, Urbanization, Unsupervised Classification, Supervised Classification

Multiscale Monitoring of Urban Green Space Dynamics and Heat Stress Using UAV and Satellite Data

Hetti Arachchige Nalani and Gamage Sanka Nirodha Perera
Sabaragamuwa University, Sri Lanka

Urban green spaces play a vital role in mitigating the impacts of climate change by regulating urban temperatures, enhancing air quality, and reducing the Urban Heat Island (UHI) effect. However, rapid urbanization and climate shifts are causing significant green space loss, leading to increased urban heat stress in cities. This study presents an integrated assessment of urban green space dynamics and associated heat stress using both Unmanned Aerial Vehicle (UAV) imagery and satellite remote sensing data. High-resolution UAV imagery were used to map the current distribution of urban green spaces, while historical changes were analyzed using vegetation indices (NDVI) derived from Sentinel-2 and Landsat imagery. Land Surface Temperature (LST) data extracted from Landsat thermal bands were utilized to map heat stress patterns over time. Geospatial analysis techniques, including regression analysis and zonal statistics, were applied to examine the relationship between green space loss and rising temperatures, and to identify critical urban hotspots. The study focuses on Colombo urban area, Sri Lanka, experiencing rapid development and climate challenges. The results provide valuable insights for urban planners and policymakers to design climate-adaptive strategies and promote sustainable urban growth. By integrating UAV and satellite data at multiple scales, the study offers a practical, data-driven approach to monitor and manage urban environmental health. On average, 86% of the urban area exhibited a surface urban heat island (HI), while most surface urban freshness islands were located near watercourses, parks, slopes, and valley bottoms, highlighting the influence of green areas and topography on the creation of microclimates. The HI demonstrated significant seasonal variability. Further improvements can be achieved by integrating UAV thermal imagery and LiDAR point clouds with the aid of AI techniques.

Keywords: *Remote Sensing Data, UAV, Urban Green Space Dynamics, Heat Stress*

Drought Monitoring in Coastal Agricultural Zones of Tola, Nicaragua Using Open-Source Satellite Data

Emerson Javier Martinez Garcia

Drought is one of the most pressing climate challenges in Central America, increasingly threatening smallholder agriculture and local water supplies. This project presents a practical, open-source methodology for monitoring drought dynamics in Tola, Rivas, Nicaragua — a coastal municipality highly dependent on seasonal rainfall for its agricultural activities. By relying exclusively on freely available satellite data and Python-based tools, the approach is designed to be both accessible and replicable in data-scarce regions.

Sentinel-2 imagery is used to generate monthly time-series of vegetation indices such as the Normalized Difference Vegetation Index (NDVI), Vegetation Condition Index (VCI), and Standardized Vegetation Index (SVI). In parallel, CHIRPS precipitation data is incorporated to track rainfall trends and anomalies, providing a deeper understanding of vegetation stress observed in satellite imagery.

The workflow involves clipping and preprocessing imagery over Tola, computing monthly NDVI composites for 2015–2024, deriving VCI and SVI to assess drought severity, and cross-analyzing vegetation stress against rainfall anomalies.

The project will deliver:

1. Vegetation and drought severity maps, updated monthly.

2. Precipitation anomaly maps to track deficits.

3. Time-series graphs linking vegetation health to rainfall.

4. Zonal statistical summaries to pinpoint vulnerable farming areas.

These outputs aim to equip Tola's local authorities with clear, actionable insights to detect early drought signals, prioritize at-risk communities, and support adaptation planning. The project directly supports the mission of the AGSE 2025 Conference, demonstrating how applied geoinformatics and open science can help address climate challenges at the local scale, while advancing progress toward the Sustainable Development Goals.

***Keywords**: Drought monitoring, detecting and mapping vegetation stress, Sentinel2, CHIRPS, NDVI, VCI, SVI, open source GIS, climate change adaption*

GNSS Space Geodesy and its Contribution to Society and the Understanding of Earth Dynamics in Colombia: Achievements and Challenges

Hector Mora-Paez and Jose-Fernando Mejia-Correa

Universidad Manizales, Colombia

The northwestern corner of South America, where Colombia is located, as well as southeastern Central America and the Caribbean region, correspond to the interaction of the South American, Nazca, Cocos, and Caribbean tectonic plates and the Northern Andes, Panama, Chocó, Maracaibo, and Bonaire tectonic blocks, wedged within these plates. This is reflected in a high tectonic and geographic complexity, represented by interplate and intraplate deformation, widely distributed earthquakes, as well as a region prone to large earthquakes in the subduction zone, a high density of geological faults, volcanic eruptions, landslides, floods, and subsidence, which have impacted Colombia and neighboring countries. In this sense, conceptual advancements, improved instruments, the emergence of new space-based geodetic applications, and the production of new geodetic products and services have expanded the range of applications in topics related to Earth dynamics, thus transcending different fields of study in Earth sciences at the global, regional, and local levels. The initial conception is based on the understanding that the Earth is a planet with processes occurring within, on, and outer of it, which are related to various phenomena inherent to its dynamics and can be measured and monitored through geodetic observations. This requires a geodetic infrastructure that allows the gathering of good quality geodetic data, as well as computational systems that process the data and generate geodetic inputs for various applications. Since several years ago, Colombia has been implementing, through the leadership of government institutions, continuously operating GNSS geodetic stations-cGNSS. These stations have permitted obtaining products related to the Earth's crustal deformation, providing data for both cadastral surveys and updating the cartographic products, and also providing the geodetic community with different applications. However, several challenges arise regarding the use of cGNSS station data, among them, for atmospheric studies of both the ionosphere and troposphere layers, sea level, and other aspects that will allow the generation of new knowledge about the Earth's dynamics in this part of the world. In this context, an additional purpose is the use of artificial intelligence methods, in a first approach, for ionospheric studies. Therefore, the University of Manizales has installed a station for this purpose, through international cooperation. This article presents the achievements made in Colombia through the use of GNSS space geodesy data for various purposes and also the challenges that must be addressed by expanding potential applications to improve the knowledge of the Colombian territory in the solid, liquid, and atmospheric Earth using geodetic data.

Keywords: *GNSS, Crustal strain, Disaster risk management, Ionosphere*

Multitemporal Monitoring of Subsidence in Bogotá D.C. Using PS-InSAR Techniques: Geoinformatics Integration for Sustainable Urban Management

Paola Andrea Suarez Jaimes, Edilberto Suárez Torres and José Luis Herrera Escorcia

Universidad Distrital Francisco José de Caldas, Facultad de Ingeniería

Land subsidence poses a significant challenge to urban sustainability, particularly in Bogotá D.C., which suffers from the overexploitation of groundwater and the rapid, inadequately planned growth of the city. This research applies PS-InSAR methodologies to study surface uplift and subsidence in Bogotá during the 2022–2023 period. Using Sentinel-1 imagery, approximately 2.6 million persistent scatterer points were obtained, allowing the identification of subsidence rates (LOS) of up to 7.5 cm/year in key industrial and residential areas. These results were corroborated with geotechnical and land-use data to define deformation patterns potentially caused by subsurface structures and human interaction in the area. Deformation and its temporal behavior were studied through interferometric processing, which, when combined with spatial-geopositional analysis, formed the foundation of the research. The development of this technique enabled systematic and continuous monitoring—an essential input for adjusting and updating urban planning and risk management models—reaffirming the utility of PS-InSAR. This geoinformatics approach is valuable for developing early warning systems, mitigation strategies, and resilient cities, thereby modernizing urban management. Integrating the PS-InSAR technique in urban monitoring alongside cadastral information, urban regulations, and geotechnical models will significantly enhance spatial planning decision-making. This research contributes to the design of open-data early warning systems using Earth observation techniques tailored for Latin American cities.

Keywords: *Subsidence, PS-InSAR, geoinformatics, ground deformation*

Dealing Dengue Fever with Drone Technology

Md Zahid Hasan Siddiquee

Institute of Water Modelling, Bangladesh

Dengue fever has escalated into a severe public health crisis in Dhaka, Bangladesh, with record-breaking outbreaks in recent years. In 2023 alone, Bangladesh reported 321,179 confirmed cases and 1,705 deaths—a dramatic surge from 62,382 cases and 281 deaths in 2022 (DGHS, Bangladesh). As Dhaka accounted for over 60% of national cases, the urgency for innovative vector control strategies is clear. This study explores the application of unmanned aerial vehicles (UAVs) to rapidly identify Aedes aegypti breeding grounds in selected urban areas of Dhaka during 2019. UAVs offer distinct advantages over traditional ground surveys, including efficient coverage of large or inaccessible areas, very high-resolution spatial data acquisition, and reduced human resource demands. Aerial imagery was processed using advanced analytical techniques to detect potential breeding habitats, such as waterlogged flowerpots, rooftop tires, and stagnant water pockets in building crevices. The analysis provided spatially explicit insights into the distribution of breeding sites, with high-resolution imagery enabling the identification of even small, overlooked water-holding containers critical for targeted interventions. The results demonstrate UAVs' potential to deliver timely, comprehensive data to Dhaka City Corporation, empowering data-driven vector control efforts. By optimizing resource allocation and precision, this approach could significantly reduce dengue transmission and mitigate future outbreaks, ultimately saving lives in a city repeatedly crippled by the disease.

Keywords: *Dengue Fever, Unmanned Aerial Vehicles, Photogrammetry, Geoinformatics, Publish Health*

Multi-Criteria Proposal Model for Forest Fire Prediction Based on the Use of Information Processed in AI and the Role of Quantum Sensors in Colombia

Paula Campos and William Benigno Barragán Zaque

Universidad Distrital Francisco José de Caldas

Climate change has intensified forest fires globally, affecting ecosystems and communities. High temperatures, prolonged droughts and alterations in precipitation have created conditions conducive to the spread of fire, increasing CO_2 emissions and exacerbating global warming. Although current satellite sensors allow mapping hot spots and modeling forest fuels, their low-resolution limits early detection. In response, European projects such as SenForFire implement low-cost wireless sensor networks and artificial intelligence to generate automatic alerts and more accurate predictive models. In parallel, the Quantum Flagship program is promoting high-precision quantum sensors useful in environmental monitoring. These sensors, under development by institutions such as the Fraunhofer Institute and European universities, can detect minute variations in temperature, humidity and gases, even in extreme conditions. Their application in Colombia promises to strengthen fire prevention and response through integration with GIS, AI and early warning

Keywords: *Forest fires, Climate change, Quantum Sensors, Environmental monitoring, Early detection*

Thermal Dynamics in Agriculture: An In-depth Analysis of Land Surface Temperature and Its Impact on Crop Yield at Thanjavur, Tamil Nadu, India

Karuppasamy Sudalaimuthu and Karthik Karunakaran

SRM Institute of Science and Technology, India

Climate change has emerged as a significant challenge to global agriculture, food security and sustainability. The rising temperature, shifting precipitation patterns, and increasing frequency of extreme weather events have disrupted traditional farming practices, particularly in climate-sensitive regions like Thanjavur, Tamil Nadu. The study underscores the critical role of Landsat thermal data in agricultural forecasting, ensuring a sustainable and secure food supply in the face of climate change. This study investigates the relationship between historical satellite-derived Land Surface Temperature (2001-2023), combined with field-based crop yield records using multiple machine learning techniques including Random Forest (RF), Artificial Neural Networks (ANN), and Geographically Weighted Regression (GWR), to determine the most accurate model for yield estimation. By comparing these models, the research identifies key environmental factors influencing rice production and assesses the impact of temperature anomalies on crop health. The thermal response of paddy fields is analyzed to understand seasonal variability and long-term trends in rice yield under different climatic conditions. The impact of climate change on these crops is assessed using similar machine learning models to predict yield variations and recommend climate adaptation strategies. The research findings align with global efforts to enhance agricultural resilience and contribute to Sustainable Development Goals (SDG) 2 (Zero Hunger) and SDG 13 (Climate Action). The findings of this study provide valuable insights for policymakers, agronomists, and farmers to develop data-driven strategies for improving agricultural sustainability. By integrating remote sensing and machine learning, policymakers can formulate climate adaptation strategies, optimize water resource management, and promote precision agriculture to mitigate climate risks. Additionally, the research underscores the importance of early warning systems and climate-resilient crop varieties, which can be promoted through government interventions and agricultural policies to ensure food security and sustainable farming practices. The integration of IoT-based smart farming and GIS-driven decision support systems could further enhance precision agriculture and resilience strategies in the face of climate variability.

Keywords: *Thermal Dynamics, Climate Change, Land surface Temperature*

Estimation of Tropospheric Water Vapor from GNSS Signals: Applications and Benefits of CORS Stations in Environmental Management and Sustainable Development

Neyit Peña

Universidad Distrital Francisco José de Caldas y Cuatro Conceptos S.A.S.

As part of the National Multipurpose Cadaster policy led by the Agustín Codazzi Geographic Institute (IGAC), the project for the densification of the MAGNA-ECO National Geodetic Network (National Geocentric Reference Framework Continuous Stations) is being implemented through the installation of Continuous Operating Reference Stations (CORS) in various municipalities across the national territory. These GNSS stations are gaining growing relevance beyond their traditional applications in geodesy and surveying. One of their lesser known yet highly promising contributions lies in their ability to provide precise and continuous data for the estimation of precipitable water vapor (PWV), a key atmospheric variable in weather forecasting, risk management, and climate studies. This article presents the results of an applied study conducted as part of an undergraduate internship in Topographic Engineering, focusing on the estimation of PWV from GNSS observations recorded at a CORS station located in the municipality of Cumaribo, Vichada. The project is embedded within the broader effort to densify the MAGNA-ECO National Geodetic Network, under the leadership of IGAC and primarily executed by the Research, Development, and Innovation Unit (R+D+i) of the company Cuatro Conceptos S.A.S, officially recognized by resolution of the Ministry of Science and Technology.", which has played a pivotal role in deploying CORS infrastructure nationwide through an efficient industrial construction model.

The findings, along with the development of an educational learning guide, and the implementation of a knowledge transfer process tailored to rural contexts, underscore how these technologies can empower rural, indigenous, and afrodescendant communities to better respond to contemporary environmental challenges.

Keywords: *National Geodetic Network, Continuous Operation Reference Stations, GNSS, Tropospheric Water Vapor, Zenith Hydrostatic Delay, Meteorology, Knowledge Transfer*

Geoprocessing WorldClim maps using Python

Jose Luis Gutierrez Ossio

Nowadays, around the world and among the scientific community and society, there is almost a general consensus that climate change is present and affecting all, but especially those under-developing countries and low-income populations, which do not have enough resources to tackle the impacts of climate change. It is necessary to have historical meteorological data in order to define a strategy to adapt to climate change to avoid the most pervasive effects of the heat waves, more severe storms, increased droughts, loss of species, food insecurity, health risks, poverty, and displacements. Unfortunately, historical meteorological data coming from weather stations are not appropriate, especially in developing countries, due to the low density of stations and gaps in the recorded data.

During the past decades, international institutions and universities have been working to overcome the problem of lack of weather data, developing methods and generating raster maps from remote sensing, radar systems, and data assimilation models that provide society with free data for developing and adapting agriculture, risk assessment, water resources management, disaster management, and early warning systems. Usually for developed countries, their meteorological services assume the challenge of providing the historical, present, and future meteorological data for their territory; on the contrary, for most developing countries, the only source of the mentioned data comes from institutions that generate data for the whole planet. One of those institutions is the University of California, where WorldClim data was developed.

WorldClim provides gridded climate data (raster format) based on observed data from weather stations around the world, interpolated to create continuous surfaces. It's managed by the Climatic Research Unit (CRU) and the University of California, Berkeley. The spatial resolutions range from about 10 minutes (~340 km²) to 2.5 minutes (~21 km²). The temporal coverage on the updated version includes 1960-2021 for minimum and maximum temperature and precipitation.

For the historical monthly weather data, the one it will be used for, the lowest spatial resolution available is 2.5 minutes (~21 km² at the equator) for the period 1960 to 2021 (62 years). Seven “zip” files must be downloaded; the first six files contain 120 GeoTiff files, for each month of the year, for a 10-year period. The last one contains 24 files. Each download must be for the maximum and minimum temperatures, and precipitation.

Because of the high number of GeoTiff files to work with, the use of conventional GIS software, such as QGIS, is not efficient, since it is required to work in batch mode. Since Python is usually used in the GIS arena, it was selected to carry out the geoprocessing of the historical weather data of WorldClim with the help of packages such as GDAL, NUMPY, PANDAS, and MATPLOTLIB, to mention some of them. Since most of the territories of developing countries lack historical weather data, this study could give the monthly weather information for the whole country with a given data of the correlation between WorldClim and the collected ground weather station, which gives an idea of the accuracy of the generated data. So far, the historical daily weather information, which is most required for detailed hydrological studies, is not publicly available, but the methodology presented could be used, with small modifications, when it is available.

Keywords: *Geoproccessing, Batch processing, Weather data, WorldClim, Adaptation to climate change, Water management*

Gender-Responsive Spatial Analysis of Climate Change Impacts on Land Access and Use in Namibian Urban Areas

Michael Mutale

Copperbelt University, Zambia

Despite the existence of progressive legal frameworks in Namibia, gender-based disparities in the access to and utilization of urban land continue to persist, further intensified by the escalating impacts of climate change. The prevailing urban planning and climate adaptation strategies are deficient in comprehensive gender-responsive spatial analysis frameworks, resulting in policies that inadequately address the specific vulnerabilities and requirements of women within urban environments. Although there has been an increase in research focusing on gender-responsive methodologies concerning environmental issues and land accessibility on a global scale, the intersectionality of these themes within the urban context of Namibia remains insufficiently explored, particularly with respect to the incorporation of spatial analysis tools to confront these challenges.

This research endeavour seeks to formulate a gender-responsive spatial framework aimed at analysing and addressing the impacts of climate change on urban land access and utilization in Windhoek, Namibia. Utilizing Feminist Political Ecology as the theoretical underpinning, the study employs a mixed-methods approach that integrates sophisticated spatial analysis techniques with stakeholder engagement. The methodological framework encompasses gender-disaggregated mapping of land access patterns, spatial analysis of climate change ramifications, and the development of GIS-based instruments for gender-responsive urban planning. Engagement with stakeholders through interviews, focus groups, and participatory mapping activities guarantees robust representation of women and marginalized communities, thereby capturing local insights on gender-specific land use dynamics and climate impacts.

Anticipated outcomes include comprehensive gender-disaggregated maps that delineate areas of inequality, spatial models that depict the gendered consequences of climate change on urban land, and a GIS-based framework for gender-responsive climate-adaptive urban planning specifically tailored to the Namibian context. The research will also yield policy recommendations aimed at integrating gender considerations into urban land governance and climate adaptation strategies.

The findings are expected to enrich both theoretical discourse within Feminist Political Ecology and practical policy implementations, equipping urban planners and policymakers with evidence-based tools for fostering more inclusive decision-making processes. This research aspires to exert influence on Namibian urban planning policies by presenting a replicable methodology for gender-responsive spatial analysis, ultimately facilitating the advancement of more equitable and climate-resilient urban development. The outcomes of the study will hold particular significance for other African urban centres grappling with similar obstacles in addressing gender disparities in urban land access while concurrently striving to enhance climate resilience.

Keywords: *Gender, climate change, urban planning, spatial analysis, GIS, Namibia*

Assessing Long-Term Trends in Land Surface Temperature and Normalized Vegetation Index in Coastal Ecosystems: A Case Study of Kalpitiya Peninsula (1994–2024)

Vithanage Primali Anuruddhika Weerasinghe and M.K.G.A.N. Senavirathne

University of Kelaniya, Sri Lanka

Climate change and land-use modifications significantly impact local temperature dynamics, particularly in coastal ecosystems. The interaction between vegetation and land surface temperature (LST) is useful for understanding the effects of climate change and urbanization on ecosystem sustainability. The Kalpitiya Peninsula, known for its ecological diversity and human settlements, has experienced significant land-use changes over the past three decades. This study aims to investigate the temporal trends and correlations between LST and the Normalized Difference Vegetation Index (NDVI) from 1994 to 2024, providing insights into the impacts of vegetation loss on temperature dynamics. Landsat imagery from 1994, 2004, 2014, and 2024 was downloaded from the United States Geological Survey (USGS) platform and was processed using ArcGIS 10.8 software to derive LST and NDVI values. Statistical analyses, including Spearman's correlation and trend assessments, were conducted to quantify the relationship between these parameters. Results indicate a significant increase in average LST from 28.03°C in 1994 to 36.53°C in 2024, marking an 8.5°C rise over three decades. NDVI values initially increased from 0.178 (1994) to 0.240 (2014) but declined to 0.206 by 2024, reflecting vegetation loss. The LST-NDVI correlation weakened from -0.48 in 1994 to -0.22 in 2024, suggesting that factors beyond vegetation loss, such as urbanization and land-use change, increasingly contribute to temperature rise. These findings highlight the urgent need for sustainable land management strategies, afforestation, and climate adaptation measures to mitigate surface warming in Kalpitiya. Future research integrating higher-resolution data and climate models could enhance the understanding of localized climate variability and inform conservation efforts.

Keywords: *Land Surface Temperature, NDVI, Landsat, Climate Change, Urbanization, Kalpitiya*

Modeling Future Streamflow under Climate and Land Use Scenarios in the Lower Okavango River Basin

Kaleb Gizaw Negussie[1], Daniel Wyss[2] and Martin Kappas[2]

[1] Department of Land and Spatial Sciences, Namibia University of Science and Technology, [2] Department of Cartography, GIS and Remote Sensing, Georg-August University Göttingen

This study investigates the long-term impacts of climate change and land use/land cover (LULC) dynamics on streamflow within a transboundary section of the lower Okavango River Basin, spanning northeastern Namibia and southern Angola. Employing the SWAT+ hydrological model, we simulated historical and future hydrological responses under combined scenarios of climate and LULC change using four CMIP6 general circulation models (GFDL-ESM4, IPSL-CM6A-LR, MPI-ESM1-2-HR, NorESM2-MM) and 1-km resolution global land projection datasets. The model was calibrated and validated with historical streamflow data at Rundu, achieving reliable performance statistics. Future scenarios—spanning the periods 2025–2040, 2041–2070, and 2071–2100—were run under moderate (SSP2-4.5) and high (SSP5-8.5) emission trajectories.

Results indicate a consistent decline in precipitation and an amplified reduction in streamflow, with peak runoff periods significantly shortened and dry-season flows nearing collapse by 2100. Model projections show strong agreement in the direction of change, particularly in the latter half of the century. Parallel LULC projections reveal a rapid loss of wetland and natural vegetation, coupled with an expansion of cropland and urban areas—particularly around Rundu. These land use transitions further intensify hydrological losses by reducing infiltration capacity and enhancing surface runoff.

Water yield simulations reflect this compounding impact, with historically high-yield zones gradually shrinking and nearly disappearing by the end of the century. The study highlights the disproportionate sensitivity of streamflow to both upstream rainfall and local land management, underscoring the urgent need for coordinated adaptation strategies. Findings provide critical insight for water resource managers and policymakers aiming to address long-term water security and ecological stability in one of Southern Africa's most vulnerable transboundary river systems.

Keywords: *Climate change, Land use land cover change, Streamflow simulation, SWAT+ model, Okavango River Basin, CMIP6, Water yield, SSP scenarios, Semi-arid hydrology*

Tracking Climate Variability for Rainfed Agriculture in Ghana Using Google Earth Engine: A Multi-Year Analysis (2015–2025)

Naa Dedei Tagoe[1] and Edward Martey[2]

[1] University of Mines and Technology, [2] CSIR-Savanna Agricultural Research Institute

Ghana's agricultural sector remains highly dependent on rainfed cultivation due to the limited reach of irrigation infrastructure. As a result, farmers are increasingly vulnerable to shifting rainfall patterns and unpredictable weather conditions, which threaten crop yields and food security. This study presents the development and application of a cloud-based climate monitoring tool, built on Google Earth Engine (GEE), to analyse spatiotemporal climate dynamics across Ghana from 2015 to 2025. The system focuses on tracking rainfall onset and cessation, soil moisture suitability, temperature variation, and rainfall variability to support climate-resilient agriculture and early warning systems. The tool integrates multi-source geospatial datasets, including Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) data for precipitation, TerraClimate for temperature, MODIS Normalized Difference Vegetation Index (NDVI) for vegetation dynamics, and NASA's Soil Moisture Active Passive (SMAP) for soil moisture. Rainfall onset and cessation are computed annually using agro-meteorological thresholds. The system further analyses monthly maximum and minimum temperatures, diurnal temperature range (DTR), and computes the coefficient of variation (CV) for annual rainfall to detect areas with high climatic instability. Soil moisture was assessed using an HWSD-based suitability index and NASA SMAP-derived surface moisture trends, allowing the identification of periods of moisture stress or retention, which is particularly useful in near-real-time monitoring for rainfed zones. Additional data layers on elevation provide localized context for climate risk assessments.

The platform includes an interactive dashboard where users can click on a point or upload shapefiles to generate detailed time series charts for selected clusters. Drop-down filters support custom exploration of rainfall and temperature trends by year or variable, while export features allow downloading of cluster-level statistics for further analysis or integration into decision support systems.

Findings from selected clusters confirm strong seasonal and interannual climate variability. Maximum temperatures regularly exceed 38°C in northern zones, while DTR values above 14°C persist throughout the year. Rainfall charts reveal delayed onset, sharp seasonal peaks, and high CV values in the northern interior, indicating elevated climate risk. Cluster-specific visualisations also highlight spatial differences in thermal stress and moisture availability, which are critical for planning resilient, rainfed agricultural interventions.

This paper aligns with the AGSE 2025 Theme Day on "Climate Change Monitoring through Remote Sensing Imagery and Processing", demonstrating the application of Earth observation data for monitoring rainfall, temperature variability, and soil moisture in support of climate-resilient planning in rainfed agricultural systems.

Keywords: *Rainfed Agriculture, Climate Variability, Rainfall Onset and Cessation, Soil Moisture Monitoring, Google Earth Engine, Diurnal Temperature Range, Spatiotemporal Analysis*

Multitemporal monitoring of cloud forest ecological restoration using remote sensing: evidence for local climate change adaptation

Monica Alejandra Acosta Vega

Cloud forests are strategic ecosystems, vital due to their high biodiversity and their key role in water regulation. In Colombia, these forests face growing threats such as deforestation and land-use change, which compromise essential ecosystem services: regulation of the hydrological cycle, erosion control, carbon sequestration, and local microclimate regulation. These functions are critical for local climate change adaptation, making it urgent to promote and assess ecological restoration processes that aim to recover them.

In this context, an ecological restoration process was initiated in 2011 with the support of the local community in the village of Prado (Facatativá, Cundinamarca), on land previously degraded by grazing and erosion. The initiative has aimed to restore the ecological functionality of the cloud forest. However, despite visually evident improvements, no quantitative assessments had been conducted to measure the ecological impact and, in particular, the hydrological recovery of this effort.

This study addresses that gap through a multitemporal analysis (2011 - 2025), using freely available satellite imagery from Landsat (5, 7, 8) and Sentinel-2, processed in Google Earth Engine. Several biophysical indices are applied to evaluate the restoration process: NDVI and EVI for vegetation vigor; NDMI and NDWI for canopy moisture and surface water; LAI as a proxy for biomass; and SMI (based on Sentinel-1 radar data) for soil moisture. These indices allow for the spatiotemporal analysis of key variables from the beginning of the process, comparing the state of the area before, during, and after the intervention, and evaluating trends and improvements over time. Despite the technical challenges posed by the persistent cloud cover typical of these forests, the combination of remote sensing and local knowledge allows obtaining reliable data.

This quantitative analysis provides objective evidence of the positive impact of ecological restoration on the functional recovery of the ecosystem, supporting informed decision-making and encouraging future restoration initiatives. Thus, the integration of remote sensing data with local knowledge emerges as a strategic tool to drive nature-based solutions that contribute to climate change adaptation in highly vulnerable strategic ecosystems.

Keywords: *Cloud forests, Ecological restoration, Remote sensing, Climate change adaptation, Multitemporal analysis, Ecosystem services, Google Earth Engine, Sentinel, Landsat, NDVI, NDWI*

GeoASG: A SaaS Solution for Geo Data-Driven Sustainability Management

Diana Catalina Blanco Figueroa and Neira Yolima Figueroa Galvis
Sistemas Sostenibles SAS, Colombia

Effective sustainability management increasingly relies on geospatial intelligence to ensure traceability, transparency, and accountability across Environmental, Social, and Governance (ESG) frameworks. This article presents the design, development, and early implementation of GeoASG, a SaaS-based platform currently being piloted in a pharmaceutical corporation to validate its operational scalability and sectoral adaptability. Despite advances in geoinformatics and data science,
many organizations—particularly in Latin America—still struggle with fragmented, inaccessible, or siloed ESG data. These gaps hinder accurate diagnostics, risk assessment, compliance monitoring, and the design of resilient sustainability strategies.
This study aims to develop and present a theoretical and methodological framework for integrating geospatial intelligence into sustainability management processes through the GeoASG platform. By addressing challenges related to data fragmentation, accessibility, and ESG data governance, the project seeks to support organizations, especially those with limited resources, in adopting evidence based, scalable, and interconnected decision-making models that enhance sustainability outcomes in Latin America and beyond.
As part of the practical implementation, the development of a Minimum Viable Product (MVP) is proposed using technologies such as Angular and Node.js to build dynamic web interfaces and backend services, respectively. The integration of geospatial tools such as GeoNode and ESRI, a suite of industry-leading solutions for spatial analysis used to model, monitor, and project sustainability scenarios with high precision, is also planned. This MVP will serve as a starting point for scaling a comprehensive platform that drives evidence-based sustainability management, particularly in regions facing technical and financial constraints.

This paper outlines the foundations of a theoretical and methodological framework for geospatial information for sustainability and highlights the challenges of data integration, interoperability, and governance. It advocates for the democratization of geospatial technologies beyond expert domains to empower organizations with limited technical or financial resources.

GeoASG is a SaaS-based platform designed to facilitate ESG data capture, integration, and visualization. It offers a conceptual and operational framework to make geospatial sustainability tools
more accessible, actionable, and scalable. In this context, GeoASG aims to break down silos by integrating environmental, social, and governance data to enable more strategic and connected decision-making. To inform the development and validation of this framework, a stakeholder survey involving 85 companies operating in Latin America was conducted, identifying barriers, priorities, and expectations regarding geospatial ESG solutions. These companies helped refine GeoASG's functionalities based on their evolving needs, allowing for measurable improvements in their internal processes, decision-making, and sustainability outcomes. Furthermore, the platform is scheduled for pilot implementation in a pharmaceutical company to further validate its operational scalability and sectoral adaptability.

Keywords: *Geospatial Intelligence, Sustainability Management, Data Integration, Digital Transformation, SaaS Platforms, Latin America, Interoperability, Open Access Data, Stakeholder Engagement. Minimum Viable Product (MVP), Spatial Data Management*

Geospatial Approaches to Plant Invasion Risk under Climate Change: A Synthesis of Recent Advances (2020–2025)

Sooraj Nediya Parambath, Aleesha Fathima S L, Jaishanker R, Gopakumar V, Sajeev C Rajan and Vishnu M.
Kerala University of Digital Sciences, Innovation and Technology (Digital University Kerala)

Climate change is altering ecological boundaries, creating conditions that enable invasive alien species to spread and thrive in areas that were previously unsuitable or unoccupied. Multi-pronged approaches are widely utilized to analyse the distribution, dynamics, and risk of biological invasions across spatial and temporal scales. This synthesis examines the application of remote sensing and geospatial techniques to assess and predict plant invasion risks under different climate change scenarios. Fifty peer-reviewed articles were selected from the Scopus and Web of Science databases, published between 2020 and 2025, based on the inclusion and exclusion criteria. The review focuses on the integration of satellite data, GIS-based approaches, and species distribution models (SDMs), especially those incorporating future climate projections such as Representative Concentration Pathways (RCPs) and Shared Socioeconomic Pathways (SSPs). Key trends identified include the growing use of high-resolution imagery, advancements in geospatial techniques, machine learning for distribution and risk modelling, and a focus on early detection and proactive management strategies. However, significant gaps remain in coverage across various geographical regions. The results emphasize the need for transboundary monitoring and predictive tools to improve invasive plant management in response to global environmental change.

Keywords: *Invasive Alien Species, Plant Invasion, Risk Assessment, Climate Change, SDM, RCPs, SSPs*

Fuzzy Logic and Deep Learning for susceptibility zonification related to volcanic eruptions

Martha Patricia Valbuena Gaona [1], David Doncel Ballen [1] and Rodrigo Alexander Hernandez Vargas [2]

[1] Procalculo Colombia, [2] Universidad Nacional de Colombia

The 2024 eruption of Colombia's Los Aburridos mud volcano affected 109 families, highlighting the need for advanced risk management strategies. This study integrates multicriteria analysis (AMC), hydrological modeling, and geospatial data using fuzzy logic and deep learning to identify vulnerability zones. Fuzzy logic quantifies uncertainties in risk factors, while the U-Net deep learning model processes satellite imagery for land cover classification. The methodology produced a vulnerability map with a 93% match to the areas impacted by the eruption. These results validate the approach, offering a robust framework for assessing volcanic risks and enhancing disaster preparedness and mitigation strategies.

Keywords: *Vulcanology, Vulnerability, Deep Learning*

Enhancing Vertical Accuracy of readymade DEMs in Hilly Terrain Using LiDAR-Derived GCPs and Random Forest Regression

Gamage Sanka Nirodha Perera and Hetti Arachchige Nalani

Faculty of Geomatics, Sabaragamuwa University of Sri Lanka

Digital Elevation Models (DEMs) are fundamental for terrain analysis, hydrological modeling, and spatial planning, but their vertical accuracy is often compromised in complex landscapes. In particular, global readymade DEMs such as those produced by MAXAR tend to show significant vertical discrepancies in hilly and densely vegetated regions due to canopy interference, steep gradients, and sensor limitations. This study presents a machine learning-based approach to enhance the vertical accuracy of MAXAR DEMs using Ground Control Points (GCPs) derived from a high-resolution LiDAR-based DEM.

The selected study area lies within the central hill country, characterized by steep slopes and dense forest canopy—conditions under which global DEMs typically perform poorly. To model and correct elevation errors, a Random Forest regression algorithm was employed using GCPs extracted from the LiDAR DEM as reference points. In addition to elevation differences, terrain attributes such as slope, aspect, curvature, and land cover were used as predictive variables to capture the spatial variability of elevation error across the landscape.

The results show a substantial reduction in vertical root mean square error (RMSE) after correction, with marked improvements observed in steep and vegetated zones. The use of LiDAR-derived GCPs enabled precise error modeling while minimizing field-based data collection efforts. This approach demonstrates the potential of combining high-accuracy elevation references with machine learning techniques to refine global DEM products at local or regional scales, particularly in topographically challenging environments. The methodology offers a scalable and effective solution for enhancing elevation data quality in regions where traditional correction methods are less feasible due to terrain complexity or resource constraints.

Keywords: *DEM, Vertical Accuracy, GCPs,Random Forest*

MapBiomas Ecuador: Applying Machine Learning to Monitor Land Cover and Land Use Changes from 1985 to the Present

Wagner Holguin

EcoCiencia Foundation, Ecuador

MapBiomas Ecuador is the first spatiotemporal monitoring system of remaining natural cover and land use in Ecuador, covering the period from 1985 to present. The initiative used all cloud-free scenes from the Landsat image catalog (including TM onboard Landsat 4 and 5, ETM+ onboard Landsat 7, OLI-TIRS onboard Landsat 8, and OLI-2 TIRS-2 onboard Landsat 9), along with machine learning algorithms—particularly the Random Forest classifier—and cloud computing to generate annual thematic land cover and land use maps.

As of 2023, Ecuador retains 58.48% of its territory under forest cover (both primary and secondary). An additional 8.33% is covered by other natural non-forest formations (e.g., grasslands, shrublands, and others). In terms of net change, at least 1.1 million hectares of natural cover were lost between 1985 and 2023. By 2023, 32% of the country had been transformed into anthropogenic land uses, mainly agricultural mosaics. Other land uses such as aquaculture (0.6%), forestry (0.16%), and mining (0.05%) were also mapped and show expansive temporal dynamics.

Although dense forest experienced the largest absolute reduction in area (-981,000 ha), mangroves declined by 9,000 ha—significant losses considering their already limited distribution and high degree of ecological transformation. In terms of glaciers, Ecuador went from having 7,949 hectares in 1985, to 5,019 in 2023. This is a significant loss of 37%, considering that glaciers do not recover.

In contrast, agricultural areas increased by 16% over the 39-year period, while forestry and aquaculture expanded by 46% and 151%, respectively—nearly doubling their extent since 1985. Mining, which was undetectable by satellite in 1985, has now emerged prominently; in the Amazon biome alone, it has reached an area of 9,0000 hectares, of which 1,405 ha (15.7%) were added in a single year between 2021 and 2022—marking the most rapid expansion detected.

The monitoring system analyzes land cover change trends at a biogeographical level by dividing the country into five biomes: Amazon, Andes, Galápagos, Pacific Tropical Rainforest, and Equatorial Dry Forest. The Amazon biome recorded the largest loss of natural cover and also experienced a 154% increase in anthropogenic land uses compared to 1985 levels.

This annual thematic mapping effort constitutes the most comprehensive reconstruction of land cover transformation in Ecuador over nearly four decades. It is designed as a continuously improving and updatable tool to support land use evaluation and planning across various sectors of society.

Keywords: *Satellite monitoring, Natural cover, Land use, Change detection, Ecuador, Remote sensing, Land cover classification, Climate Change*

AI-Enhanced 3D Landcover Classification Using Fused LiDAR and UAV Images

Hetti Arachchige Nalani

Sabaragamuwa University, Sri Lanka

Accurate landcover classification is essential for a wide range of applications including precision agriculture, environmental monitoring, forest resource management, and urban planning. Traditional classification methods using only 2D spectral data (RGB or multispectral) often fail to capture the complexity of land surface features in heterogeneous terrains such as urban-rural fringes, mountainous areas, and dense forests. LiDAR data, acquired via UAVs, provide detailed 3D structural information but lack spectral context. This research aims to overcome these limitations by integrating UAV-based LiDAR point clouds with UAV imagery using advanced AI techniques. Specifically, we propose a dual-stream deep learning architecture that utilizes PointNet++, a hierarchical point-based neural network for classifying 3D point clouds, and DeepLabv3+ with Xception backbone, a state-of-the-art semantic segmentation model for 2D imagery. The outputs of the two streams were fused through a late fusion strategy to enhance classification accuracy. The innovation of this approach lies in the synergistic use of both geometric and spectral data, which enables more robust and accurate landcover classification. The study area is located in Sabaragamuwa university premises, Sri Lanka. The overall classification accuracy exceeded 95%, demonstrating that semantically-rich 3D landcover maps can be generated with substantial accuracy improvements over single-modality approaches. Some misclassifications were observed among certain classes. Despite these challenges, the results are promising—surpassing those obtained using more complex geometric feature sets.

Keywords: *Landcover Classification, UAV LiDAR, UAV Images, Deep Learning*

Assessing land suitability for leguminous crops in the Okavango River basin: A multicriteria and machine learning approach

Kaleb Gizaw Negussie [1], Bisrat Haile Gebrekidan [2], Daniel Wyss 3 and Martin Kappas [3]

[1] Department of Land and Spatial Sciences, Namibia University of Science and Technology, Windhoek, Namibia;
[2] International Maize and Wheat Improvement Center (CIMMYT), Addis Ababa, Ethiopia;
[3] Department of Cartography, GIS and Remote Sensing, Georg-August University Goettingen, Germany

This study aimed to create a model to identify land suitable for growing sunn hemp (Crotalaria juncea) and pigeon pea (Cajanus cajan) in the Okavango River basin of the Kavango East region of Namibia. Advanced tree-based ensemble learning models, including Random Forest, Extra Trees, Gradient Boosting, XGBoost and multivariate regression analysis, were employed to enhance analytical accuracy. The Random Forest and XGboost models exhibited outstanding performance, as evidenced by their respective accuracy values of 0.97 and 0.96. In addition, this study proposed an innovative approach through the integration of subjective and objective analytical methods, which are independent of one another. The subjective component of the analysis employed a Multi-Criteria Decision Making-Analytic Hierarchy Process (MCDM-AHP). On the other hand, the objective component used a data-driven multivariate approach supported by tree-based learning algorithms. Twenty-two variables were considered, encompassing climatic conditions, hydro-geomorphologic features, soil characteristics, vegetation patterns, and socio-economic factors. These variables played a crucial role to identify the most suitable areas for growing the selected leguminous crops. The MCDM-AHP method utilised expert evaluations to rank the importance of variables, identifying water sources, slope, and soil properties as key factors. A suitability mapping analysis revealed that 17.63% of the area was highly suitable and 62.77% moderately suitable, while 10% was less suitable and 9.59% unsuitable for growing these two legumes. According to the data driven methodology, soil fertility and nitrogen content emerged as key determinants for land suitability. This is particularly relevant for nitrogen-fixing leguminous crops such as sunn hemp and pigeon pea, which play a central role in improving soil quality and ensuring food security.

Keywords: *MCDM, Ensemble Learning Models, Leguminous Crops, Land suitability, Okavango river, Namibia*

Integrated Analysis of Groundwater Responses to Climate Change and Agricultural Water Demand Using AI and Geographic Modeling

Jorge Alberto Valero-Fandiño [1] and Josue Medellin-Azuara [2]

[1] Universidad Distrital Francisco Jose de Caldas, [2] University of California

This research analyzes the potential effects of climate change and land use dynamics on groundwater in highly productive agricultural regions dependent on water imports and groundwater regulation. Before focusing on the research topic, solving a series of conceptual, operational, and computational challenges, such as having reliable, integrable, and fast models, was necessary. Initially, we evaluate the performance of three emulators of the sophisticated hydrology model known as the Fine Grid California Central Valley Groundwater-Surface Water Simulation Model (C2VSimFG) to estimate how climate and agriculture affect groundwater levels. Once the best emulator was identified, we assessed the hypothesis that groundwater levels in the Greater Kern County Region would exhibit a more rapid decline with projected climate change scenarios compared to historical climate resembling 1995 and 2015. Finally, we focus on determining economically and environmentally optimal operational policies for the Shafter-Wasco irrigation district by considering the conjunctive water use approach and identifying the best policies through Bayesian Optimization Programming. The findings suggest groundwater levels will likely decline unless agricultural water demand is reduced and recharge is increased, with climate scenarios exacerbating this decline compared to historical conditions. Our findings underscore the balance between profit and aquifer recovery, indicating farmers' need to curtail profits to achieve groundwater sustainability. Ultimately, our method can potentially integrate water and agricultural systems facing various uncertainties, providing valuable insights into optimal operational policies and tradeoffs.

Keywords: *Groundwater, Climate Change, Agricultural Water Demand, AI, Geographic Modeling*

Remote sensing applied to spectral, soil and morphological characterization for archaeological prospecting purposes. A comparative study about Cerro Tusa and Morro de Tulcán, Colombia

Rafael Wueffer

Remote sensing is a discipline oriented to observe the Earth's surface in order to know physical-chemical properties of matter. This technology is an attractive option for archaeological exploration and prospecting. In this article, two study areas were selected: One to represent slightly disturbed archaeological relics (Morro de Tulcán in Popayán, COLOMBIA); and other that is taken as a natural monument, usually confused with archaeological ruins (Cerro Tusa in Venecia, Antioquia COLOMBIA). For both areas, the potential of some freely accessible remote sensing options to improve preliminary archaeological exploration was evaluated. Four options of satellite data were analyzed coming from specialized satellite data portals (SoilGrids-WoSIS, ASF Vertex Data Search, NASA-Gionanni and USGS-GLOVIS). From these services, 13 indicators were derived and measured for those study areas; These indicators take into account: data-quality of the data, archaeological relic expected characteristics and the usual characteristics of natural monuments. After that, a comparative analysis was done, including two strategies: internal comparison, to compare the study areas and their context regions (in order to determine how distinguishable they are from their surroundings); and external comparison, to match study areas each other; in order to determine differentiable indicators (between archaeological remains from natural monuments). The results showed that ground surface temperature (LST) and bare soil index (BSI) were the best indicators for preliminary archaeological exploration.

Keywords: *Archaeology, spectral, Morphology, Soil, Vegetation, Indicators*

Approaches for measuring the accuracy of landscape metrics derived from remote sensed data in small scale agricultural areas of sub-Sahara Africa

Gillie Cheelo

Copperbelt University, Zambia

Small scale agricultural cultivated area expansion is one of the main drivers of forest fragmentation in sub-Saharan Africa (SSA), which creates numerous small single tree forest fragments inside and around the agricultural fields. Forest fragments impact the ecosystem provision and biodiversity loss in the region. Studies on forest fragmentation in SSA mainly use freely available coarse spatial resolution Landsat imagery. The use of coarse spatial resolution such as Landsat imagery misses, exaggerating, oversimplify and generalizing the small forest fragments which dominate small scale agricultural landscapes in the region. This causes accuracy concerns on the determined forest fragmentation results. Despite these inaccuracy concerns, studies in SSA rarely measure the accuracy of the landscape metrics used to measure forest fragmentation. Therefore, this study firstly reviews theoretical approaches to guide how to measure and account for uncertainty in forest fragmentation measurements. Then develops novel approaches which measure the accuracy of landscape metrics and ways of reducing errors in forest fragmentation analysis relevant in small-scale agricultural landscapes of SSA. The proposed approach uses high-resolution imagery (UAV-generated orthophotos and WorldView-2) as reference data to determine accuracy of landscape metrics derived from landcover maps classified from satellite imagery such as Planet Scope, Landsat, and Sentinel-2 imagery. The level of uncertainty and accuracy of each imagery will be determined using Root Mean Square Error (RMSE), standard deviation (SD), Monte Carlo analysis, sensitivity analysis, and Bayesian analysis. The proposed approach will account for the unique characteristics of small-scale agriculture landscapes, the main driver of forest fragmentation in SSA. Hence contributing towards more credible determination of forest fragmentation and its related effects on biodiversity in the region.

Keywords: *Landscape metrics, uncertainty, small-scale agriculture, satellite data, forest fragmentation, biodiversity, landcover, Sub-Sahara Africa*

Interpreting ENVI-met Simulated Microclimate Data with Measured Observations in HFT Stuttgart

Muhtasimul Islam Rushdi [1], Angela Blanco-Vogt [1] and Sourav Karmaker [2]

[1] University of Applied Sciences Stuttgart, [2] Hessische Verwaltung für Bodenmanagement und Geoinformation, Wiesbaden, Germany

The study investigates the impact of green surface areas on urban microclimates using ENVI-met simulation software, focusing on Hochschule für Technik Stuttgart (HFT Stuttgart). The study validates ENVI-met's accuracy in predicting microclimatic conditions and recommends urban design strategies to mitigate the Urban Heat Island (UHI) effect. Findings show significant temperature reductions in areas converted from paved to green surfaces, with decreases of up to 1.15°C in Block 1, 0.70°C in Block 2, and 1.00°C in Block 3. Statistical analysis reveals strong correlations between measured and simulated data, with maximum R^2 values of 0.81 for temperature and 0.93 for humidity, confirming the model's reliability. The study underscores the importance of integrating green surfaces into urban planning to enhance thermal comfort and sustainability, validating ENVI-met as a robust tool for micro climate analysis.

Keywords: *Urban Microclimate, Urban Heat Island, Green Surfaces, Microclimate Simulation, ENVI-met, GIS*

Analysis Tool for Sustainable Land Resource Management Case Study: Municipality of Palmira, Valle del Cauca

Edwin Cortes

Egresado Universidad Distrital Francisco Jose de Caldas, Colombia

This paper presents an analysis tool for the sustainable management of land resources, using the political-administrative boundaries of the municipality of Palmira, Valle del Cauca, as a case study. The research problem addresses territorial conflicts caused by the intensive use of land resources for anthropogenic activities and their spatial distribution, which result in changes in environmental, social, economic, and cultural relationships. The theoretical framework supporting the identification of categories and variables is drawn from authors such as Brundtland (1987), Soil Survey Staff (1994), Martín (1998), Bocco (2007), Echeverri (2009), Van Miegroet and Johnson (2009), and Rafino (2020), among others, who define the territory as a strategic space where all human activities converge. The study develops a methodology to obtain results in four phases: the initial phase involved a literature review based on the project's conceptual framework; the first phase provides a diagnosis of conflicts caused by land-use change in the study area through the compilation and analysis of geographic information; the second phase analyzes these conflicts from environmental, sociocultural, and economic perspectives through impact evaluation; and the third phase establishes the characteristics that an analysis tool must possess. The result is three impact management records and a final record containing the proposed analysis tool, which, once implemented, could reduce territorial conflicts within the political-administrative boundaries of Palmira.

Keywords: *geoinformation, standards and sources, analysis, territorial conflict, management instrument, soil resource*

From Technocracy to Data Sovereignty, Open Data and Use of Open Source Geospatial Technologies

Franz-Josef Behr
Stuttgart University of Applied Sciences, Germany

When Donald Trump was inaugurated on January 20, 2025, the heads of major US technology companies such as Amazon, Meta, Google, Tesla Motos and Apple stood just a few meters away from him in Capitol Rotunda (The Guardian 2025). They had previously donated millions to the election campaign and the inauguration. Even some of them, such as Meta CEO Mark Zuckerberg, had already adapted business concepts to Trump's policies in advance. Trump himself and the Department of Government Efficiency (DOGE), for which E. Musk is a senior advisor, are aggressively pushing ahead with the restructuring of the state. And many are concerned that even sensitive data of citizens is no longer secured on the basis of GDPR-compliant data transfers between the EU and the United States, but could be misused or access jeopardized.

In the emerging technocracy, as in the case of DOGE, experts from different fields are deployed to advise political decision-makers, regardless of whether democratic principles and the rule of law are called into question in the process (Thiel 2009). Search engines, digital media, web browsers, mail servers, cloud solutions, navigation systems and map apps: a large proportion of our data is in the hands of large US companies. Here issues such as digital colonialism play a role (Ziai 2020). Resources from the "global South" are used to create data and information as input for AI applications) (Anwar & Graham 2022, Malik 2022a, Dachwitz & Hilbig 2025). Widespread applications can also be used, to influence different areas of the economy (Malik 2022a).

We have thus made ourselves dependent at various levels on algorithms that influence our opinions, on platforms that control our communication, on corporations that dominate political processes (https://digitalrechte.de/). It is therefore worth taking a look at possible alternatives at local and indigenous level to established and often easy-to-use US services. Basically there are plenty of them: A website with the name “European Alternatives” (https://european-alternatives.eu/alternatives-to) was launched. It lists apps that were developed in Europe at and therefore also comply with European data standards. Other collections, such as the “Open Alternative” website (https://openalternative.co/alternatives), collect applications that were developed according to the open source principle.

As experts in the procurement and processing of geospatial data, we need to address the use, storage and processing of geodata in particular. In doing so, we must keep our data sovereignty in mind and focus on the use of own or open source products: Using data, know-how and financial resources locally, regionally or nationally. free vector geodata and remote sensing data as well as the offerings of the OSGeo Foundation can make a significant contribution to digital sovereignty. In addition to introductory background information on the drivers of technocracy, aspects of data sovereignty, ideas about the principles of commons, freely available data sources and the extensive range of open source solutions are presented.

Keywords: *Digital Colonialism, Digital Sovereignty, Technocracy, Open Data, Open Source, OSGeo Foundation*

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The role of Geospatial Information Infrastructure for Large Scale Topographic Mapping Acceleration in Indonesia

Winhard Tampubolon

Geospatial Information Agency of Indonesia (Badan Informasi Geospasial, BIG), Indonesia

Legislation in Act Nr. 4 / year 2011 about Geospatial Information (UUIG) mandates the fundamental availability of Geospatial Data and Information (GD/I) as a basis for accountable, measurable and objective decision-making process. However, the challenges of implementing GD/I, especially at the highest level of detail or on a large scale for the territory of the Republic of Indonesia, which covers a land area 5 times the size of the Federal Republic of Germany, certainly require an accelerative and innovative breakthrough strategy. The strategy for implementing GD/I through an innovative acceleration process has been chosen as the optimal solution based on considerations of production cost efficiency factors in the form of the application of standardized Geospatial Processing Center (GPC) and the development of Human Resources (HR) in the GD/I field as its main driving force.

In accordance with UUIG, the role of Geospatial Information Infrastructure (IIG) which includes policy, institution, technology, standard and HR is a key factor towards the aforementioned acceleration process. The IIG components should be developed in an integrated (non-partial) manner and connected to each other, for example in the development of innovation in GD/I acquisition technology, it is necessary to develop standards that are always dynamic in keeping up with developments in science and technology. As a comparison, the Federal Republic of Germany has a large-scale basic mapping technical unit equipped with the latest equipment including GD/I human resources with technical competencies covering data acquisition processes, geospatial processing and presentation and updating of geospatial data (geodata) in each region of the 16 states.

Considering that the conditions and readiness of IIG between regions in our country are still not standardized, the acceleration process of Basic GD/I is still carried out centrally in this case by the Geospatial Information Agency (BIG) as the National Mapping Agency in accordance with UUIG. As a consequence, the role of GD/I standards becomes very essential and fundamental as a reference for the provision and implementation of GD/I on a massive scale, even to the individual level, by referring to the Competency Qualification Standards for implementing GD/I. In addition, there is also a significant role of the Geospatial Reference System, especially when associated with the increasingly high resolution of geospatial data produced to achieve the highest level of accuracy. For this reason, a Geodetic Control Network standard is needed that can be referred to by stakeholders.

In addition to the need for technology and methodology that are well standardized, of course, certified professional personnel are needed with knowledge qualifications, skills, and/or expertise and work attitudes that are relevant to the implementation of their duties and job requirements in what is called the Job Competency Standard (SKJ) in the government scope or the Indonesian National Work Competency Standard (SKKNI) in the industrial world. Meanwhile, the Indonesian National Standard (SNI) acts as a reference for the GD/I industrial sector in developing its business voluntarily so that its quality, objectivity, efficiency and effectiveness are certainly guaranteed.

Especially in the GD/I industrial sector which is market-driven, in addition to SKKNI and SNI, competency standards can also refer to international standards or special standards. For example, in supporting the acceleration of the production of Large-Scale GD/I Scale 1:5,000 and 1:1,000 and the realization of the Electronic-Based Government System (SPBE), a living and dynamic standard is needed related to the parallel implementation of GD/I activities, especially in the next 5 years. Since

2023, the Technical Committee 07-01 Geographic Information/Geomatics has increased its role to become a Participating Member (P-Member) in the ISO/Technical Committee (TC-211) Geographic Information by nominating experts who are active in various Working Groups (WG-1 and WG-6).

Keywords: *standard, geospatial, competency, radar*

Webinar

From Blueprints to Digital Twin – A GIS-Based Smart Campus

Nicolas Luna and Joaquin Huerta

Universitat Jaume I, Spain

The development of a Smart Campus application at Universitat Jaume I (Spain) integrated 3D modeling, geospatial databases, and indoor navigation technologies to improve spatial management and accessibility. The project used Blender to generate high-quality 3D models of campus buildings from AutoCAD blueprints, providing a realistic and data-rich representation of university facilities. These models were integrated into ArcGIS Indoors within ArcGIS Pro, where a structured geospatial database was created to manage spatial units using unique identifiers.

Beyond building structures, the database was enriched with external data, many from OSM, incorporating points of interest such as waste bins, information kiosks, faculty and staff office locations, banking services, and printing services.

A key component of the project is multimodal navigation, implemented through 3D Network Analysis. This feature enables optimized routing for vehicles, bicycles, and pedestrians, facilitating efficient movement across the campus. Additionally, indoor navigation was deployed by publishing services in ArcGIS Enterprise and configuring the system using ArcGIS Online templates. This allows users to seamlessly transition between outdoor and indoor navigation, ensuring accessibility and efficient wayfinding inside university buildings.

The final result is a first version of a dynamic digital twin of the university campus, integrating 3D visualization, real-time spatial analysis, and interactive navigation. The next step is to connect to real-time building and exterior sensors to facilitate monitoring and analytics. This digital twin enhances decision-making processes, improves facility management, and provides students, faculty, and visitors with an intuitive tool to navigate and interact with campus spaces. The combination of ArcGIS Indoors, other GIS services, and 3D modeling establishes a smart campus framework that supports future expansions and innovations in university infrastructure. Multiple graduate students participated in its creation, providing them with a realistic digital twin experience that might later be applied to careers involving smart city projects that utilize similar software stacks.

Keywords: *3D modeling, ArcGIS Indoors, Digital twin, GIS, Indoor navigation, Smart Campus*

Harnessing Deep Learning and Remote Sensing for Water Segmentation

Amina Said

Dublin City University, Ireland

Water is an important resource that occupies about 70% of the Earth's surface. However, the ongoing climate change has led to significant spatial variation of water bodies. Remote sensing has proven to be an effective tool in the study of water extent, which relies on the traditional approach of using spectral indices such as normalized difference water index (NDWI). With the advancement of technology and improved computational resources, deep learning models like U-NET have been adopted in segmentation of the water bodies. There is a rich amount of freely accessible satellite data with good spatial resolution, which facilitates the integration of deep learning techniques with remote sensing. This will improve the water body extraction accuracy, scalability and enable effective monitoring of water body changes.

Keywords: *deep learning, remote sensing, segmentation, water*

Stand age diversity (and more than climate change) affects forests' resilience and stability, although unevenly

Elia Vani [1], Daniela Dalmonach [1], Elisa Clocolo [2], Gina Marano 3, Leonardo Bianchini [2], Paulina Puchi [1], Elisa Grieco [1], Alessandro Cescatti [4], Andrea Colantoni [2], Gherardo Chirici 5, Alessio Collati [1]

[1] CNR-ISAFOM, Italy, [2] University of Tuscia, Italy, [3] ETH Zürich Switzerland, [4] JRC, [5] University of Florence, Italy

Stand age significantly influences the functioning of forest ecosystems by shaping structural and physiological plant traits, affecting water and carbon budgets. Forest age distribution is determined by the interplay of tree mortality and regeneration, influenced by both natural and anthropogenic disturbances. Unfortunately, human driven alteration of tree age distribution presents an underexplored avenue for enhancing forest stability and resilience. In our study, we investigated how age impacts the stability and resilience of the forest carbon budget under both current and future climate conditions. We employed a state–of–the–science biogeochemical, biophysical, validated process–based model on historically managed forest stands, projecting their future as undisturbed systems, i.e., left at their natural evolution with no management interventions (i.e., forests are left to develop undisturbed). Such a model, forced by climate data from five Earth System Models under four representative climate scenarios and one baseline scenario to disentangle the effect of climate change, spanned several age classes as representative of the current European forests' context, for each stand. Our findings indicate that Net Primary Production (NPP) peaks in the young and middle-aged classes (16- to 50-year-old), aligning with longstanding ecological theories, regardless of the climate scenario. Under climate change, the beech forest exhibited an increase in NPP and maintained stability across all age classes, while resilience remained constant with rising atmospheric CO2 and temperatures. However, NPP declined under climate change scenarios for the Norway spruce and Scots pine sites. In these coniferous forests, stability and resilience were more influenced.

These results underscore the necessity of accounting for age class diversity –lacking in most, if not all, the current Global Vegetation Models – for reliable and robust assessments of the impacts of climate change on future forests' stability and resilience capacity. We, therefore, advocate for customized management strategies that enhance the adaptability of forests to changing climatic conditions, taking into account the diverse responses of different species and age groups to climate.

***Keywords**: carbon cycle, climate change, forest resilience, forest age, forest management, modeling*

AI-based Enrichment of Building Data by Predicting Demographic Data

Fatemeh Rafiei[1], Angela Blanco-Vogt[1] and Robert Hecht[2]

[1] Stuttgart University of Applied Sciences, [2] Leibniz Institute of Ecological Urban and Regional Development

Accurate demographic predictions at fine spatial resolution play a critical role in helping urban planners allocate resources efficiently, ensuring better housing, transportation, and services for diverse populations. Traditional data collection methods, such as censuses and surveys, suffer from limitations in frequency, spatial resolution, and cost, which make it difficult to capture dynamic demographic changes in urban areas. This research proposes a solution to address this gap by leveraging machine learning (ML) models to enrich building data with predicted demographic characteristics at the building level. The primary aim of this study is to evaluate the effectiveness and adaptability of machine learning models, specifically Random Forest (RF) and Extreme Gradient Boosting (XGBoost), for predicting demographic patterns, including population count and age group proportions, in the German context.

The study uses Stuttgart, known as an economic hub with a strong industrial presence and a mixture of industrial and modern urban developments, as the training area. Dresden, a historical city with a mix of heritage and modern developments, is used as the test area to examine the generalizability of the models across cities with contrasting urban forms. The dataset includes detailed two-dimensional building attributes derived from 3D CityGML data, 100-meter grid census data, OpenStreetMap points of interest (POI), block data, house coordinate data, and accessibility measures. Through extensive feature engineering, over 50 predictive indicators were generated. These indicators fall into two main categories: building-level attributes (e.g., area, height, volume, shape complexity measured by Equivalent Rectangular Index (ERI) and Proximity Index (PI)) and urban-level indicators (e.g., walking distance or time to the city center, built-up density, number of neighboring buildings, and accessibility to various POI types within a 15-minute walk).

A key challenge in this research was the disaggregation of demographic data from the grid level to individual buildings, which significantly influenced the model outcomes. Despite these challenges, the results demonstrate that population prediction achieved good accuracy using the RF model, showing that building-level data combined with ML can effectively estimate population distribution. However, the prediction of age-related demographics was less precise, primarily due to inaccuracies and limitations in the input datasets. The analysis also revealed that POI data had an impact on age-group predictions but played a less critical role in population estimation.

This research highlights the potential of integrating AI with urban data as an alternative or complement to traditional demographic data collection methods. It demonstrates the critical importance of high-quality, detailed building data and carefully designed feature engineering for achieving accurate demographic predictions. Future work should focus on refining model hyperparameters and incorporating more accurate building-level demographic data. Addressing these challenges is essential for enhancing the generalizability of the approach and ensuring its applicability across diverse urban environments.

***Keywords**: Machine learning, Random Forest, EXtreme Gradient Boosting, Demographic prediction, Building data enrichment*

Mapping Climate Memory: Climate Justice, Indigenous Counter-Mapping, and OpenSource Empowerment in Arabic and Welsh Multi-Ethnic Language Outsider Communities

Rupert Allan

Royal Scientific Society (Jordan), Cambridge University (UK)

This paper examines evidence from multi-ethnic indigenous participatory OpenStreetMapping work as community-designed place-making practice. OpenStreetMap has been called 'the wikipedia of maps', one of the OpenSource 'liberation technologies' increasingly populating thinking in GIS, public policy and human rights. Comparing multi-ethnic precarious groups in the Black Desert of the Levant (Jordan) with indigenous historically displaced communities in the Green Desert of the Cambrian Ucheldir/Uplands (Wales), this paper looks to discuss these parallels in the context of OpenStreetMap community-led participatory mapping, where Community Archive is generated by the local people themselves as auto-ethnography in their own language. Here, not only the survey answers are decided by the community, but the questions themselves.

In the drying-out desert oasis of Al Azraq, Jordan, Bedouin, Druze, Palestinian, Syrian and Chechen groups have cohabitated since it served as the headquarters of T.E.Lawrence and before. This land has progressed from wetland to arid desert within living memory as a result of localised water extraction and global climate change. Even the younger generation remember fish and wildlife in what are now arid dusty plains.

In the Cambrian Mountains communities carry clearly remembered childhood memories of dwellings in thriving mountain settlements which now stand in ruins, forested-over by over-enthusiastic policy-makers less than two generations ago. Community life has witnessed withdrawal of public transport, schools and social infrastructure from this once central heartland of cultural heritage, now designated an area of mass deprivation.

Findings across each of these projects reveal many parallels: land-features are prominent; the connections with practical, rural horseback life are strongly evident, still-used, and very 'mappable' in both landscapes. Abandoned villages litter both of these deserts, standing in ruins as testimony to multiple forced/voluntary displacements. These settings carry stories of mining, dynamite, camel-racing and community toponymy. In each context, intergenerational memory is bound-up in the practices, coping mechanisms and adaptations of multiple cultural approaches and languages.

How do people invisage their place-based lived experiences of climate and cultural change on this scale, and at this speed? What geospatial indicators can communities now devise in the OpenSource revolution to express climate memory in the Arabian Peninsula and in the Green Desert in new ethnographic ways? And how can displacement, livelihoods and wider determinants of well-being be visualised in the universal spatial language of the wiki-map?

ML Insights for Climate Change and Snow-melt Dynamics in Pakistan

*Dawood Ahmed[1], Muhammad Shees Saleem[1], Saira Bano[2], *Shahid Parvez[1]*
[1]Institute of Space Science, [2]College of Earth & Environmental Sciences,
University of the Punjab, Lahore, Pakistan.
(Email: shahid.spsc@pu.edu.pk)

Glacial melt and snow cover changes in Northern Pakistan are more than just environmental shifts. They are powerful signals of how climate variability is reshaping this region. These changes directly affect water availability and the resilience of ecosystems that depend on seasonal snow and ice. In this study, we used a data-driven approach to predict Snow Melt (SM) and Snow Cover Area (SCA), combining remote sensing derived datasets like GLDAS and MODIS with advanced machine learning techniques. We tested five predictive models (Random Forest, Support Vector Machine, K-Nearest Neighbors, Gradient Boosting, and Linear Regression) across historical data spanning 1948 to 2014 for SM, and 2001 to 2014 for SCA. Before modeling, we applied rigorous preprocessing steps to clean and transform the data, including outlier removal and statistical normalization. We also addressed multi-collinearity to ensure more reliable predictions. Gradient Boosting and Random Forest performed best for SM prediction, with high accuracy (R^2 = 0.9254 and 0.9233). SCA prediction was less robust due to limited long-term data ($R^2 \leq 0.20$), yet trends were revealing. From 2001 to 2014, SCA declined steadily, with notable variability in 2004, 2009, and a sharp drop in 2012. Monthly climatology showed snow cover peaking in March–April (~3.8×10^{12} km²) and reaching a minimum in July–August (~9.0×10^{11} km²). SM followed a similar seasonal pattern, peaking in April (0.104 kg/m²) and dropping to near-zero in winter. By combining machine learning with remote sensing and climate data, this study offers a scalable and robust framework for cryosphere monitoring and water management in Northern Pakistan.

Keywords: Machine Learning, Remote Sensing of Environment, Climate Change, Snow Melt, Snow Cover Area.

Temporal Monitoring to Track the Health of Olive Trees and Increase Productivity Under Global Climate Change for the Assessment of Biophysical Parameters and Soil and Water Properties in the Tabarjal/Al-Bassita (Al-Jouf Region - SA) Using Sentinel-1& 2

Nabila Abd El Hamed and Ali Aldosari

This study investigates the temporal monitoring—monthly, annually, and occasionally daily—of olive tree growth, focusing on intensive olive plantations known for their rapid growth, unique morphology, denser planting arrangements, and increased annual yields compared to traditional methods. The research is conducted in the Tabarjal and Al-Bassita regions of Al-Jouf Province, Saudi Arabia. Monitoring utilises freely accessible medium- and high-resolution satellite images from Sentinel-1 (radar) and Sentinel-2 (optical), which are provided by the European Space Agency's Copernicus programme. Sentinel-2 imagery significantly improves Earth observation services by offering essential data for land cover change mapping and assessing vital biophysical parameters, such as Leaf Area Index (LAI), Leaf Chlorophyll Content (LCC), and Leaf Cover (LC). The main goal is to provide accurate, up-to-date land cover information to aid environmental monitoring, climate change research, and the management of extensive agricultural operations, especially where on-ground monitoring faces labour constraints.

Major agricultural companies like Al-JOUF and NADEC are increasingly adopting advanced technologies, including ground-based meteorological stations, to oversee their operations. This research enhances such efforts by offering digital geospatial monitoring services, particularly for pinpointing areas with poor soil conditions that could impact crop health and productivity. The results also support broader applications in spatial planning, forestry management (for olive, palm, and fruit trees), regional water resource management, agriculture, and food security.

Keywords: Arbequina Olive, Sentinel 1&2, Climate Change, Precision Farming, Tabarjal-Al-Basit-Al-Jouf-NADEC-SA.

Assessing smartphone sensors for mobile data capturing and mapping

Paul Rawiel
University of Applied Sciences, Stuttgart, Germany

Smartphones are widely distributed devices with many different sensors on board that can be used for a huge variety of applications that are related climate monitoring, efficient transport, mobile mapping and many more. To build so called apps on android smartphones for applications in the above-mentioned areas, it is essential to know about the different sensors that come with the device, how to access the data measured by these sensors, how to process that data and how to visualize the results.

The workshop offers a hands-on experience to make a first step into the programming of apps for android devices based on the programming language java and the development environment Android Studio.

Participants will learn how to program an app using the Android Studio and install it on an Android Smartphone. As an example, a compass will be programmed using the magnetic field sensor and the accelerometer of the smartphone.

Participants should bring an android smartphone and a cable to connect it to the computer.

Keywords: *Android Studio, Java Programming, Smartphone Sensors, App Programming*

Digital Data Acquisition with QField Cloud and QGIS

Hamidreza Ostadabbas
Geoinformatics Department at die STEG Stadtentwicklung GmbH

This workshop introduces participants to modern digital data acquisition workflows using QField Cloud and QGIS. The goal is to empower users to collect, manage, and synchronize spatial data and multimedia (images/videos) using mobile devices in real-world urban and environmental projects. Participants will learn how to design custom attribute forms, and collect spatial data, photos, and videos using mobile devices.
We'll explore real-time synchronization between field and office teams via QField Cloud. The session is ideal for urban planners, surveyors, and GIS users involved in fieldwork. No advanced coding required – just practical tools for smarter data acquisition. Includes a live demo and interactive field simulation.

By the end of the workshop, participants will be able to:
• Understand the workflow between QGIS (desktop) and QField/QField Cloud (mobile/cloud).
• Configure and publish attribute forms in QGIS for structured field data collection.
• Use mobile devices to capture images, videos, GPS locations, and other field observations.
• Synchronize data between field teams and office teams using QField Cloud.
• Apply the workflow to urban planning or GIS-related fieldwork.

Workshop Topics
• Introduction to QGIS and QField ecosystem
• Creating and configuring attribute forms in QGIS
• Setting up a project in QField Cloud
• Collecting spatial data, images, and videos using smartphones or tablets
• Offline/online synchronization with QField Cloud
• Best practices in mobile data acquisition (field tips, accuracy, etc.)
• Live demonstration & hands-on session

Requirements:
• Laptop with QGIS installed (latest version)
• Android/iOS smartphone or tablet (with QField app installed)
• QField Cloud account (free or organizational

Venue / Location

Country

Colombia is a diverse country, known for its natural richness, warm people, and colorful culture. From Caribbean beaches to the peaks of the Andes and the Amazon rainforest, it offers varied landscapes and unique experiences. Its music, cuisine, and art reflect a blend of Indigenous, African, and European traditions. Cities like Bogotá, Medellín, Cartagena, and Cali combine history, innovation, and vibrant urban life. With one of the highest levels of biodiversity in the world and a welcoming spirit, Colombia is a fascinating destination for those seeking adventure, culture, and an authentic connection to Latin America.

City

Bogotá, the capital of Colombia, is a city where modernity and history coexist at over 2,600 meters above sea level. With its cool climate, diverse culture, and rich culinary scene, it captivates visitors with landmarks like Monserrate Hill, the Gold Museum, and the historic La Candelaria neighborhood. It is a hub for street art, music, cultural festivals, and artisan markets. Thanks to its blend of tradition and modernity, Bogotá offers an authentic and dynamic experience for anyone looking to explore the cultural and political heart of the country.

The University

The Universidad Distrital Francisco José de Caldas is a public higher education institution with over seven decades of history, nationally and internationally recognized for its commitment to research, innovation, inclusion, and cultural outreach in Colombia. With around 12 campuses across Bogotá, the AGSE 2025 event will take place at the Aduanilla de Paiba campus, located at Avenida Calle 13 and Carrera 32.

This campus is a remarkable example of adaptive heritage conservation, as it occupies the former Municipal Slaughterhouse of Bogotá, now transformed into an academic and cultural space where original architectural elements—such as brick vaults and metal structures—are preserved and integrated with modern infrastructure. The event will be held mainly in the Aduanilla Central Auditorium and the library, both offering excellent technical facilities and capacity for plenary sessions, conferences, and networking, all within a setting that blends historical value, functionality, and central urban location.

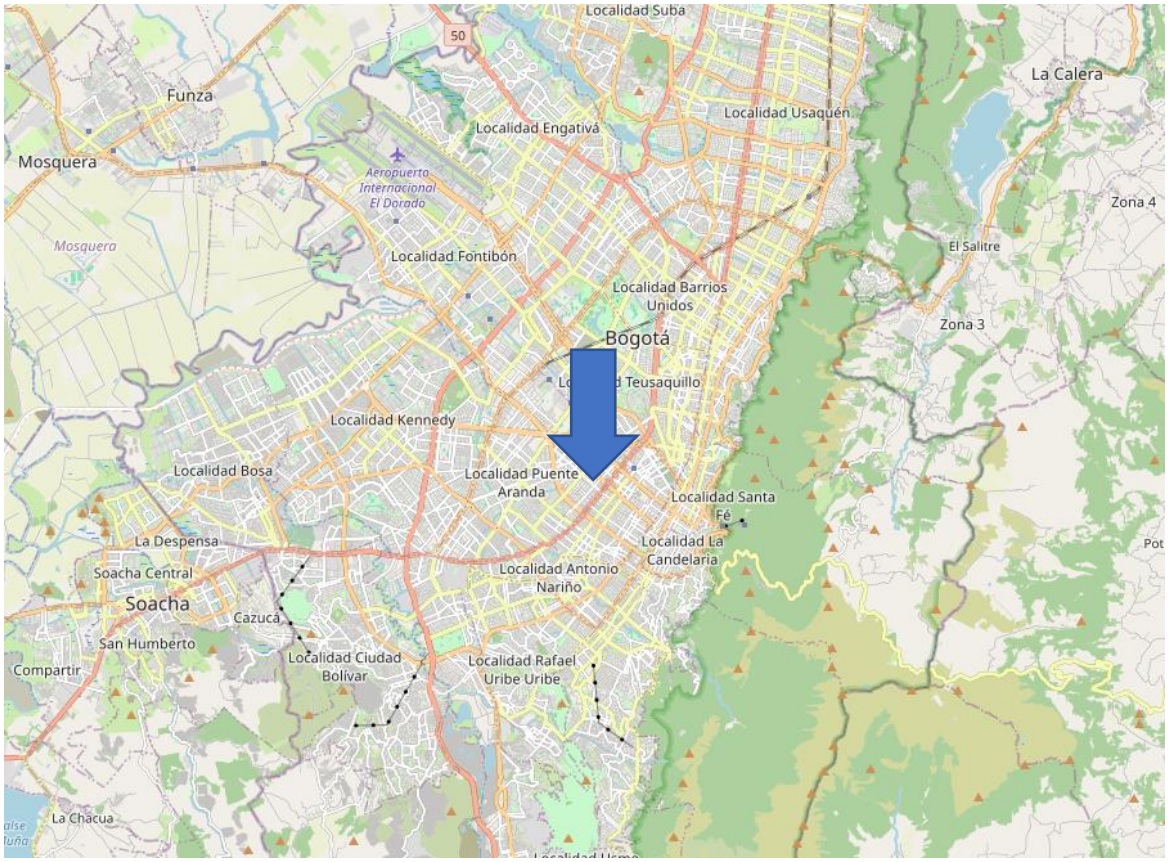

Figure 1: The location of AGSE 2025 (Source OpenStreetMap)

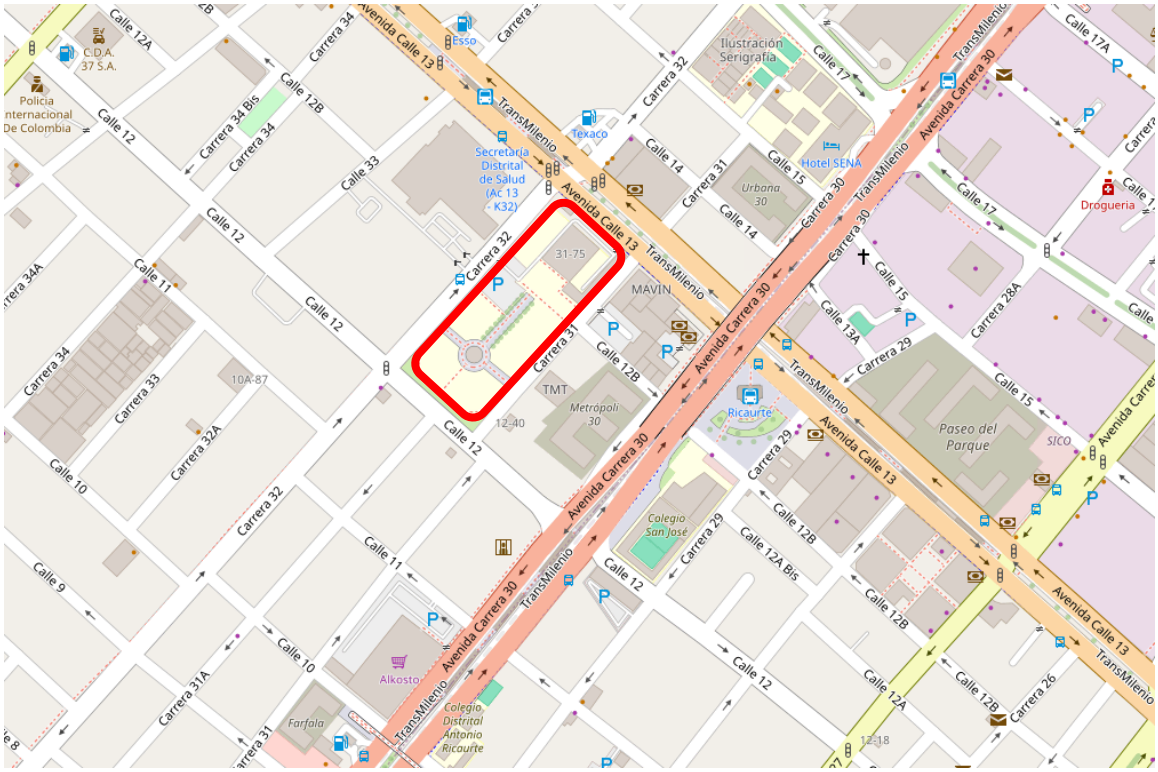

Figure 2: The location of AGSE 2025 at Aduanilla de Paiba campus (Source OSM)

Having Lunch at Universidad Distrital

The Universidad Distrital Francisco José de Caldas, at its Aduanilla de Paiba campus, offers several food options both on and off campus. Inside, near the central courtyard, there is a cafeteria that serves snacks, drinks, and hot fast meals throughout the day. It is open Monday to Friday until 4:00 p.m.

In addition, downtown Bogotá is just a few minutes away, offering a wide variety of dining options, including local restaurants, fast-food places, bakeries, and street vendors with traditional Colombian food at affordable prices.

For AGSE 2025 attendees, this provides easy access to varied and convenient lunch options. However, since lunch and snacks are included as part of the event, it is recommended to remain within the university campus during meal breaks.

Public transport and Parkings

The Aduanilla de Paiba campus is easily accessible via the city's mass transit system called TransMilenio. The nearest stations are Ricaurte (on the NQS Avenue) and CDS CRA 32 (on Calle 13).

For greater convenience, traditional taxis or ride-hailing platforms like Uber are recommended, as they offer comfortable services at affordable prices. Official taxis in Bogotá use regulated taximeters, and ride-hailing apps allow users to view an estimated fare before starting the trip, ensuring better control and safety. It is advisable to avoid peak hours (7–9 a.m. and 5–7 p.m.) for lower fares and less traffic. Both options are reliable, although Uber offers greater convenience for those who prefer digital payments, while taxis are useful for cash transactions or areas with limited mobile signal.

Parking: The Aduanilla campus provides on-site parking for visitors and attendees of AGSE 2025.

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DAAD Deutscher Akademischer Austauschdienst German Academic Exchange Service

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