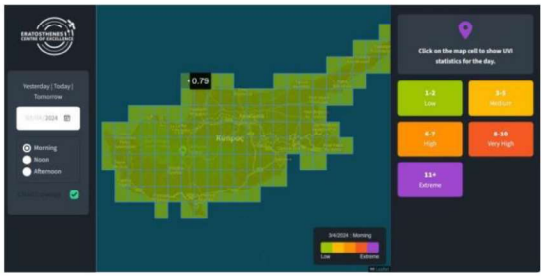
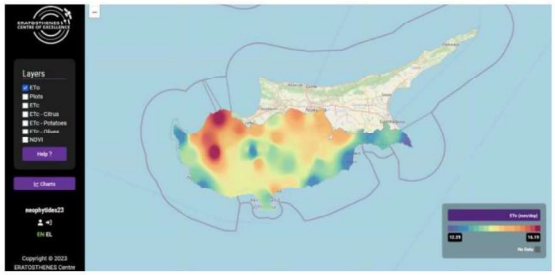
Eleventh International Conference

on Remote Sensing and Geoinformation of Environment

17-19 March, 2025 - Paphos, Cyprus





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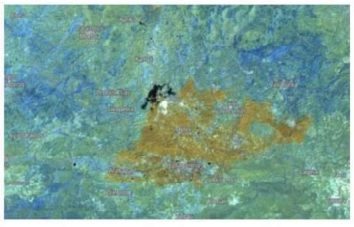

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The RSCy2025 conference is under the auspices of
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RSCy2025

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INTRODUCTION

The Organizing Committee, Scientific Committee and Editors would like to thank the authors and participants who are attending the RSCy2025 "Eleventh International Conference on Remote Sensing and Geoinformation of Environment" in Paphos, Cyprus from 17-19 March 2025. The Conference focuses on emerging issues in remote sensing and geoinformation of environment. This year's Conference focuses on the three main thematic areas of Environment and Climate, Resilient Society and Big Earth Data Analytics. The Keynote Speakers and thought-provoking technical program encourage the exchange of ideas and provide the foundation for future collaboration and innovation. The RSCy2025 Conference is organized by the ERATOSTHENES Centre of Excellence, the EXCELSIOR Project (www.excelsior2020.eu, that has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 857510 (Call: WIDESPREAD-01-2018-2019 Teaming Phase 2) and the Government of the Republic of Cyprus through the Directorate General for European Programmes, Coordination and Development) and the Cyprus Remote Sensing Society, under the auspices of the Deputy Ministry of Research, Innovation and Digital Policy.

We are honored that so many experts from all over the world specializing in so many diverse areas of remote sensing and geoinformation are attending this Conference. This Conference is an excellent opportunity for colleagues to share their knowledge, network and collaborate on future research. We encourage you to take this opportunity to learn about the latest, most state-of-the art findings and applications in remote sensing and geoinformation.

The following abstracts, reviewed for presentation and accepted for publication by the Scientific Committee, represent continued advancements in remote sensing and geoinformation. The program, which included oral and poster presentations, is organized around 22 major themes: Hazards, Fires, Forestry, Marine, Coastal, Cultural Heritage, SAR, Remote Sensing, Atmosphere, Ionosphere, Meteorology, Agriculture, Environment, Water, Hydrology, Water Resources, Floods, Land Use, Land Cover, Urban, Artificial Intelligence, Big data etc. The abstracts and subsequent papers make important contributions to the open scientific literature on remote sensing and geoinformation. We thank the authors for sharing their knowledge and enthusiasm. Over 300 authors from nearly 30 countries are represented in the abstracts presented in the Conference program. At the Conference closing ceremony, awards will be given for the best paper and best poster, following peer-review. In order to be eligible for the best paper and best poster award, it is necessary for the authors to have submitted a manuscript for the SPIE Conference Proceedings, to have registered for the Conference and present their paper or poster.

We would like to thank the organizations who have supported the conference. Special thanks are due to the Conference chairs, the personnel of the ERATOSTHENES Centre of Excellence and the members of the Cyprus Remote Sensing Society who provided invaluable assistance during the event. Thanks, are also due to the staff at SPIE for following the Proceedings through the publication process.

The Editors:
Andreas Christofe, Diofantos G. Hadjimitsis, Silas Michaelides, Kyriakos Themistocleous, Chris Danezis Nicholas Kyriakides, Vincent Ambrosia, Florian Schwandner, Andreas Anayiotos, Ioannis Gitas

EXCELSIOR – ERATOSTHENES CENTRE OF EXCELLENCE

The integration of novel Earth Observation, space and ground-based integrated Technologies can contribute to more sustainable and systematic monitoring of the environment, the growth of vital economic sectors and the timely detection, monitoring and analysis of natural and anthropogenic threats. The ERATOSTHENES Centre of Excellence, established through the **'EXCELSIOR', H2020** Widespread Teaming Phase 2 project, is focused on excellence in multidisciplinary Earth observation research towards a better understanding, monitoring and sustainable exploitation and protection of the physical, built and human environment, in line with international policy frameworks, with a regional focus in the Eastern Mediterranean, Middle East and North Africa (EMMENA), positioning itself as an innovation gateway for Cypriot, regional and European stakeholders.

The mission of the ERATOSTHENES Centre of Excellence is to conduct both basic and applied research towards improved understanding, management, and monitoring of natural resources and infrastructures and to offer expert services and products of excellent qualities in line with the latest development remote sensing and related geospatial technologies or other high-tech tools. The vision of the ERATOSTHENES Centre of Excellence is to become a world-class Digital Innovation Hub for Earth Observation, space technology and Geospatial Information and to be the reference Centre in the Eastern Mediterranean, Middle East, and North Africa.

The ERATOSTHENES Centre of Excellence works closely with the strategic partners of the EXCELSIOR project, which include the Cyprus University of Technology, the German Aerospace Centre (Germany), the National Observatory of Athens (Greece), the German Leibniz Institute for Tropospheric Research (Germany), the Department of Electronic Communication of the Deputy Ministry of Research, Innovation and Digital Policy (Cyprus), as well as the affiliated partners CyRIC (Cyprus) and Physical Meteorological Observatory in Davos - PMOD/WRC (Switzerland) to strategically engage Cyprus in a path of innovative growth in newly developed capabilities.

The ERATOSTHENES Centre of Excellence is dedicated to the creation of a fully functional **Digital Innovation Hub** and a Research Excellence Centre for Earth observation in the EMMENA region, creating an ecosystem where state-of-the-art sensing equipment, cutting-edge research, targeted education services and entrepreneurship come together. The ERATOSTHENES Centre of Excellence adopts a Multi-Actor approach, where stakeholders participate in the co-design, cocreation, commercialization and promotion of novel remote sensing products and services.

The Digital Innovation Hub consists of four value-adding chains and three thematic clusters/ departments within a two-axis model. The three thematic clusters/departments include:

Environment & Climate which exploits state-of-the-art infrastructure and Earth observation data for aerosol and cloud monitoring as well as developing a supersite for calibration/validation activities.

Resilient Society focuses on research and services that are applicable to the general public, with a primary focus on Disaster Risk Reduction and Access to Energy.

Big Earth Data Analytics is designed to allow the discovery of new information hidden in the data and promote the value-adding combination with non-Earth observation data streams.

The four value-adding areas of the Digital Innovation Hub include **Infrastructure, Research, Education and Entrepreneurship.**

The **Infrastructure Area** is responsible for the seamless use of the existing and future ERATOSTHENES Centre of Excellence infrastructure, their proper operations and the unobstructed access to Earth observation data by the ERATOSTHENES Centre of Excellence staff and stakeholders. It will include state-of-the-art infrastructure, including the Ground-based atmospheric remote sensing station, which is a supersite for aerosol and cloud monitoring as well as the Satellite data direct receiving station that will be able to directly receive image-based satellite data from Earth observation satellite missions, which will allow Near Real Time monitoring and thereby provide time-critical information, especially in the region of Eastern Europe, Northern Africa and the Middle East.

The **Research Area** is responsible for the development of science and research that lead to the development of ERATOSTHENES Centre of Excellence services. The high quality and innovative research are expected to significantly impact not only the scientific community but also stakeholders, policymakers and the general public.

The **Education Area** focuses on developing critical skills in Earth observation through activities such as the MSc & PhDs hosting programme, a Skills Development Centre and a Professional Training Programme.

The **Entrepreneurship Area** is responsible for ensuring the sustainability of the ERATOSTHENES Centre of Excellence and stimulating national and regional growth through the exploitation of the IPR, licensing of innovation and market uptake of new Earth observation-based products, services and solutions generated by the ERATOSTHENES Centre of Excellence and the Strategic Partners. The Centre is dedicated to developing an entrepreneurial mentality within the Space related research areas to connect with industry through its networking and knowledge hub.

The ERATOSTHENES Centre of Excellence considers innovation as the key and core aspect that ensures the sustainability of the Centre and contributes to national, regional and European prosperity in economic, social and environmental terms. Therefore, the Centre is dedicated to supporting the development of innovative start-ups in the Earth Observation field and cultivating the Space Technology ecosystem in Cyprus and the Eastern Mediterranean, Middle East and North Africa region through incubation and acceleration services. The Centre will be launching a Space BIC program that will aim to promote, stimulate and develop innovative start-ups through the delivery of effective incubation processes, with the goal of contributing to the development of novel space technologies and applications and in general to the growth of the Space Startup ecosystem in Cyprus with the goal of contributing ultimately to regional/local economic development. The program will support entrepreneurs with the ambition of exploiting space technology applications and systems. In addition, the Centre is active in developing an entrepreneurial mindset in researchers through targeted training so that research activities can lead to innovative Earth observation applications, technologies and services. For this purpose, the Office of Innovation of Eratosthenes Centre of Excellence (InECoE) was established to provide the administrative infrastructure for the procedures for IPR development for all ECoE researchers and staff for exploitation of our research results. To advance excellence in Earth observation and encourage collaboration between scientists, the Living Labs Program has been developed, which combines network activities with research infrastructure and network for collaboration to provide services for the benefit of society and the economy.

The ERATOSTHENES Centre of Excellence aims to strengthen the interaction between scientific researchers and local as well as broader EMMENA region stakeholders through the Networking & Knowledge Hub, to foster the cross-fertilisation of ideas and uptake of ERATOSTHENES Centre of Excellence's research and innovation output. This will be accomplished through the networking platform to foster stakeholder registration and interaction in an organised way. The end-users will be able to network with other researchers with complementary expertise, promote their institutes and enhance communication and visibility, make common research efforts, facilitate the transfer of knowledge and data sharing, as well as exchange knowledge.

The ERATOSTHENES Centre of Excellence is dedicated to social responsibility, accomplished by awareness, interaction, involvement and engagement with the public and stakeholders. The objective of the activities is to inform and engage with the wider public regarding the beneficial impact of the research conducted on the environment, society and the economy. The ERATOSTHENES Centre of Excellence is active in social responsibilities, especially in climate change, natural and built environment, environmental protection, disaster management and cultural heritage, among others. Several activities include the digitization of archaeological sites and churches as well as environmental monitoring and protection using Earth observation and remote sensing techniques, including drones, ground penetrating radar, Geographical Information Systems, etc.

The ERATOSTHENES Centre of Excellence is focused on establishing a state-of-the-art institution in the Earth observation sector that is dedicated to collaborating with the industry, society, academia and Government in joint projects, proposals, networks, initiatives, etc., to provide a more effective framework where Earth observation can be used to provide vital information for decision-making and quality of life. The ERATOSTHENES Centre of Excellence foresees innovation as the key and core aspect for ensuring the sustainability of the Centre and its contribution to the National, regional and European prosperity in economic, social and environmental areas.

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ABSTRACTS

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ID: 0001

LONG-TERM EXPOSURE TO ULTRAFINE PARTICLES AND NEURODEGENERATIVE DISORDER-RELATED MORTALITY

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Keywords: Ultrafine particles, neurodegenerative disorder, mortality, long-term exposure

Abstract: Background: Ultrafine particles (UFP) emerged as a particularly concerning air pollutant due to their potential adverse health effects, especially on neurodegenerative diseases. However, the health effects of UFPs are not yet fully understood, partly due to limited monitoring and studies. This study aims to explore the association between long-term UFP exposure and neurodegenerative disorders mortality, considering social demographic disparities, seasonal patterns, and the modifying effects of meteorological factors and other critical air pollutants (i.e., O3, NH3, SO2, summer temperature, winter temperature, and relative humidity). Methods: We used a Difference-in-Difference design at the county subdivision level in New York State (NYS) from 2013 to 2019, with exposure data on UFPs, other pollutants, and meteorological factors simulated using GEOS-Chem-APM at 17*17 miles refined resolution. Mortality data on neurological disorders was obtained from Vital Records for Upstate NY and NYC. Results: Neurodegenerative disorder-related mortality and its subtypes (i.e., Alzheimer, Dementia, and Parkinson) generally increased over the period from 2013 to 2019 in NYS, with a significant association between UFP exposure and excess risk of neurodegenerative disease-related mortality (ERIQR=6.49), particularly Alzheimer's (ERIQR=20.93). Females, Hispanics, non-Hispanic whites, older adults (>=65 yrd), and individuals living in urban or suburban areas showed a significant excess risk from UFP exposure (ERIQR ranged from 8.27 to 49.21). The UFP-mortality association was significant during winter (ERIQR=8.74), but not in other seasons. The modification effects of meteorological factors and other air pollutants on UFP- mortality associations were not statistically significant.

Conclusions: These findings indicate a long-term association between UFP exposure and Neurodegenerative disorder-related mortality, particularly Alzheimer's, with higher risks observed among specific demographic groups. However, Meteorological factors or other air pollutants did not modify the associations.

ID: 0002

GENERATION OF DIGITAL TERRAIN MODELS FROM DIGITAL SURFACE MODELS USING A WATERSHED TRANSFORMATION APPROACH

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Keywords: l Surface Model, Digital Terrain Model, DSM, DTM, Watershed-transformation, Urban Digital Twin, 3D City Model

Abstract: The basis of Urban Digital Twins are 3D city models generated from airborne or spaceborne remote sensing imagery. These remote sensing data allows the extraction of digital surface models (DSMs) representing the absolute geographical height of each pixel together with orthorectified image mosaics. But for the derivation of a city model also the height of the urban objects and the height of the ground – the digital terrain model (DTM) – is needed. So in a first step there has to be a method to derive the digital terrain model (DTM) from the generated digital surface model (DSM). The extraction of DTMs from DSMs is such a basic task for many decades and there are many approaches but still there is no general fully satisfying solution for this demand. In this paper we present a novel method for deriving a DTM from a provided urban DSM based on

the inverted watershed-transformation. The watershed-transformation normally fills up sinks in a DSM up to a ridge-line where two sinks meet. So, the result is a segmentation of a DSM to distinct sinks. Using the inverted watershed-transformation delivers a segmentation to single elevated objects. The boundary points where each of these elevated segments meet are taken as possible candidates for ground areas. But such boundaries may also lie, for example between adjacent roofs. Using a dynamically determined threshold in the height distribution of each watershed segment gives a possible ground candidate area of the segment. Merging all ground candidate areas and taking only larger areas with special properties into account gives all ground candidates. Keeping only the heights of these areas as real ground and filtering and filling them gives the final DTM. In the presented paper we describe the method in detail and apply the method to different DSMs of rather flat and hilly urban and non-urban environments, discuss the results and give finally an evaluation of the quality of the results.

ID: 0003

CYPRUS' STRATEGIC ROLE IN EU GOVSATCOM: END-USER REQUIREMENTS AND INDUSTRIAL CAPABILITIES FOR SECURE SATELLITE COMMUNICATIONS

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Keywords: GOVSATCOM, IRIS2, EGNOS, Galileo, Space Situational Awareness, Secure SATCOM, GNSS, Surveillance, Crisis Management, Humanitarian aid, Civil Protection, Law Enforcement Interventions, Key Infrastructure

Abstract: The development of Governmental Satellite Communications (GOVSATCOM) is a fundamental component of the European Union's foreign and security policies, ensuring secure, resilient, and high-speed satellite communications for governmental authorities. Given its strategic geopolitical position and geographic distance from the EU mainland, Cyprus is well-placed to address critical security and connectivity requirements through GOVSATCOM.

This work, conducted under the ESA CALL "ESA AO/1-11236/22/NL/SC" and funded through the Plan for European Cooperating States (PECS), identifies and classifies the specific requirements for implementing GOVSATCOM in Cyprus. Based on institutional end-user needs and use cases, it proposes a governance framework and infrastructure tailored to Cyprus's strategic role.

The study's key objectives include defining mission requirements, establishing the Competent GOVSATCOM Authority (CGA), and developing a secure local infrastructure integrated with the EU GOVSATCOM Hub. Additionally, it explores the potential integration of quantum communication technologies for secure satellite communications while assessing industry market competency. The study provides a comprehensive overview of Cyprus's capabilities in the satellite communications sector, highlighting both strengths and areas for improvement.

Mapping industrial capabilities underscores Cyprus's strategic role in supporting GOVSATCOM by leveraging its geographic advantages and existing infrastructure for regional service provision and European partnerships.

The findings reveal significant opportunities for local industry synergies across ground, space, and user segments, alongside government-led initiatives aimed at enhancing competitiveness. The study highlights the advantages of GOVSATCOM and its industrial potential within the IRIS² framework, particularly in the field of Quantum Communications, to ensure the highest level of security. Furthermore, it emphasises the importance of fostering collaboration between

governmental and private stakeholders while demonstrating Cyprus's readiness to contribute to EU satellite communication initiatives.

ID: 0004

CYPRUS USER ACCESS MANAGEMENT TO MULTIDOMAIN MARKETPLACE (CUAM3)

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Keywords: Civil Security, SatCom, Earth Observation, Disasters, Emergencies, Marketplace, Cyprus

Abstract: CUAM3 is an ESA-funded project that seeks to integrate space technology such as earth observation (EO) and satellite communications products, into the internal processes of governmental users in Cyprus dealing with civil security emergencies.

The project focuses on two critical disasters relevant to Cyprus: earthquakes and wildfires. By leveraging CUAM3, users can more effectively respond to emergencies and reduce the impact of natural disasters.

CUAM3 achieves this objective by creating a marketplace that aggregates demand for satellite communications with EO products and services, thus reducing costs for users while fostering a customer base for space businesses.

Building on the success of other ESA projects, (Cyprus GOVSATCOM study) CUAM3 is integrated with the GOVSATCOM Hub (SatCom services) and the Civil Security from Space (CSS, for Earth Observation products). As this project is overseen by ESA project and coordinated by European University Cyprus (EUC), CUAM3 brings together expertise to create a comprehensive solution for Cyprus' public institutions.

ID: 0005

EVALUATION OF PRE-PROCESSING METHODOLOGIES FOR NORMALIZED VEGETATION ANALYSIS DATA.

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Keywords: NDVI; Time Series Analysis; Remote Sensing; Machine Learning; Google Earth Engine; Data Processing

Abstract: Global climate change and human activities have increasingly put pressure on ecosystems, making the monitoring and analysis of vegetation change essential for addressing environmental challenges and promoting sustainable development. This is particularly critical in Mediterranean climate zones, where seasonal variations and extreme weather events significantly impact ecosystem health. By systematically analyzing NDVI (Normalized Difference Vegetation Index) data, it becomes possible to assess long-term vegetation dynamics, predict ecological degradation, and anticipate extreme climate events. Such analyses provide valuable scientific insights for ecological restoration, land management, and water resource protection. Therefore, long-term vegetation monitoring not only aids in natural resource conservation but also enhances

decision-making in agriculture, forestry, and water resource management, contributing to ecological sustainability and improving society's capacity to respond to climate change.

This study focuses on the Troodos Mountains in Cyprus, where 100 random points were selected using Google Earth Engine (GEE) to extract NDVI data spanning from 1985 to 2020. The data underwent a rigorous process of missing value and outlier detection, followed by the application of established data filtering techniques. To ensure temporal consistency, the NDVI data was resampled to create a time series with a fixed 15-day interval between each data point. This comprehensive data pre-processing approach lays a solid foundation for further analysis of vegetation trends, facilitating informed decision-making in ecological conservation and environmental management. In this paper we will present the performance of several pre-processing methodologies on NDVI data.

ID: 0006

EMPLOYING SPATIAL QUERIES IN QGIS: IDENTIFICATION AND EVALUATION OF POTENTIAL SITES FOR FOREST NURSERIES INSTALLATION IN THE LIMASSOL REGION.

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Keywords: Qgis, Optimal land use selection, Forest artificial regeneration, Forest ecosystems, Limassol – Cyprus

Abstract: Geographic Information Systems (GIS) are a modern instrument for administering, applying, and processing spatial and temporal data. This technology guarantees secure and reliable data in parallel with a steady and valid flow of information. The proficiency in utilizing GIS has allowed modern societies to achieve precise and rational conclusions, particularly when various decision-making centres are called upon to engage with phenomena, processes, and activities that are intricately connected to the broader economic and social dimensions of human activity.

Integrating GIS into the comprehension, prediction, analysis, and surveillance of forest fires in science has for many years fostered collaboration among diverse socioeconomic stakeholders, including governmental bodies, academic institutions, and various organizations, to address this devastating issue. As a cause-causation of Climate change, forest fires are the dominant threat to Cypriot Forests. Given the sluggish natural regeneration of the island's forests, primarily caused by climatic constraints, steep terrain, and inadequate moisture and precipitation, there is an urgent need to implement artificial reforestation strategies.

This study seeks to identify and define suitable locations for establishing and managing nurseries in the Limassol prefecture, which local forestry services and various public or private entities can leverage. The optimal selection of nurseries guarantees a reliable supply of plant resources to entities participating in the activities and initiatives focused on the artificial regeneration of Cypriot forests. Such nurseries are envisioned to facilitate future reforestation projects while fostering economic growth and activity among the mountain and peri-urban populations. The study's workflow is within the Qgis free software environment, leveraging satellite imagery from the Limassol provincial unit, the latest Land Use Cover maps, Digital Elevation Model maps, and maps of ecologically vulnerable areas and regions under conservation protection. Data regarding the hydrographic and road networks of the examined area are also employed. The conclusive selection of viable locations involves critical information related to the cultivation of native forest species, such as Pinus nigra and Pinus silvestris, as well as factors that facilitate the seamless and continuous operation of the nurseries.

Findings from the study demonstrate that the ideal areas for establishing and managing nurseries in the wider Limassol prefecture are confined to the northern mountainous massif. These areas are

scattered and vary in size, situated within zones of existing forest ecosystems and accessible through the current road network alongside the existing hydrographic net. This study aspires to be an integral part of the framework for forthcoming assessments and evaluations focusing on identifying suitable areas for rational grazing, pasture farming, sustainable hunting, agrotourism, and selecting prime locations for establishing tourist units.

ID: 0007

APPLICATION OF SENTINEL-2 SATELLITE DATA FOR MONITORING SNOW COVER IN TERRITORY OF RILA MOUNTAIN, BULGARIA

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Keywords: Satellite data, Normalized Difference Snow Index (NDSI), snow cover, climate change

Abstract: In the present study, optical satellite data from Sentinel-2 MSI for a period of 10 years, for the month of April, from the territory of Rila Mountain were used. For each year of the selected time period, a Normalized Snow Difference Index (NDSI) was generated for each month of April, and the dynamics of the spatial distribution of snow-covered areas was observed based on the values derived from the applied NDSI index. Individual threshold values were determined for each generated index and results were obtained including the estimated snow-covered areas during the study period. The results on the dynamics of snow cover in the Rila Mountain region are of great importance, as it is the highest mountain in the Balkans and can serve as an indicator target for monitoring climate change and global warming at local and regional level. The results obtained in the study can be used and integrated for ongoing observations, studies and scenarios on the impact of climate change on hydrology, agriculture, forestry, biodiversity etc. at local and regional level.

ID: 0008

SENSING UNDERWATER LANDSCAPE OFF COASTAL CITIES: IMPLICATIONS FOR BETTER MANAGEMENT STRATEGIES

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Keywords: Multibeam echosounder, coastal geomorphology, anthropogenic features, hydroacoustics, Lesvos Island

Abstract: Coastal zone hosts a number of seafloor features formed both by natural processes and human activities. The last decades, satellite, aerial and marine remote sensing techniques are utilized to map the coastal environment, however it is undisputed that the increased spatial resolution of Multibeam Echo Sounders (MBES) provides the best means for accurate seabed mapping. During this study a Teledyne Reson SeaBat T20-R MBES was used to map the coastal area off Mytilene, aiming to develop an inventory of coastal features based on hydroacoustic measurements, to classify them according to their potential origin and to define their geophysical and geomorphological parameters.

The surveyed area covered approximately 58 km², located within a 12 km radius of Mytilene port, and revealed several intriguing features that were classified into three categories. First, those certainly produced by physical processes. These include a paleochannel that hosts locally mounded structures probably of biogenic origin (coralligenous), bedforms that may hold a potential for

marine aggregate extraction and the identification of the deep boundary of Posidonia oceanica meadows. P. oceanica deeper limit was found to lie within a critical anchoring zone for large cruise ships, a region that cannot be effectively monitored using satellite imagery. Secondly, evidence of anthropogenic activities was documented, including dumped materials, anchor scars, fishing (trawling) marks, whilst within the port the survey managed to delineate the extent of the heavily disturbed seabed due to anchoring scars, and to observe small boat wrecks and signs of instabilities around the dock. Last, features of unknown origin included a large, elongated depression (400 m long) surrounded by P. oceanica meadows along with deeper-seated smaller depressions, as well as rhythmic but complex geomorphological structures off the Medieval castle of Mytilene. Despite the high-resolution information from the MBES, the backscatter and various extracted derivatives (slope, curvature, roughness, bathymetric position index) interpretation uncertainties will remain unless a detailed ground truthing campaign, using optical and sediment sampling instrumentation, will be performed.

The findings from this study provide essential information to guide further investigations into the origin, composition, and ecological significance of these features. Moreover, the data could support the designation of protected marine habitats, the sustainable management of resources, and the mitigation of human impacts, ensuring the preservation of the region's natural and cultural heritage. Thus, they are considered of critical importance for local authorities, port authorities, archaeologists, and tourism stakeholders. If this number of features were detected in this rather small and not so busy area, like Mytilene city, one could only imagine what could be discovered in the coastal zones of larger and busier cities.

ID: 0009

ONE YEAR OF GROUND-BASED SOLAR IRRADIANCE MEASUREMENTS: DATA QUALITY ASSESSMENT AND INSIGHTS FROM LIMASSOL CYPRUS SITE

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Keywords: Solar Radiation Measurements, solar energy, climatic research, Cyprus

Abstract: This study presents a comprehensive evaluation of the first year (2024) of ground-based solar radiation measurements conducted at Limassol, Cyprus [34.67˚ N, 33.04˚E, altitude of 31m]. The data include global horizontal irradiance (GHI), direct normal irradiance (DNI), and diffuse horizontal irradiance (DHI), with an annual availability exceeding 99%. The measurements underwent rigorous quality control procedures, including range, closure, and consistency tests, ensuring the reliability of the dataset. Annual sums of irradiance reveal a total of [1941 kWh/m²], with DNI contributing [2266 kWh/m²], emphasizing the region's high solar energy potential. Temporal variations indicate peak solar energy availability during summer, with marked diurnal and seasonal patterns influenced by solar zenith angle and atmospheric conditions.

The station follows the Baseline Surface Radiation Network (BSRN) recommendations for quality control procedures, ensuring robust and reliable data for long-term analysis. Closure tests were performed to verify the consistency among the radiation components by assessing the ratio of diffuse to global horizontal irradiance (DHI/GHI) and the ratio of global horizontal irradiance to the sum of direct and diffuse irradiance (GHI/(DNI + DHI)). Both ratios are expected to remain close to 1 under normal conditions, indicating the physical coherence of the measurements. The results

confirmed the dataset's accuracy, with minimal deviations observed under specific atmospheric conditions.

These measurements represent the first year of operation, but the station is designed for long-term monitoring to support ongoing research and regional energy planning. The dataset serves as a benchmark for validating solar energy forecasting models and investigating atmospheric radiative transfer processes. Furthermore, the findings underscore the value of continuous, high-quality ground-based measurements in addressing regional energy planning and climatic research needs.

ID: 0010

CFAR-BASED AUTOMATIC SHIP DETECTION EXPLOITING POLARIMETRIC CORRELATION DESCRIPTORS

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Keywords: CFAR, Ship detection, SAR, Marine Security

Abstract: Ship detection is an important task of ocean remote sensing, where Synthetic Aperture Radar (SAR) serves as a valuable tool for delineating and monitoring moving ships in coastal areas and beyond. SAR-based ship detection has emerged as a significant research topic with remarkable improvements in recent years due to advancements in SAR technology from co-pol to dual or quad-pol. Commercial applications include cargo monitoring, illegal fishing operations, and tracking a specific ship.

SAR provides a reliable remote sensing solution for detecting ships over vast oceanic regions under all-weather and day-night conditions. However, ambiguities often arise due to variations in the normalized radar cross-section (NRCS), hindering accurate detection. To address these challenges, we leverage correlations between polarimetric channels—copolarized, cross-polarized, and dual-polarized modes—to effectively mitigate these ambiguities. By integrating these polarimetric correlation descriptors with a constant false alarm rate (CFAR) algorithm, we achieve robust automatic ship detection.

Our approach explores both bimodal and statistical distributions of SAR data to make use of CFAR thresholding (T_{CFAR}) for ship detection effectively. For a balanced ship and water pixels classes, experimental results demonstrate that the proposed framework yields high detection accuracy with minimal root mean square error (RMSE), outperforming conventional methods significantly. This validates the robustness of combining correlation descriptors with CFAR as a promising framework for automated ship detection in SAR imagery.

The application of this framework to SAR data from the Mediterranean Sea near Cyprus showcases its potential not only for accurate ship detection but also for addressing maritime security challenges by preventing illegal activities.

ID: 0011

EXPLORING MULTITEMPORAL REMOTE SENSING FOR SUBTERRANEAN FEATURE DETECTION

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Keywords: Multi-temporal remote sensing, Subterranean structures, Spectral anomalies

Abstract: his study proposes a novel remote sensing methodology designed to detect subterranean structures by analyzing surface traces through satellite imagery. The motivation for developing this method arose from the operational requirements of the Thessaloniki Water Supply and Sewerage

Company (EYATH), which manages a 52-kilometer subterranean water transfer pipeline that supplies approximately 35% of the water consumed in Thessaloniki, a city with a population exceeding one million residents. The methodology was specifically developed to precisely locate the reinforced concrete water pipeline, detect potential water leakages, and evaluate its structural integrity. While initially fitted to meet the specific operational challenges of EYATH, the approach demonstrates significant potential for adaptation and application to other use cases.

The methodology is based on the principle that subterranean structures alter surface soil conditions, creating detectable spectral variations due to changes in soil moisture, nutrient distribution, and vegetation stress. These anomalies, often subtle and inconsistent, are challenging to detect with conventional remote sensing techniques. To address this, the approach integrates multi-temporal satellite imagery to generate synthetic maps that enhance the visibility of such traces. The process begins with acquiring georeferenced satellite or aerial imagery, corrected for geometric and atmospheric distortions. A grid-based framework extracts pixel-level spectral data, which is standardized into grayscale values to detect subtle variations. Data normalization, based on mean grayscale values of sampling points and their surroundings, enhances significant anomalies while reducing environmental noise. The normalized data is combined into synthetic maps that aggregate multi-temporal information, highlighting surface traces linked to underground features. An exponential transformation amplifies critical patterns while suppressing irrelevant variations. These maps are then manually analyzed to identify areas of interest where traces indicate potential subsurface structures.

The method successfully identified the location of a 2-meter-deep water transfer pipeline managed by EYATH and highlighted time periods and areas with pronounced surface traces, warranting further investigation. Variations in detectability were attributed to subsurface processes and interactions between the pipeline and surrounding soil, including moisture distribution and soil composition. These results emphasize the importance of in situ validation, such as test trenches, to improve accuracy. Additionally, validating the method on subterranean structures with known locations is essential to evaluate its sensitivity, reliability, and broader applicability. Collaborative efforts among remote sensing specialists, archaeologists, geologists, and environmental scientists, accounting for soil properties, vegetation conditions, and characteristics of underground structures, will enhance the validation and refinement of this approach.

ID: 0012

THE STUDY OF THE IMPACT OF GEOLOGICAL, PETROGRAPHICAL, ENVIRONMENTAL CONDITIONS, AND DETERIORATION FACTORS ON THE ARCHAEOLOGICAL SITE OF THE TOMBS OF THE KINGS IN PAPHOS, SW CYPRUS

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Keywords: Tombs of the Kings, failures, mineralogical perspective, environmental conditions, seismicity

Abstract: The study area is located in Paphos, at the archaeological site of the necropolis on the northeastern side of the city, outside the fortification wall. This site spans approximately 1.2 square kilometers and is about 150 meters away from the coastal zone, and is referred to as the "Tombs of the Kings." The "Tombs of the Kings" appear to have served as a burial site for the political and administrative elite of the capital of Cyprus during the Ptolemaic period. The "Tombs of the Kings" are rock-cut burial monuments and are regarded as one of the few remaining examples of Hellenistic architecture in Paphos. As a result, UNESCO recognizes it as part of the international cultural heritage and its preservation is considered vital. The site consists of eight burial monuments. This paper focuses on tombs 3 and 4. The paper aims to examine the existing failures

related to the rock quality and environmental conditions of the two identified tombs. To achieve this, measurements were taken to determine the orientation of the primary tectonic discontinuities and rock fractures, while petrological samples were collected along with photographic documentation of damage and failure sites in the surrounding area. It is also known that this archaeological site was used as a quarry from the Hellenistic through the Roman period. This led to the extensive removal of stone blocks for the construction of the city of Paphos and its surroundings. This extraction process has caused deterioration in the quality of the stone blocks over time. Additional deficiencies were also found on both the surface and underground sections of the monument. Due to the various uses of the site and the resulting deterioration, it is challenging to trace the origins of the failures. However, based on up-to-date scholarly work and field observations, an attempt has been made to identify potential causes of the monument's degradation. Possible factors include its proximity to the coastal zone of Paphos, the area's high humidity levels, and winds carrying sea-water droplets enriched with salts and sand grains, which contribute to the development of the "honeycomb" phenomenon. The study of cracks in the monument which seem to align with a fault running in a north-south direction, indicates that micro-seismicity in the region plays a significant role in the monument's deterioration. Lastly, despite the monument being made of high-porosity limestone, air pollution does not appear to have a significant impact on its condition.

ID: 0013

THE ROLE OF AGRICULTURAL ADVISORY SERVICES IN FACILITATING THE ADOPTION OF NEW TECHNOLOGIES BY YOUNG FARMERS IN THE MUNICIPALITY OF SERRES

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Keywords: Agricultural Innovation, Advisory Services, Technology Adoption, Municipality of Serres

Abstract: Emerging challenges facing agriculture, such as population growth, climate change and the production of agri-food products using sustainable methods, lead to the adoption of innovative technologies. The cornerstone of the production chain is young farmers, who are called upon to respond to these challenges. This study investigates the role of agricultural advisory services in the adoption of innovative technologies by young farmers in the Municipality of Serres, Greece. A survey was conducted between May and August 2024 to collect data. The results demonstrate a general acceptance of the adoption of new and innovative methods of agricultural production with a simultaneous acceptance of receiving agricultural advice from competent scientists for a fee. At the same time, the hypothesis that examines the relationship between "payment for advisory services" and "innovation implementation" is examined. Finally, through the research findings, it is demonstrated that the provision of agricultural advice is directly associated with overcoming difficulties in adopting innovative technologies, promoting sustainable practices and increasing productivity.

ID: 0014

ASSESSMENT OF ELECTROMAGNETIC RADIATION IN THE URBAN ENVIRONMENT

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Keywords: Electromagnetic radiation; electric field; Electromagnetic pollution, environmental legislation, EMF monitoring

Abstract: With the development and improvement of mobile communications, a very topical issue in urban areas is electromagnetic pollution (EMP) from telecommunication technologies. These are the so-called artificial sources of electromagnetic fields that affect the environment and living organisms. The paper presents an analysis and evaluation of results from measurements of electromagnetic radiation from base stations of mobile operators in a sparsely urbanized environment. The presented results were obtained using mobile measurement equipment Narda AMB-8057-03 in the frequency range 100 kHz to 7 GHz. This frequency range covers the frequencies of all mobile operators operating on the territory of Bulgaria and allows tracking the dynamics of electromagnetic emissions from the antennas, on weekdays and weekends. The observed dynamic changes were analyzed as a function of local time, distance from base stations, data traffic load, and the characteristics of the surrounding environment. The data obtained prove that the measured levels of electromagnetic fields are safe, according to current national legislation and European standards. The development of mobile communications requires continuous monitoring and control of electromagnetic pollution, through the construction of systems for monitoring electromagnetic emission.

ID: 0015

SPECTRAL MAPPING OF AN UNREGULATED DUMP AROUND SOFIA MUNICIPALITY

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Keywords: climate change, satellite data, Landsat 9, Sentinel - 3, LST, unregulated dump

Abstract: Landfills are a source of heat and form their own thermal field, which is different from the natural thermal background of the environment, leading to the generation of thermal pollution, which is formed through the processes of biochemical decomposition of waste [1], and this in turn leads to the formation of local heat islands. Monitoring landfills (regulated or unregulated), their thermal pollution and dynamics by remote methods has a number of advantages that make these methods extremely effective. This is because remote sensing (RS) contributes to greater safety and accessibility for researchers, the observation of multiple parameters, much more effective monitoring of landfills, devoid of the subjective factor, easy detection of illegal landfills and efficiency. This type of monitoring contributes to the Assessment of the risk of natural disasters, control over the tracking of recycling and waste, reduction of financial costs for in-person monitoring and, last but not least, generation of a large database for climate analyses. This study presents various approaches to spatial data analysis that can be used to locate and map unregulated dumps located within the Sofia Municipality. Various methods for visualization and interpretation of satellite data have been used.

Composite images from the multispectral instrument (MSI) of the Sentinel 2 platform of the Copernicus program of the European Space Agency were used. The surface temperature of the landfill was calculated using the heat (THERMAL) bands from the Landsat as Landsat 8, Landsat 9 (OLI / TIRS) and Sentinel 3 SLSTR sensors. Data from different seasons and years were used in order to monitor the dynamics of thermal pollution in the study area. Assessment of the territory on which the unregulated dump located has been made.

ID: 0016

ECOLOGICAL ASSESSMENT OF SHABLA TUZLA LAKE USING SATELLITE METHODS FOR THE PERIOD 2017–2024

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Keywords: Satellite data, Sentinel, Wetlands, Monitoring, Modeling, Indices

Abstract: Shabla Tuzla is a saline lake-lagoon located approximately 3.7 km east-northeast of the town of Shabla, Bulgaria. The lake is separated from the Black Sea by a sandbar. During the summer months, the lake often nearly dries up. Its bottom is covered with therapeutic mud (hydrogen sulfide sludge), with reserves exceeding 200,000 tons, which are used for mud therapy. The wetland is of critical importance for the conservation of rare and endangered animal species and habitats. Shabla Tuzla falls within two categories of the European Ecological Network NATURA 2000.

To support the work of local authorities and conservation organizations, an eight-year monitoring period (2017–2024) was conducted using satellite data.

Recent advancements in high-resolution satellite imagery and data from the European Space Agency's Sentinel missions have significantly enhanced the ability to monitor ecological and hydrological processes in Shabla Tuzla Lake. The Sentinel-2 satellites, equipped with multispectral sensors, are particularly well-suited for detailed land and vegetation monitoring, while the Sentinel-3 satellites provide critical data on surface temperature, water color, and altimetry. These datasets provide comprehensive long-term information on water and environmental resources, facilitating the examination of trends such as variations in water levels, shifts in vegetation patterns, and the detection of potential contamination sources. This research employs Sentinel-2 and Sentinel-3 satellite data to investigate the spatiotemporal dynamics of the area between 2017 and 2024, offering critical insights into ongoing environmental changes and supporting informed strategies for sustainable management and conservation. An index-based classification was used in the study, for classifying the contents within the wetlands boundaries. The results demonstrated the effectiveness of these indices in facilitating accurate mapping and monitoring of wetland areas, providing valuable insights into their ecological characteristics and changes over time.

ID: 0017

MONITORIG OF SOLAR PARK "GORNA MAHALA" BY REMOTE SENSING AND GIS

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Keywords: Climate change, Digital Twins, LST, Sentinel 3, Renewable energy

Abstract: Monitoring through satellite data, in situ (including spectrometer data, GPS, thermal camera), Open data, data from various devices and Unmanned aerial vehicles (UAV) in the selected anthropogenic sites is of extremely high ecological importance for tracking natural processes, the consequences of climate changes. The timeliness of the data and the spatial extent of the observed objects allow satellite information to be reliable in monitoring and making predictions about the risk and potential risk of natural disasters, rise of average air temperatures and anthropogenic pollution. Solar parks are a source of heat from their own thermal field, which is different from the natural thermal background of the environment. In some cases, solar panels might cause changes in the albedo (reflectivity) of the land, which could potentially alter local microclimates. This could lead to slight changes in temperature, which may affect local flora and fauna. Last but not least,

large solar parks require significant amounts of land, which can lead to habitat destruction, especially in areas where the land is rich in biodiversity. Satellite data can collect large amounts of data in a short period of time, eliminating the need for prolonged fieldwork or expensive surveys. This makes them a highly efficient tool for gathering data in remote or hard-to-reach areas. Data from the Multispectral Instrument (MSI) of the Sentinel 2 platform of the European Space Agency's Copernicus program, spectrometer (380-780nm) and drone data were used. Landsat sensors and data from Sentinel 3 (EUMETSAT) were used to calculate the land surface temperature of renewable energy sites such as photovoltaic parks.

ID: 0018

MONITORING APPLE SCAB EPIDEMIOLOGY IN A CHANGING CLIMATE: INTEGRATING PRECISION TOOLS AND ADAPTIVE MANAGEMENT STRATEGIES

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Keywords: Apple scab, decision-support systems (DSS), agricultural advisory services, farmer-centered advisory, fungicide, infection risk modelling

Abstract: Climate change is significantly impacting agricultural practices, particularly in the management of plant diseases such as apple scab, caused by the fungal pathogen Venturia inaequalis (Cooke) G.Wint. Traditional fungicide applications, while effective, often rely on calendar-based schedules, leading to overuse and environmental concerns. The integration of precision agriculture tools, such as addVANTAGE Pro (in conjunction with Adcon's telemetry devices) and RIMpro decision-support systems (DSS), offers a promising approach to optimize fungicide use while maintaining effective disease control. Agricultural advisors play a crucial role in bridging the gap between technological innovation and on-farm implementation, providing tailored guidance to growers on interpreting DSS outputs, calibrating models to local microclimates, and transitioning to dynamic, data-driven spray regimes. Both DSS utilize weather data, pathogen biology, and infection risk models to provide real-time recommendations for fungicide applications.

For three consecutive years, we explored the epidemiology of V. inaequalis under local climatic conditions in an experimental apple orchard (cv. Fuji) of 0.4 ha, located in the area of Polykarpi, Kastoria, Northern Greece. Warmer temperatures and shifting precipitation patterns are influencing the pathogen's life cycle, necessitating adaptive management strategies. Three-year field trials have demonstrated that DSS-guided spray programs reduced fungicide use by up to 25% compared to conventional methods, without compromising disease control efficacy. This underscores the importance of advisory services in disseminating region-specific best practices, conducting hands-on training for technology adoption, and fostering farmer confidence in precision-based interventions. Furthermore, we observed that apple scab symptoms strongly align with the phenological stages of the crop (symptom initiation remains stable annually). These findings highlight the dual benefits of addVANTAGE Pro and RIMpro in enhancing sustainability and resilience in apple production.

Advisory frameworks must also emphasize continuous, iterative learning—equipping growers with tools to monitor shifting disease pressures and adjust strategies collaboratively with researchers and extension specialists. As climate change continues to challenge traditional pest management practices, decision-support systems, coupled with robust advisory support, will play a critical role in enabling growers to adapt while reducing reliance on chemical inputs. This study underscores the importance of integrating technology, climate-smart strategies, and farmer-centered advisory systems to ensure the long-term viability of apple cultivation in a changing environment.

ID:0019

ASSESSMENT OF MOSSES IN ANTARCTICA AND BULGARIA BY REMOTE SENSING AND CHLOROPHYLL FLUORESCENCE

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Keywords: DinSAR, earthquake, Tibet, co-seismic displacement

Abstract: The earthquake on January 7, 2025, with a magnitude of 7.1, occurred in the southern Tibetan Plateau, north of the boundary between the Eurasian and Indian plates. The rupture occurred on a roughly north-south striking fault, dipping moderately to the east or west. The continental collision between the Indian and Eurasian plates drives the uplift of the Himalayan Mountains. The region near the India-Eurasia plate boundary has a history of large earthquakes. In the past century, there have been numerous earthquakes of magnitude 6 and greater in the research region of the January 7, 2025 earthquake.

Sentinel-1 is an important mission for monitoring seismic activity on Earth with its InSAR capabilities. Sentinel-1 is the first space component of the Copernicus program. The satellites perform interferometric SAR scans of the Earth's surface to create paired or multiple interferograms—images that reveal changes in the landscape over large areas in high detail.

Interferograms are visualized with optical interference patterns of light that reflect together to form a colorful and comprehensive map. The colored stripes represent changes in the topography/surface of the Earth due to seismic activity, each corresponding to a 28 mm displacement. To determine the Earth displacements that have occurred, we need data from two radar images: the first before the event and the second after the earthquake.

To determine the displacements that occurred after the earthquake on January 7, 2025, we processed Sentinel-1 TOPS (Terrain Observation with Progressive Scans) SAR images (C-band with radar wavelength of 5.6 cm) from two different viewing geometries. We used 8 radar images in total, from 3 overlapping ascending and descending tracks (ascending: tracks 12; descending: tracks 48, 121) of the Sentinel-1 A satellites operated by the European Space Agency (ESA; Figure 1 and Figure S1 in Supporting Information S1). The fault, including its main central segment and several faults in the S-N direction, is entirely covered by the InSAR data. We used two different models to mitigate topographic contributions to the interferometric phase DEM, such as: Shuttle Radar Topography Mission (SRTM) 1 arc sec (~30 m resolution) digital elevation model (DEM) and Copernicus DEM (30 m resolution) digital elevation model (DEM). Following interferogram formation, we applied the Goldstein phase filter for reducing the phase noise contribution to the signal, which is well-suited for measuring tectonic deformation around active faults.

The determined displacements along the line of sight (LOS) are then decomposed into vertical displacement and the west-east component of deformation.

The earthquake and the fault are located at the boundary, exactly where eastward rotation occurs. We determined the displacement in the eastward direction, but due to the almost polar orientation of the satellites' orbits, we cannot calculate the displacements in the S-N direction.

ID: 0020

THE ROLE OF WHOLESALE AND RETAIL MARKETS IN THE SUPPLY CHAIN FOR FRESH FRUITS AND VEGETABLES IN GREECE

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Keywords: wholesale, retail markets, supply chain, fresh fruit and vegetables

Abstract: Greece, being an acknowledged producer of fresh fruits and vegetables, produces 1.582 million tons. Greek fresh fruit and vegetable exports for 2024 increased by 8.2% to exceed 1.861 billion euros. This effort for higher quality production is very vital later than assisting all the stakeholders in the fresh supply chain. Specifically, the wholesalers ought to develop excellent cooperation with producers and retailers, as long as they want to satisfy the necessary standards of consumers' preferences. For this reason, through this research we aim to record these mechanisms cooperation, which lead all stakeholders to coexist in fresh supply chain fruits and vegetables. for better post-harvest management to final agricultural products. Moreover, the empirical analysis of wholesale and retail markets with statistical data, it has purpose to propose a particular food policy that should reinforce national effort for special agricultural marketing system on Greek fresh production. The pilot research was based on qualitative research with market experts of wholesale and retail markets all around Greece, and we go on with quantitative research via two different questionnaires on these different markets. The results indicated that independent producers as members of agricultural cooperatives are inextricably linked with wholesale and retail markets. Finally, we attempted to examine through empirical analysis to these markets, if there is an extended regulatory role of Greek agricultural cooperatives.

ID: 0021

THE URBISPHERE SPECTRAL LIBRARY V1.0: ENABLING URBAN MATERIAL IDENTIFICATION ACROSS CITIES USING MULTI-SENSOR SATELLITE IMAGING

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Keywords: urban, hyperspectral, multispectral, hyspex, rs-3500, x-svm, spectral library

Abstract: Being able to identify urban surface materials using Earth Observation data has the potential to support urban weather and climate modelling, urban planning and to help assess climate resilience strategies. However, the varied composition of these materials, the three-dimensionality of the urban canopy and the spatial scales cause high likelihood of mixed pixels, each pose numerous challenges. Existing spectral libraries do not cover the diversity of urban materials needed for image-based surface cover classification. Here, we develop an urban hyperspectral library in the frame of the European Research Council project urbisphere with high-resolution spectral data collected from a wide range of urban materials across Europe.

The urbisphere spectral library v1.0 contains more than 10,000 in-situ hyperspectral measurements from various natural and artificial materials collected from several European cities, such as Heraklion, Paris, and Berlin, and is set to be expanded in the coming years. These measurements were captured under varying conditions of shading, weathering, and viewing angles, using the HySpex Mjolnir VS-620 hyperspectral camera harmonized with the RS-3500 spectroradiometer.

In an exploratory study, hyperspectral signatures from the urbisphere library were adjusted to align with the multispectral bands of the WorldView-3 and Sentinel-2 satellites, as well as the hyperspectral bands of PRISMA and EnMap. These adjusted signatures were used to train separate X-SVM classifiers for each satellite. The trained models were then applied to classify the respective satellite imagery acquired over Heraklion, Greece. The results highlight the library's capability to detect various natural and artificial materials in urban environments and reveal the limitations associated with differing spatial and spectral resolutions. This methodology demonstrates precise identification of urban surface materials while reducing reliance on labour-intensive, image-based end-member extraction.

ID: 0022

EXTRACTING AND LABELLING HYPERSPECTRAL REFLECTANCE SIGNATURES FROM HYSPEX IMAGERY

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Keywords: HySpex; Hyperspectral; Urban Classification; Material Detection

Abstract: Accurate in-situ hyperspectral reflectance signatures are essential for remote sensing applications, particularly in urban classification and material detection. Collected under diverse environmental conditions, these signatures provide detailed spectral information that enables the identification and differentiation of various natural and artificial materials, such as asphalt, concrete, ceramic tiles, metals, soils, and both photosynthetic and dry vegetation. The extraction and organization of these hyperspectral signatures into clusters (groups of spectra with similar characteristics and spectral shapes), following a standardized labelling protocol, is crucial for maximizing their utility across a range of applications.

In this study, a HySpex VS-620 hyperspectral camera was used in field campaigns to capture in-situ high-resolution radiance images, with each pixel corresponding to a unique spectral signature from the respective surface, covering a spectral range from 410 nm to 2500 nm. The radiance images were converted into reflectance images using at least four reference reflectance signatures, measured with an RS-3500 spectroradiometer from homogeneous surfaces within the image boundaries. To create a meaningful dataset, groups of pixels from the same material with similar spectral reflectance characteristics were collected and labelled based on seven attributes: a) material type, b) colour, c) usage, d) structure, e) state, f) city, and g) sensor.

Furthermore, three HySpex images, captured from three neighbourhoods in the cities of Heraklion, Paris, and Berlin, were analysed, covering a wide range of urban materials. A dataset of more than 5,000 spectral signatures was extracted, labelled, and organised into 100 clusters. Additionally, image classification was applied to each HySpex image using the X-SVM classifier, trained with the extracted hyperspectral signatures and validated with randomly selected pixels. This approach enables the extraction of thousands of spectra from a single image, covering a wide variety of materials, offering a time-efficient alternative to traditional spectroradiometers.

ID: 0023

NEAR-REAL TIME ACTIVE FIRE DETECTION WITH THE FOREST-CONSTELLATION

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Keywords: wildfire, fire detection, thermal infrared imagery, forest constellation

Abstract: Fueled by climate change, the number of extreme wildfires per year has doubled in the last 20 years [1]. Fires grow out of control quickly so early detection is essential for effective mitigation. However, dense, continuous monitoring of large areas across the globe is hardly feasible on the ground. Satellite imagery can help close this gap but many of the relevant public satellites in low earth orbit have overpass times around midday. This leaves a significant blind spot in large parts of the afternoon - a peak burning period for many fires. By the time these fires are detected which is often only the next day, it can be often too late already.

Private satellite missions, such as OroraTech's upcoming Forest constellation can close this gap. With three successful launches already and 8 more satellites in-orbit by April 2025, the constellation will reach a revisit time of 12 hours anywhere on Earth and focus on late afternoon orbits. With upcoming launches in the following years, the constellation will reach an eventual revisit time of 30 minutes across the globe. With dense temporal and spatial coverage, fires can be detected much earlier.

However, detecting a fire is only part of the equation. The latency requirements by first responders ask for minimal additional time to pass between a satellite overpass and the communication of discovered fires. Therefore, satellites of the Forest constellation are equipped with a GPU unit on the satellite for on-orbit fire detection. While much more processing power would be in principle available on the ground, transferring the whole satellite image to Earth is already a time bottleneck. This is why the fire detection is run on-orbit directly so that the relevant communication can be restricted to specific fire events. To send detected fire events to first responders, OroraTech's FireLink technology will place designated ground stations in key customer locations to enable communication from orbit in minutes.

With Forest-2, this processing chain has been tested end-to-end with promising results. The fire detection running on-orbit can reach low latencies already with regular ground station networks. This is expected to decrease significantly once customer-specific small ground stations are in place as well. At RSCy2025, we aim to show first light results from scaling Forest-2 to our first plane of 8 satellites and give a roadmap of future improvements and needs for better fire detection from space. This will include first results on fire detection performance and latencies with the first plane to enable first responders on the ground.

ID: 0024

ACCURACY ASSESSMENT OF GLOBAL AND REGIONAL LAND COVER MAPS: A CASE STUDY IN NORTHERN GREECE

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Keywords: global land cover products, remote sensing, validation, Sentinel-2

Abstract: Accurate and up-to-date land cover information is essential for natural ecosystem monitoring, land management and planning, decision making and climate modeling. Recent advancements in remote sensing technology, combined with the increasing availability of high-resolution satellite imagery, have significantly improved land cover mapping capabilities. Modern machine learning algorithms and cloud computing platforms have enabled the systematic generation of higher resolution global and regional land cover products (Phiri et al., 2020; Venter et al., 2022). Among the most recent high-resolution land cover products are the ESA WorldCover, ESRI Land Use/Land Cover (LULC), Dynamic World (Xu et al., 2024) and the Copernicus Global Dynamic Land Cover and CLC+ Backbone, all derived from Sentinel-2 imagery at 10 m spatial resolution. While these products offer consistent land cover information at large scales, their accuracy can vary across different regions due to differences in classification methodologies, training data availability, and landscape complexity. Uncertainties can also arise from spectral similarity between classes, seasonal variations in land cover, and differences in classification schemes used by each dataset. Errors are often more pronounced in heterogeneous landscapes where mixed land cover types can be found. Additionally, discrepancies between products may be linked to the training datasets and classification algorithms employed, which can introduce biases in specific land cover categories. Therefore, independent validation studies or even intercomparison among products are essential steps to assess their reliability and guide users in selecting the most appropriate product for specific applications.

This study evaluates the spatial accuracy of two global products, ESA WorldCover and ESRI Global LULC, and of the pan-European Copernicus CLC+ Backbone product over a large region in Northern Greece. These were selected as they provide maps for the same year, 2021, as the reference dataset. Validation was performed using an independent reference dataset that was created by means of very high-resolution imagery interpretation and ground-truth measurements, following a stratified random sampling approach. Confusion matrices were constructed to compute Overall Accuracy, Producer's Accuracy, and User's Accuracy, allowing for a detailed comparison of classification performance across land cover classes. Prior to the accuracy assessment, land cover classes were harmonized among all three products to ensure that all maps are comparable thematically. Finally, the error matrices were analyzed to identify systematic misclassification patterns and assess class-specific reliability.

Preliminary results indicate notable variations in classification accuracy, with thematic inconsistencies observed in certain land cover classes. Although for some classes (e.g. water, built-up) the agreement was high among the products, differences in mixed-vegetation classes suggest that some products may be more suitable for certain applications than others. This study underscores the importance of independent validation in assessing the performance of global and European land cover products at regional level, ensuring their effectiveness in environmental monitoring and decision-making processes. The findings provide insights into the strengths and limitations of each dataset and their suitability for regional applications.

ID: 0025

HARMONIA: INTRODUCING A DIGITAL URBAN PLANNING DECISION SUPPORT TOOL, TOWARDS MORE RESILIENT AND SAFER EUROPEAN CITIES

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Keywords: Urban Remote Sensing, Urban Resilience, Decision Support System, Urban Planning, Risk Assessment

Abstract: Cities are currently grappling with major challenges stemming from climate change, such as the increased frequency and severity of extreme weather events, urban greenness loss, urban flash floods, air quality degradation and increased greenhouse gas emissions, geo-hazards, and urban heat fluxes among others. Strengthening urban resilience and effectively addressing these impacts require advanced digital tools and Decision Support Systems (DSS). These technologies can play a crucial role in aiding decision-makers by offering access to relevant data, analytical models, and in-depth insights, enabling them to identify and prioritize the most effective mitigation strategies. In order to address urban hazards like flash floodings, urban heat fluxes, air pollution and geohazards, we introduce an innovative Urban Planning Decision Support System (UP DSS) developed within the framework of the HARMONIA project (HORIZON 2020 programme - GA 101003517). By integrating diverse urban data and applying a rule-based approach, the system provides tangible urban planning solutions tailored to the studied areas. Accompanying the UPDSS, a state-of-the-art web visualization platform has been deployed, constituting an advanced user interface with 4D geospatial data handling and visualisation capabilities. This work outlines the functioning of an urban-planning DSS that exploits a multiparametric risk assessment methodology for a variety of smart digital planning tools have been developed tailored to the needs of policymakers providing a comprehensive virtual environment for efficient policy-making, enhancing users' experience and understanding. The proposed solution is fully operational and offered as a web-based application with a user-friendly interface, able to efficiently handle and visualize multidimensional geospatial information, demonstrated in four different and diverse European urban environments, i.e., the cities of Milan, Piraeus, Sofia, and Ixelles.

ID: 0026

INNOVATIVE COASTAL MANAGEMENT: LEVERAGING AI AND SATELLITE IMAGERY FOR MONITORING URBAN AND PORT ENVIRONMENTS WITHIN THE OCEANIDS PROJECT

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Keywords: Coastal Monitoring; Ports Management; Satellite Imagery; Earth Observation; Environ- 17 mental Sustainability; Data Fusion

Abstract: Coastal cities and ports are vital to global trade, urban development, and environmental sustainability, yet they face growing challenges due to climate change, urbanization, and operational complexities. Addressing these challenges requires robust monitoring systems to support economic efficiency, environmental protection, and public safety. This study, conducted within the framework of the OCEANIDS project, investigates the integration of satellite imagery, climatic data, supporting data (meteorological and socioeconomic indicators), and artificial intelligence (AI) methodologies to enhance the monitoring and analysis of coastal and port areas. Leveraging multi-source Earth Observation (EO) data, combined with advanced machine learning techniques, the study provides a systematic approach to environmental monitoring, operational assessment, and the identification of critical environmental changes. Case studies illustrate the application of these methods in monitoring urban expansion, detecting port congestion, and assessing environmental impacts. This study evaluates the priorities and challenges faced by coastal regions in the Mediterranean, Boreal, and Atlantic climatic zones, as identified through end-user feedback within the OCEANIDS framework. Regional outcomes were assessed for their relevance to navigation safety, environmental monitoring, and climate risk management. Results indicate a uniform high priority for solutions such as wind forecasting, ice risk monitoring, and ocean level monitoring across all regions, highlighting their critical role in maritime operations and environmental sustainability. Region-specific needs, such as landslide risk assessment in the Azores

and snow cover monitoring in Finland, underscore the importance of tailored solutions. Satellite data, combined with advanced forecasting models and GIS-based tools, proved instrumental in tackling the identified challenges. This study provides actionable insights to guide targeted applications and enhance resilience strategies for coastal and port regions. This work establishes a practical framework for scalable and sustainable monitoring solutions, paving the way for future advancements in coastal city and port management while addressing critical challenges in global coastal sustainability.

ID: 0027

METHODOLOGY FOR JELLYFISH RESEARCH IN THE BLACK SEA USING UAV

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Keywords: Macrozooplankton, Unmanned Aerial Vehicles, Bulgarian Black Sea, Aurelia aurita, Rhizostoma pulmo

Abstract: The aim of this study is to apply an advanced methodology for monitoring jellyfish populations in the Black Sea using Unmanned aerial vehicles (UAVs). This innovative, non-invasive approach provides accurate data on jellyfish abundance, distribution, and biomass, which is essential for both ecological research and environmental management practices.

Material and Methods. The research utilizes a UAV (DJI Phantom 4 Pro) equipped with a high-resolution camera. Since August 2023, 116 systematic missions have been conducted, covering predefined transects in various regions of the Bulgarian Black Sea, with a primary focus on the Varna Bay area. Continuous visual data are captured (using Pix4D app) to detect jellyfish presence and quantify their size and biomass. Additionally, environmental parameters such as water temperature, turbidity, and wind force are recorded to assess their influence on jellyfish distribution. The collected imagery is further processed with Agisoft Metashape to generate orthophotomosaics for detailed spatial analysis. Furthermore, GPS modules ensure precise navigation and accurate geolocation of the surveyed areas.

Main Results: The UAV-based methodology proved highly effective in identifying and quantifying jellyfish populations across diverse habitats in the Black Sea. High-resolution imagery facilitated detailed measurements of individual jellyfish, while integrating environmental data provided valuable insights into habitat preferences and seasonal dynamics. Preliminary results highlighted significant spatial variability, with higher concentrations observed in nutrient-rich coastal zones and areas with lower turbidity. The extensive coverage achieved through UAVs, combined with their ability to minimize human interference, represents a significant improvement over traditional sampling techniques, offering both scale and precision.

Conclusion: This study underscores the potential of UAVs as a transformative tool for marine biodiversity monitoring, particularly for species like jellyfish, which often pose challenges for traditional sampling methods. By integrating visual and environmental data, the methodology offers a holistic understanding of jellyfish ecology and distribution, supporting more effective management and conservation efforts. Future work will focus on expanding the temporal scope of surveys to capture seasonal variations and further refining data processing algorithms for increased accuracy. Additionally, the methodology holds promise for adaptation to other marine organisms and ecosystems, broadening its applicability in marine research.

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ID: 0028

HIGH RESOLUTION AND HIGH FREQUENCY THERMAL INFRARED MONITORING OF SEA SURFACE TEMPERATURE (SST) FROM THE FOREST-CONSTELLATION

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Keywords: Sea Surface Temperature, SST, Forest-constellation, thermal infrared imagery

Abstract: This study proposes a near real-time oil spill surveillance system using Sentinel-1 synthetic aperture radar (SAR) imagery. The users only need to provide the coordinates of their areas of Sea Surface Temperature (SST) is a key parameter in oceanographic processes, climate dynamics, marine biodiversity, and global ocean circulation. Monitoring SST in coastal and open oceanic regions is essential for assessing climate change impacts. However, traditional SST measurement methods, such as in situ observations and lower-resolution satellite imagery, often lack the spatiotemporal resolution required for comprehensive analysis, particularly in dynamic coastal zones where temperature changes can be rapid and localized.

The advent of OroraTech's Forest CubeSat constellation represents a significant advancement in SST monitoring. Equipped with advanced thermal infrared sensors, it offers a unique SST measurement capability providing high spatial resolution (200m) at a 12-hour revisit time starting April 2025. With a 410km swath width and radiometric accuracy target of 3K, it enables continuous global monitoring of oceanic and coastal temperature patterns. Additionally, the alignment of overpass times with peak diurnal warming periods will offer enhanced insight into the peak temperatures of ocean surfaces, which are critical for understanding marine ecosystem responses to climate shifts, such as coral bleaching and fish migration patterns.

As a preliminary analysis, we qualitatively assessed Forest-2 imagery against two Copernicus Marine Service products: (1) the Copernicus Global SST Daily Dataset [1] (~10 km resolution) and (2) the Copernicus Mediterranean Sea SST Analysis [2] (~4 km resolution). These datasets were selected for their temporal resolution, with the first providing daily global SST products and the second offering sub-hourly updates for the Mediterranean Sea. The comparison, conducted over Anticosti Island, Canada, and part of the Aegean Sea, suggests that Forest-2 effectively captures finer-scale thermal structures in both open ocean and near-shore environments, offering improved insights into localized oceanographic phenomena such as coastal upwelling and river runoff.

This work will present the methodology for processing, calibrating, and validating SST measurements from the Forest constellation. The quality and applicability of this data will be evaluated for ocean circulation modeling, and marine resource management. Preliminary results highlight the ability of the Forest system to provide consistent, high-resolution SST data at high revisit rates, offering a cost-effective and scalable solution for global ocean observation. The integration of Forest data into Earth system science could significantly enhance climate impact assessments and support better-informed policy decisions for marine conservation and management.

ID: 0029

Assessment of Post-Fire Disturbances based on Remotely Sensed Methods and Data

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Keywords: Remote Sensing, Wildfire, Post-fire forest disturbance, Disturbance Index, Direction angle, Sentinel 2

Abstract: Wildland and forest fires serve as key ecological factors, significantly influencing the dynamics and functioning of global ecosystems. However, when uncontrolled, fires can pose a serious threat to the environment and human lives, leading to substantial economic and ecological losses. It is essential to enhance research on forest fire management systems to improve prevention, monitoring, and mitigation strategies. Remotely sensed aerospace methods and data are widely utilized for monitoring and conducting ecological research. This paper aims to assess post-fire forest disturbances using tasseled cap-derived indices, specifically the combination of Disturbance Index and Direction Angle. The proposed method relies on linear orthogonal transformation of multispectral satellite images and offers higher accuracy compared to standard approaches based on vegetation indices. The test area is located in the Slavyanka Mountain, Bulgaria, where a wildfire in the summer of 2024 affected approximately 20,000 decares of forest, with around 4 decares burned on the Bulgarian side. Multispectral satellite images derived from Sentinel 2 were utilized before and after the fire. The results of the current research demonstrate that the applied remote sensing methods are effective for ecological assessment of post-fire disturbances.

ID: 0030

ASSESSMENT OF SNOW AND AVALANCHES IN LONGYEARBYEN, ARCTIC

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Keywords: Radar remote sensing, avalanche monitoring, Arctic, TCT

Abstract: The mapping of snow and snow avalanche dynamics is important for determining potential danger zones, planning protective measures and understanding of climate change. Year-round snow cover monitoring through land surveys is almost impossible in the Longyearbyen area, aerial photography surveys are also insufficient due to the specific conditions of sunshine and the lack of it during the winter season. Due to the presence of clouds the snow cover information is very limited by the optic satellite images. Microwave images have the advantage over visible and NIR techniques as they are sensitive to changes in surface moisture and thus provide useful information about changes in their physical states. The study evaluates the usefulness of C-band SAR images for data mining for wet snow and snow from other surfaces, but also uses optical indices and indicators. TCT (Tasseled Cap Transformation) was used as a moisture indicator, as well as NDVI (Normalized-Difference Vegetation Index), which was used to map snow as a normalized difference of two bands (one in the visible and one in the near-infrared or short-wave infrared parts of the spectrum).

The subject of the study is the dynamic of the snow and the snow avalanches during the different seasons in Longyearbyen, Svalbard, Arctic. The objects were analyzed and mapped according to the European Space Agency (ESA) data acquired by sensors Sentinel-1 SAR, Sentinel-2 MSI and in-situ data. Results have been obtained for changes in snow coverage during the winter-spring

transition and its dynamics. The data used is with high time-spatial resolution, which is an advantage when looking at the snow cover. The changes of the environmental objects are shown with different processing approaches. The results clearly show that snow melting can be registered by using SAR data via different polarization, TCT and NDVI. The effect of the research on aerospace data and technology enables us to obtain different digital models, structuring and analyzing results excluding the subjective factor.

ID: 0031

USING SATELLITE DATA TO MONITOR YIELDS OF BARLEY GROWN UNDER ORGANIC FARMING CONDITIONS

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Keywords: Satellite data, Organic farming, yield, barley

Abstract: The interest in organic farming is growing due to the increased interest of consumers in consuming healthy and safe food that organic farming provides. In addition, it is part of the green transition that the European Union is striving for. Remote sensing technologies in agriculture provide very good opportunities for monitoring different types of crops. Barley is a major cereal crop, which, in addition to feeding the population, is also used as a fodder crop and in brewing. In recent years, interest in it has increased, as it is also distinguished by its good nutritional qualities. It fits very well into crop rotation, which is why it is also very suitable for organic farming, where a wide variety of crops is needed. A literature review found that there are extremely few studies related to monitoring of cereals grown in organic farming conditions using satellite data. Organic farming differs from conventional farming in that organic fields, unlike conventional ones, are a mixture of weeds and cultivated plants. It is of interest to investigate the possibility of satellite data to track the development of yields in organic cereal crops and their suitability for predicting and determining yield. In this study, the development of an organic field sown with barley was tracked in several of the main phenological phases and a statistical analysis was made between the actual yield and satellite data, establishing in which phenological phases and which vegetation indices are most suitable for monitoring yields in organic barley.

ID: 0032

AN ENTROPY-BASED ATTENTION NETWORK FOR ROBUST MULTI-MODAL REMOTE SENSING APPLICATIONS

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Keywords: Entropy-Based Attention, Multi-Modal Remote Sensing, Uncertainty Estimation, Transformer Architecture, Semantic Segmentation.

Abstract: We present a novel multi-stage, entropy-driven attention network designed to enhance the robustness and accuracy of multi-modal remote sensing tasks, such as semantic segmentation. Unlike conventional transformer architectures, our framework leverages intermediate outputs—augmented by an auxiliary head—to compute entropy maps at each stage. These entropy maps act as uncertainty indicators that guide the attention mechanism in subsequent layers, enabling the network to dynamically down-weight unreliable data regions while emphasizing more confident inputs. By integrating both traditional terrain features (e.g., slope, curvature) and learned representations from diverse modalities such as multispectral, SAR, and digital elevation imagery, the model achieves improved performance on complex geospatial datasets where noise, occlusion, and incomplete modalities are common.

This work also addresses critical preprocessing steps, including hybrid normalization strategies and precomputed feature integration, to balance local detail preservation with global model consistency. Empirical evaluations on multi-modal remote sensing datasets demonstrate that our entropy-based attention mechanism effectively reduces overconfidence and bolsters adaptability to challenging environmental conditions. These findings underscore the method's potential for wide-ranging applications—from large-scale land-cover classification to post-disaster damage assessment—highlighting the benefits of incorporating uncertainty awareness within next-generation remote sensing architectures.

ID: 0033

GEOSPATIAL TECHNOLOGIES FOR MONITORING CARNIVORE ACTIVITY AT CAMPSITES: INTEGRATING REMOTE SENSING AND GIS FOR HUMAN-WILDLIFE COEXISTENCE

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Keywords: human-wildlife conflict, campsites, human-wildlife coexistence, dashboard

Abstract: The global expansion of human populations has led to the growth of human-inhabited areas, increasing interactions between humans and wildlife. As a result, many species modify their behaviors, some avoid human presence and face habitat loss, while others develop higher tolerance to humans. This tolerance often provides access to more predictable and abundant food sources, leading wildlife to utilize anthropogenic landscapes more frequently. However, increased human tolerance can also have severe consequences, escalating conflicts that pose risks to both humans and wildlife.

In the Israeli Negev Desert, carnivores such as wolves and jackals are increasingly exhibiting bold and aggressive behavior toward humans, particularly at campsites. These animals often associate humans with food and have lost their natural fear, leading to attacks—mainly on children—and raising safety concerns among campers.

Ben-Gurion University of the Negev, in collaboration with the Israel Nature and Parks Authority (INPA), is conducting research to understand carnivore behavior and reduce their presence at campsites, ultimately preventing attacks on humans. The goal is to transform human-carnivore conflict into coexistence using a multidisciplinary approach that integrates GIS, remote sensing, and in-situ monitoring through AI analysis of carnivores and humans.

The project combines geospatial technologies with field data collection. Camera traps are used to record carnivore and human activities at campsites, while campers' attitudes toward carnivores are assessed through field observations and semi-structured questionnaires. Climatic parameters such as temperature, humidity, wind speed, and direction are collected using meteorological stations and satellite-based sensors. These variables, combined with camera data on carnivore abundance, activity timing, and behaviors alongside human activities (e.g., setting up tents, cooking, waste disposal, campfires), will help predict how environmental factors influence carnivore behavior and distribution.

As part of the geospatial component, an interactive dashboard has been developed to monitor and analyze human-carnivore interactions and environmental conditions. This platform visualizes environmental data, wildlife activity, and human presence, integrating long-term observations, questionnaire responses, and attack records. The system enables the generation of reports and analyses, providing insights that can inform strategies for fostering sustainable human-wildlife coexistence in the Negev Desert.

ID: 0034

DEVELOPING A SATELLITE-BASED TECHNIQUE FOR FLASH FLOOD DETECTION IN ARID REGIONS

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Keywords: flash floods, deserts, remote sensing, hydrology, hydrometric monitoring

Abstract: Flash floods represent a significant and escalating global threat, causing substantial damage to infrastructure and loss of life. The frequency and intensity of these extreme events are increasing, largely due to the impacts of climate change, which drives more intense rainfall events through increased atmospheric moisture. Furthermore, factors like urbanisation and altered land use patterns can exacerbate flood risk by increasing surface runoff. Arid regions, characterised by their sparse vegetation and limited water resources, are especially vulnerable to these flash floods, which can severely impact local populations and fragile ecosystems. As a result, there is a need for efficient flash flood monitoring systems that can improve prediction and support more effective management of water resources in regions at high risk. Traditional monitoring methods, such as ground-based hydrometric stations, are often insufficient due to their limited spatial coverage, highlighting the need for more comprehensive approaches.

This research addresses these challenges by developing a methodology to monitor flash flood events in arid areas using remote sensing data analysis. The goal is to map and create databases of flash flood distributions, particularly in regions where ground-based data are lacking. The project uses optical and Synthetic Aperture Radar (SAR) satellite data to detect changes in soil moisture signal remaining after flash flood events, focusing on the arid regions of India and Israel, where flash floods significantly affect local communities and the environment. Change detection methods are employed to map active and inactive channels following storms, utilising the short-wave infrared (SWIR) spectral indices. Additionally, SAR data, which is capable of penetrating cloud cover, is to be integrated with SWIR values. Data from hydrometric stations in Israel are incorporated for calibration and validation. The Israeli dataset includes 190 flash flood measures from 2017 to 2023. Data processing is done using the Google Earth Engine (GEE) platform, with the development of a GIS database that includes pre-processed imagery. The produced flash flood mapping data is to be used as validation of flash flood prediction models in arid regions using AI analysis.

ID: 0035

THE IMPACT OF AIR POLLUTION ON THE SPATIAL DISTRIBUTION OF COVID-19 ACROSS BULGARIA: A STUDY USING SATELLITE AND IN SITU DATA

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Keywords: Covid-19, atmospheric pollution, remote sensing, TROPOMI, GOME-2

Abstract: As a respiratory disease, the epidemiological spread of Covid-19 may be influenced by atmospheric pollutants, particularly fine particulate matter. The aim of the present study is to examine the impact of air pollution on the spatial distribution of Covid-19. In this context, we utilize satellite data from the GOME-2 (onboard of Metop satellites series) and TROPOMI (onboard of Sentinel-5P) instruments, along with ground-based measurements, covering the period from June

2020 to July 2024, to construct the spatial distribution of particulate matter pollution over Bulgaria. Another significant atmospheric pollutant relevant to the Bulgarian context is NO2. Using satellite data from the TROPOMI instrument, we develop the spatial distribution of NO2. We analyze daily in situ data on the spread of Covid-19 across the 28 municipalities in Bulgaria in its correlation with the atmospheric pollutants. In this study, we present an assessment of the impact of the averaged pollution profile on the overall distribution of Covid-19 cases in the country.

ID: 0036

DEEP LEARNING-BASED GRASSLAND MAPPING WITH SENTINEL-2: PRIORITIZING KEY SPECTRAL BANDS AND TIME PERIODS

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Keywords: Grassland classification, Sentinel-2 imagery, Deep learning, Spectral bands, Temporal CNN, Remote sensing

Abstract: Grasslands are critical in agriculture, biodiversity conservation, and climate regulation. Accurate and timely classification of grassland areas is essential for effective land management and environmental monitoring. This study presents a novel approach for grassland detection using Sentinel-2 multispectral satellite imagery, leveraging its high-resolution optical data across 13 spectral bands. A key innovation of our approach is its ability to identify the most informative spectral bands and time periods for accurate classification. Unlike traditional methods that rely on pre-defined feature extraction, our approach employs a deep learning framework capable of performing feature selection directly within the model architecture, eliminating the need for handcrafted features and revealing which spectral bands and months are most critical for grassland identification. The proposed methodology utilizes a temporal Convolutional Neural Network (CNN) to analyze spectral reflectance values across multiple time points throughout the year, capturing spatial and temporal patterns indicative of grassland regions. Through this process, the model implicitly reveals that bands sensitive to vegetation health, such as the red edge and near-infrared bands, are significant, along with data from specific months that capture key phenological stages, such as May, July, and September. To address the challenges of class imbalance in the dataset, we implement weighted sampling strategies to ensure robust training for minority classes. Our results demonstrate superior classification performance compared to conventional machine learning approaches, highlighting the efficacy of deep learning for automated feature selection and grassland detection. Notably, the model provides insights into the relative importance of different spectral bands and time periods, demonstrating that focusing on a subset of bands and specific months yields the highest accuracy. This work underscores the potential of Sentinel-2 data in advancing remote sensing applications when coupled with a feature-selecting deep learning approach and provides a scalable solution for agricultural and ecological monitoring tasks.

ID: 0037

CLIMATE EFFECTS OF AEROSOLS IN THE BUCHAREST METROPOLITAN AREA

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Keywords: urban aerosols, particulate matter PM2.5, PM10, AOD550, MODIS Terra/Aqua, Bucharest, Romania.

Abstract: In the frame of predicted climate change due to the increasing trend of extreme events frequency, the ozone layer depletion, and global warming in the South-Eastern part of Europe, urban air pollution is an important issue in scientific research. Air pollution represents one of the most important drivers affecting the Earth's energy balance and hydrological cycle, climate, and human health. Rapid urbanization and atmospheric particles have significantly impacted climate change in large cities, with repercussions for the economy, human health, and sustainable development. This paper investigated the influences of urban aerosols on city climate both at local and regional scales in relationship with other meteorological and biophysical variables in the Bucharest metropolitan area of Romania. A spatiotemporal analysis of the aerosol concentrations in two size fractions (PM10 and PM2.5) and total aerosol optical depth at 550 nm -AOD550 to air quality (AQI) and meteorological parameters was done through the synergy of in-situ monitoring and MODIS Terra/Aqua time-series satellite data for 2020-2024 period. It was found that PM2.5 and PM10 aerosols exhibit their highest concentrations mostly in the central part of the town, due to road traffic as well as in some industrialized periurban areas. In addition to the local and regional anthropogenic PM sources, both the levels and composition of air PM depend on meteorological parameters (air temperature, air relative humidity, precipitation, wind speed and direction, planetary boundary layer, solar surface irradiance, etc.), and season of the year. The results revealed significant month-to-month variability in all AOD550 values, underlying the influence of varying aerosol load function of season. The total aerosol optical depth at 550 nm values lie in a wide range, as low as 0.2 up to 0.5. The effects of various natural and anthropogenic drivers on AOD550 were interconnected. The influence of aerosol particles on climate, and how their properties are perturbed by anthropogenic activity, is one of the key uncertainties in climate change assessments. These results contribute to a better understanding of urban decision-makers by considering the specific characteristics of different urban sectors for air quality improvement.

ID: 0038

VEGETATION INDICES GENERATED BY SATELLITE PLATFORMS USED IN ARCHAEOLOGICAL RESEARCH

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Keywords: Archaeological research; Vegetation indices; Infrared spectrum; Spectral analysis; Remote sensing; Interdisciplinary studies

Abstract: Over the past 50 years, various satellite missions have been collecting and providing data about our planet. Since the late 1980s, these data have also begun to be used for the purposes of archaeological research. The idea has been formed that in archaeology, data can be successfully used not only from the visible range of the spectrum, but also from the infrared, NIR, as well as combining data from several spectral channels. Thus, the application of vegetation and soil indices in archaeological research gradually begins.

The purpose of this report is to present the possibilities for using vegetation indices in archaeological research generated by various satellite platforms. A number of limitations in the use of vegetation indices for archaeological purposes have also been noted, as well as some approaches to overcoming them. The study was conducted by searching for scientific publications from established academic journals in the databases of ScienceDirect, Scopus, WoS, MDPI, ResearchGate, Google Scholar using keywords. The analysis is based on information extracted from the scientific literature, presenting the achievements of various scientists in this direction. Many of the studies are still experimental in nature, aiming to refine the methodology for the application

of vegetation indices in archaeology. The main vegetation indices are presented, which at this stage have found application for identifying various archaeological structures.

The main satellite platforms that have been used to generate the vegetation indices used in archaeological research are indicated. This publication may be useful in future work in this direction. In a more general sense, it has a role in improving the transfer of knowledge within interdisciplinary research.

ID: 0039

SPATIOTEMPORAL CHANGES OF BUCHAREST URBAN GREEN ANALYSIS THROUGH TIME-SERIES SATELLITE DATA

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Keywords: urban green, thermal environment, MODIS Terra/Aqua satellite data, Bucharest, Romania.

Abstract: Understanding spatiotemporal changes in urban environments is essential for regional and local planning and environmental management. With the rapid changes of Bucharest city in Romania during past decades, green spaces have been fragmented and dispersed causing impairment and dysfunction of these urban elements. However, long-term monitoring of urban green areas is needed to understand the specific mechanisms and interactions with air pollution and thermal environment, especially during the recent heat waves. The main goal of this study is to address these tasks in synergy with in-situ data and new statistical methods. Spatiotemporal monitoring of urban vegetation land cover changes is important for policy decisions, regulatory actions, and subsequent land use activities. This study uses time-series MODIS Terra/Aqua Normalized Difference Vegetation Index (NDVI), Leaf Area Index (LAI), Land Surface Temperature (LST), and evapotranspiration (ET) data to provide vegetation change detection information for the metropolitan area of Bucharest. Training and validation are based on a reference dataset collected from LANDSAT remote sensing data. The mean detection accuracy for the period 2002- 2024 was 89%, with a reasonable balance between change commission errors (20.13%), change omission errors (24.17%), and a Kappa coefficient of 0.74. Annual change detection rates across the urban/periurban areas over the study period (2002–2024) were estimated at 0.77% per annum in the range of 0.41% (2002) to 0.77% (2024). Vegetation dynamics in urban areas at seasonal and longer timescales reflect large-scale interactions between the terrestrial biosphere and the climate system. Extracted green space areas were further examined quantitatively with air quality data and extreme climate events, in terms of environmental impacts and future climate trends. We conclude that increasing the role of urban green spaces in Bucharest for their cooling effects during hot summers and cleaning air pollution over the year through proper management strategies could improve their ecological value and well-being.

ID: 0040

INVESTIGATING THE IMPACT OF DROUGHT DYNAMICS ON VINE YIELD PRODUCTION IN CYPRUS

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Keywords:

Abstract: Drought is a complex phenomenon that cannot be easily detected in its early stages and advances slowly, but cumulatively. Agricultural drought occurs when the soil water scarcity reduces

soil evaporation and limits capillary water movement. As a result, crops cannot absorb enough water through their roots to maintain their water balance, leading to a decrease in leaf transpiration. This causes a decline in evapotranspiration, which is followed by soil and canopy temperature increase. In cases of prolonged agricultural drought, the consequences include collapse of leaves and stems, eventually leading to plant death and yield loss.

Cyprus, characterized by a semi-arid climate, has experienced prolonged and frequent droughts in recent years that had multiple impacts on agricultural production and consequently the ecosystem and the economy. Vine cultivation is a well-established agricultural practice in Cyprus. The Mediterranean climate is suitable for vine cultivation, making Cyprus a well-known wine-producing region. The main varieties cultivated in the island include both indigenous varieties, such as Xynisteri, Maratheftiko and Mavro, as well as international, such as Cabernet Sauvignon and Syrah.

This study aims to investigate the relationships between vegetation and drought dynamics and yield production in vine plots over the study period from October 2018 to September 2024. Satellite-derived time series are utilized to assess the relationship between agricultural drought and yield production. In particular, vegetation indices (such as Sentinel-2 Normalized Difference Vegetation Index, Enhanced Vegetation Index, and Green Chlorophyll Index) are analysed and compared with yield production records provided from vine growers. The overall goal is to identify vine varieties that demonstrate greater resilience to drought conditions.

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ID: 0041

REMOTE SENSING AND GIS AS NON-DESTRUCTIVE METHODS IN ARCHAEOLOGY

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Keywords: Remote sensing; Archaeological research; UAV technology; GIS analysis; Digital photogrammetry; 3D modeling

Abstract: In recent years, remote sensing of the earth's surface has increasingly expanded its scope. In recent years, it has become widely used and has become an important component of archaeological research as a non-destructive method. Within the framework of remote sensing for archaeological purposes, such approaches as aerial photography of archaeological sites in the visible spectrum, laser scanning (LiDAR), thermal scanning, digital photogrammetry, creation of various spatial 2D and 3D models such as orthophoto mosaics, digital surface models (DSM), digital relief models (DEM, DTM) have been established. With the development of UAV technology, it is increasingly entering as a new powerful tool for obtaining images from the air. They provide images with very high resolution. Data is collected quickly and easily, and unmanned aerial systems themselves are becoming increasingly accessible. A geographic information system (GIS) is a computer-based system for recording, analyzing and displaying geographically related data. GIS methods provide very good opportunities for post-processing and analysis of data collected from satellite or UAV images. These systems have proven to be very effective in collecting large amounts

of georeferenced archaeological data, their digitization and long-term storage, as well as their complex processing using quantitative methods and advanced visualization in the form of maps and graphs. In this report, the authors present some of the data and experience they have gained working on various archaeological sites in Bulgaria, Romania and Germany. And how remote sensing and GIS methods are applied in archaeological research as non-destructive methods.

ID: 0042

TOWARDS A BIG DATA INFRASTRUCTURE AND MONITORING DASHBOARD FOR THE FOOD SECURITY DOMAIN

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Keywords: Food Security; Big Data Infrastructure; Distributed Stream Processing; Monitoring System; Visual Dashboard

Abstract: Lately, food security has been identified as one of the topmost priorities for the EU; the Council of the EU is in close cooperation with the UN Food and Agriculture Organization (FAO) in a joint effort towards transitioning to a sustainable food system and responding to the global food crisis (https://europa.eu/!jg3vb3). Food security, however, is a multi-faceted concept, which involves challenges in different axes. Apart from providing continuous and reliable access to safe and nutritious food to consumers, food security further entails ensuring the economic protection of producers as well as monitoring the food supply chain with respect to environmental sustainability and biodiversity. Confronting these challenges implies making proper and timely decisions, which heavily relies on the analysis of data that reside in the domain. And although several initiatives have lately emerged to gather useful data (e.g. FAOSTAT Database, EU Agri-food Data Portal, etc.), extracting knowledge from these data and transforming them to actionable insights is not trivial.

As part of project ECO-READY (https://www.eco-ready.eu/), we have designed an Observatory that aspires to help address these challenges by combining and analyzing data from different sources, including statistics at EU/governmental level, remote sensing measurements, and data from local/regional organizations. The latter involve also a network of Living Labs, which has been built and is supported as part of the project. Combining diverse data sources with information for regional food products from the Living Labs shall be useful for developing food security and food supply chain scenarios that can lead to evidence-based policymaking. The ECO-READY Observatory comprises a scalable infrastructure that effectively consumes different data as well as a dashboard interface that allows visualizing the data, detecting patterns and identifying correlations among different variables. The API supports a flexible hierarchical schema; any instance entering the infrastructure is an event. Events are organized into collections, which are, in turn, part of projects. Each organization (e.g. Living Lab or other data source) can have multiple projects.

The infrastructure is built using state-of-practice elements. Data stream input and processing take place in an Apache Kafka cluster, which is fault-tolerant, highly scalable, and capable of handling large numbers of events, even in real-time. Upon preprocessing, based on the specifics of each dataset, the events are forwarded to a centralized data store, implemented using Apache Cassandra, a distributed NoSQL database designed also for scalability and fault tolerance. The infrastructure further integrates a processing pipeline, which allows optimized filtering based on keys (indexes) and enables online calculation of statistics (e.g. mean, count) and application of mining algorithms (e.g. outlier detection, machine learning techniques). Finally, the dashboard of the Observatory can be used for seamlessly navigating over the data of the infrastructure, monitoring the continuously updated data flows and focusing on the interconnections between

different variables. This is achieved via graphs as well as via an interactive map with layers that depict useful statistics for different regions of Europe. Thus, the users can identify interesting correlations, receive early warnings about food security issues, and be presented with actionable recommendations.

ID: 0043

IMPROVING GNSS POSITIONING BY INGESTING REGIONAL CHARACTERISTICS INTO AN IONOSPHERIC MITIGATION ALGORITHM

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Keywords: Ionosphere, GNSS, Total Electron Content, Galileo, NeQuick model

Abstract: Single-frequency Global Navigation Satellite System (GNSS) ionospheric mitigation over a certain area is an important capability for accurate positioning for low-cost mobile platforms such as phones and tablets. GNSS systems such as GALILEO rely on an underlying ionospheric model (NeQuick-G) to facilitate this capability. The concept of ingesting regional ionospheric characteristics measured by a digital ionosonde to drive the NeQuick-G algorithm as opposed to a global scale representation, has been recently explored in the frames of a research project. This approach facilitates the local adjustment of Committee Consultative for Ionospheric Radiowave propagation (CCIR) files and the Az ionization level, which control the ionospheric electron density profile in NeQuick-G, therefore enabling better estimation of positioning errors under quiet geomagnetic conditions. This novel concept for local ionospheric positioning error mitigation may be adopted at any location where ionospheric characteristics can be measured, as a means to enhance the accuracy of single-frequency positioning applications based on the NeQuick-G algorithm. In this study we demonstrate the applicability of the concept over Cyprus during the rising solar activity phase of the current solar cycle.

ID: 0044

CONCURRENT OBSERVATION OF L-BAND SCINTILLATION AND ROTI OVER CYPRUS

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Keywords: Mid latitude ionosphere, ROTI, L-band scintillation

Abstract: Transionospheric radio signals are prone to rapid and random fluctuation in the received signal phase and amplitude, referred to as scintillation, caused by the variation in electron density present in the medium of propagation [Aarons, Proc. IEEE, 1982]. Such variations are most frequent and intense over the equatorial and low latitude regions, extending from 30° N to 30° S [Basu et al., J. Geophys. Res., 1996]. Over the middle latitude, such observation of scintillation is often limited, due to the absence of required background dynamics [Veettil et al., GPS Solutions, 2016]. Additionally, the occurrence of scintillation over any region, is variable depending on parameters such as solar activity, geomagnetic activity etc. In this study, we report rare occurrence of scintillation over middle latitude, with an aim to correlate such occurrence with Rate of TEC Index (ROTI).

Scintillation data has been obtained from a GNSS receiver (Septentrio PolaRxS) operating at L-band at Nicosia, Cyprus (Geographic coordinates: 35.18° N and 33.38° S) and ROTI activity has been identified from DRAWING ROTI European maps.

On a geomagnetically quiet day, June 27, 2014 (Smoothed Sunspot Number: 67), ROTI > 0.15 TECU was recorded over Nicosia, Cyprus during 21:10 UT to 21:40 UT. On the same day, corresponding signature at L-band scintillation was extracted from the GNSS receiver. The results show notable amplitude scintillation activity ((S4) > 0.20) during the same time over Nicosia, at GPS PRN 27. The study will be extended to obtain a possible correlation between the two parameters over an extended period of time.

ID: 0045

FOREST BIOMASS ESTIMATION IN RUGGED TERRAIN: SENTINEL-1 AND ICEYE SAR INSIGHTS

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Keywords: Aboveground Biomass, Forest Biomass, Synthetic Aperture Radar, ICEYE, Sentinel-1

Abstract: Forest biomass is a fundamental component of the global carbon cycle, essential for ecosystems protection and climate change mitigation. Remote sensing techniques are extensively utilized for estimating forest biomass and other inventory attributes, offering cost-effective, accurate, and timely results across vast and inaccessible areas. A variety of remote sensing data types, including optical, Synthetic Aperture Radar (SAR), Light Detection and Ranging (LiDAR), and integrations between them, have been explored for AGB and carbon quantification. Among these, multispectral and SAR image analyses are the most applied methods for large-scale biomass estimation. However, a significant challenge for both approaches is signal saturation, particularly in forested regions with complex topography. While various remote sensing techniques have been applied to estimate AGB, only one study has explored ICEYE's capabilities in AGB estimation. The aim of the present study was to investigate the potential of Sentinel-1 and ICEYE SAR data in reliably estimating aboveground biomass (AGB), which represents the total dry weight of the different tree components (stem, bark, branches, and leaves). The study area is located in Pertouli University Forest (Greece), characterized by intense topography and complex forest structure, which is challenging for both sensors. Field measurements were conducted in 2019 and 2022 with a total of 48 pure fir plots being measured in both campaigns. Each plot covers an area of 1000 m2, and the DBH and height of all trees were extracted from the forest inventory plan. A series of texture and indices was calculated on both dataset and were subsequently included as features in the predictive models. Regarding the AGB modelling, a regression analysis was performed to develop the AGB models employing the Random Forest algorithm. The specific algorithm has a significant advantage over the other machine learning algorithms in terms of its accuracy and its ability to perform with small sample sizes. Consequently, two RF models were created (one for each sensor) and their predictive performance was assessed through the k-fold cross-validation (CV) method. The results of this study highlight the significance of spatial accuracy and canopy penetration in AGB estimation over a complex structured forest with rough terrain.

ID: 0046

ASSOCIATION BETWEEN TOP AND BOTTOMSIDE IONOSPHERIC IRREGULARITIES OVER MIDLATITUDE IONOSPHERE

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Keywords: Midlatitude ionosphere; SF; topside ionospheric irregularities; MSTIDs; ROTI.

Abstract: The ionosphere, traditionally modelled as a stratified layer in Chapman's theory, exhibits electron density (Ne) irregularities across various altitudes and latitudes. These irregularities, which

range in scale from a few centimetres to several hundred kilometres, arise due to complex physical processes influenced by space weather, diurnal variations, and seasonal ionization changes. While equatorial and polar regions are more frequently affected by ionospheric irregularities, midlatitude irregularities, though less intense, are still significant. These typically manifest as diffused plasma structures known as midlatitude Spread F (SF), which can persist for several minutes to hours. Understanding the origin and evolution of these irregularities remains a key challenge, as they impact radio wave propagation and space-based communication systems. Recent advances in satellite-based observations have enabled a more comprehensive study of midlatitude ionospheric irregularities. Low-Earth-Orbit (LEO) satellite missions, such as Swarm, which operate at altitudes between 400 and 1,000 km, provide global coverage, facilitating the characterization of ionospheric structures at different altitudes. Midlatitude irregularities in the topside ionosphere are primarily attributed to plasmaspheric ambipolar diffusion and equatorward neutral wind-driven plasma drift along geomagnetic field lines. While prior studies have examined these irregularities, their formation mechanisms and relationship to bottomside ionospheric disturbances remain insufficiently understood. Swarm in-situ Ne and topside Total Electron Content (TEC) measurements, collected over nearly a decade, offer valuable insights into ionospheric irregularities and their connection to space weather phenomena.

This study investigates midlatitude ionospheric irregularities by exploring the relationship between SF events, Medium-Scale Traveling Ionospheric Disturbances (MSTIDs), and topside irregularities. SF events, detected using Digisonde observations, are analyzed alongside MSTIDs, which are identified using GNSS-derived detrended TEC (d-TEC) maps. Concurrently, in-situ Ne measurements from Swarm satellites are used to characterize fluctuations in the topside ionosphere. The study specifically focuses on European midlatitudes, where SF events coinciding with Swarm overpasses are examined to determine their correlation with topside irregularities. Our findings reveal a strong association between SF in the bottomside ionosphere and Ne fluctuations in the topside ionosphere. The latitudinal profiles of Ne from Swarm confirm the presence of irregularities in regions where SF events are observed. Additionally, GNSS-based Rate of TEC Index (ROTI) maps, which quantify the extent of ionospheric fluctuations, show that MSTIDs frequently co-occur with SF events, further supporting the hypothesis of a coupling mechanism between these disturbances. The results suggest that MSTIDs may serve as a link between bottomside and topside irregularities, potentially playing a critical role in their generation and evolution.

ID: 0047

ASSESSMENT OF THE MIDLATITUDE SF DETECTION

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Keywords: Midlatitude SF ; Automatic SF detection; QF; FF; Manual SF detection.

Abstract: The dynamics of the midlatitude ionosphere during nighttime have been extensively investigated across different regions, providing insight into the complex behaviour of ionospheric irregularities. The midlatitude nighttime ionosphere exhibits multiple diffused plasma structures, collectively referred to as midlatitude Spread F (SF), which can persist from a few minutes to several hours. Various observational studies have revealed key morphological features of midlatitude SF occurrences, including their dependence on the solar cycle, seasonal and diurnal variations, and the background conditions that act as seeding mechanisms for their generation. Numerous authors have contributed to identifying the characteristics, variability, and climatology of midlatitude SF; however, the methodologies used for SF detection have raised concerns regarding their accuracy and reliability. With the widespread availability of ionograms, automatic SF detection techniques

have become a common approach for identifying SF occurrence. Ionospheric parameters, such as QF (range spreading) and FF (frequency spreading), are used as SF indicators. These parameters serve as essential indices for nowcasting SF activity; however, their reliability in accurately identifying SF occurrence remains questionable, particularly when using autoscaled ionospheric data. In this study, we aim to evaluate the accuracy and validity of these SF detection parameters by comparing the results with manually identified SF cases over Nicosia, a low midlatitude ionospheric station. By conducting this comparative analysis, we seek to determine the effectiveness of these automated indices and assess whether they can serve as reliable tools for detecting SF activity.

ID: 0048

A STANDARDIZED FRAMEWORK FOR SPATIOTEMPORAL DOCUMENTATION OF CULTURAL HERITAGE OBJECTS

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Keywords: Cultural Objects, Spatiotemporal, standardisation, Provenance

Abstract: To identify and track the provenance of cultural objects, experts need to follow certain rules and guidelines that help them to organize and share information. This leads to the adoption of standardised frameworks to provide a consistent way of documenting cultural objects and ensure the interoperability, semantic enrichment and long-term preservation of information. The EU-funded ENIGMA project focuses on endorsing safeguarding, protection, and provenance management of cultural objects. In this context, involved parties such as Legal Enforcement Agencies officers and archaeologists need to study and document the objects to identify their provenance in both space and time. This paper explores the integration of Europeana, the CIDOC Conceptual Reference Model (CIDOC CRM), Getty Vocabularies, and Dublin Core metadata standards within a Geographic Information System (GIS) environment to develop a structured, interoperable, and semantically rich model for managing the spatiotemporal dimensions of cultural heritage data and therefore a standardised framework to support the monitoring of the provenance of potential looted cultural objects.

CIDOC CRM provides an ontological framework for modelling cultural heritage entities and their complex relationships over time, facilitating the identification of the provenance of cultural objects, the associations between them, as well as other characteristics. The controlled vocabularies at The Getty (the Art & Architecture Thesaurus (AAT), Thesaurus of Geographic Names (TGN), and Union List of Artist Names (ULAN)) are used to standardize the terminology of the descriptive attribute features. The Dublin Core and the Europeana Data Model (EDM) are used to standardise metadata and make digital resources interoperable to larger cultural property networks.

In parallel, the integration of a Geographic Information System infrastructure enhances the ability to represent, analyse and visualise the spatial and temporal routes of cultural objects, allowing researchers to reconstruct historical routes, map the presence of objects and study their patterns appearance over different time periods.

A key challenge in the use of Information Technologies in cultural heritage management is the integration of heterogeneous data sources, documenting the movement, ownership and natural or contextual changes of cultural heritage objects. This paper presents a methodological approach to encoding and visualizing these dynamics in a GIS-based environment, incorporating temporal ontologies and spatial analysis to enable detailed reconstruction of an object's historical presence and documented routes. Leveraging the principles of linked object data and semantic web

technologies, the proposed model supports the creation of knowledge graphs that link objects, locations and historical events, enabling advanced spatiotemporal analysis of cultural heritage data

ID: 0049

VALIDATION OF PRECIPITABLE WATER VAPOR (PWV) PRODUCTS USING CYMETEO GNSS NETWORK IN CYPRUS

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Keywords: GNSS receiver, Precipitable Water Vapor, Extreme precipitation events

Abstract: The Eastern Mediterranean region is one of the most prominent hot spots of climate change in the world and extreme weather and climatic phenomena in this region such as heavy and extreme precipitation events are expected to become more frequent and intense. Water Vapour is the most abundant of greenhouse gases (accounting for ~70% of global warming) and is a direct indicator of severe weather events such as heavy precipitation and floods as it can change rapidly. To improve nowcasting of local heavy rainfall and flash storm events we need Precipitable Water Vapour (PWV) data. PWV is the amount of water potentially available in the atmosphere for precipitation, vertically integrated and it is a valuable predictor for weather forecasting. In Cyprus and globally PWV data are sparse and inhomogeneous. One technique to estimate PWV is by exploiting the propagation delay of the GNSS (Global Navigation Satellite System) satellites signals. CyMETEO GNSS network installed in the frames of strategic infrastructure project “Cyprus GNSS Meteorology Enhancement” (CYGMEN) aims at developing a GNSS-based PWV monitoring system, incorporated at the CyMETEO portal, that will be used for short-range weather forecasting and extreme weather events investigation over Cyprus. To perform the GNSS-based PWV product validation of CyMETEO, we created a complete dataset on heavy precipitation events over Cyprus for the 12 CyMETEO stations from 2020-2024, based on data form the Cyprus Department of Meteorology (CY DoM) and from the European Severe Weather Database (ESWD). Heavy precipitation days are considered the days with precipitation ≥ 20 mm (Lazoglou et al. 2024, Zittis et al., 2020, Tymbios et al., 2010). This is the criterion we chose to categorize a precipitation event as day with heavy rain. From these cases we selected certain extreme events with rain ≥ 40mm, which were used to perform the validation of GNSS derived PWV and ZTD (Zenith Tropospheric Delay) employing radiosonde data from CY DoM. The GNSS tropospheric products (PWV, ZTD) were validated by utilizing existing independent datasets, such as ERA5 Reanalysis and IGRA Radiosonde data, during the selected extreme precipitation events. Additional extreme precipitation indices as well as the relationship between PWV and precipitation during the selected extreme precipitation events over Cyprus during the period 2020-2024 were also investigated.

ID: 0050

ONE-YEAR OBSERVATIONS OF HORIZONTAL WINDS IN LIMASSOL, CYPRUS USING A DOPPLER LIDAR

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Keywords: Xylella fastidiosa detection; Olives; Sentinel-2; PlanetScope
Abstract: Xylella fastidiosa (Xf) is a quarantine-listed, highly destructive bacterial pathogen that colonizes the xylem vessels of a wide range of plant species. The bacterium is introduced into plant tissues by xylem-feeding insects, such as Philaenus spumarius, and blocks water transportation, resulting in leaf scorching, branch dieback, and ultimately plant death. The first outbreak of Xf in the European Union was reported in 2013, causing widespread devastation to olive groves in the Salento region of Italy, where millions of olive trees have succumbed to the disease. After infection, olive trees can remain without visible symptoms for over five months, during which the bacterium progressively spreads via the xylem, eventually leading to water stress. Typically, the first signs of infection take 12-14 months to appear and are usually observed on the upper sections of infected branches, primarily at the top of the tree crown. Within approximately 24 months, localized symptoms expand to cover the entire crown, resulting in a scorched appearance and dieback of entire branches. Thus, the extended symptomless period hinders early intervention. The current research focuses on developing an algorithm for detecting Xf infection via remote sensing techniques, with an emphasis on automated early symptom detection. To meet this objective, healthy and infected olive orchards are being monitored using Sentinel-2 images (10 m resolution) alongside higher spatial resolution data from PlanetScope (3 m) for more detailed analysis. Indices associated with the detection of Xf, including Optimized Soil-Adjusted Vegetation Index (OSAVI), Atmospherically Resistant Vegetation Index (ARVI), Normalized Difference Vegetation Index (NDVI), Transformed Chlorophyll Absorption Reflectance Index (TCARI), Salinity Index (SI), Leaf Area Index (LAI) and Normalized Difference Water Index (NDWI), are being analyzed for their effectiveness in detecting Xf at various infection stages. Preliminary results suggest that vegetation indices like TCARI and SI effectively detect symptoms at advanced stages of Xf infection, with limitations in early disease identification.

ID: 0051

A HYBRID EDGE-TO-CLOUD ARCHITECTURE TOWARDS LOW-CODE DEVELOPMENT OF GLOBAL FOOD-SECURITY APPLICATIONS: THE NOSTRADAMUS CASE

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Keywords: Smart Agriculture; Food Security; Internet-of-Things; Domain-specific Languages; Low-code development
Abstract: The Nostradamus initiative focuses on food security, sustainability, and agricultural resilience in the EU using digital technologies. Funded by Horizon Europe, it aligns with key EU frameworks like the European Green Deal and the Common Agricultural Policy. The project has two primary objectives: firstly, to establish a robust, data-centric foundation to support the EU's food security and self-sufficiency; and secondly, to facilitate the development of open-source digital applications using low-code approaches, specifically designed to address the multifaceted challenges of contemporary agriculture. The utilization of low-code approaches is anticipated to facilitate the refinement of agricultural practices by stakeholders, who are the domain experts, with the objective of enhancing resource efficiency, reducing reliance on agrochemicals, and strengthening resilience against potential disruptions, without the necessity for a strong technological and programming background.

To achieve the project objectives, the Nostradamus hybrid Edge-to-Cloud architecture is introduced, which is divided into three distinct layers: i) the data infrastructure, supporting dataset

storage and querying in various forms such as NoSQL databases, catalog services and Data Cubes, ii) the IoT Observatory, build on-top of state-of-play tools for near real-time IoT data management, such as Kafka, CassandraDB and Redis cache, and iii) the Low-code application development and monitoring platform. Furthermore, the data infrastructure provides APIs to applications for dataset and Data Cube querying, and the IoT observatory provides an abstraction layer for connecting to domain-independent Edge systems, via an IoT broker integrated into the Nostradamus platform (namely the Edge Gateway) that supports the MQTT and CoAP communication protocols.
Nostradamus applications are divided into three distinct categories: a) Edge Components, which are software components executed on embedded devices on the Edge, handling sensory data acquisition and dispatching to the cloud, b) App Logic Components, which refer to aggregation software describing logic flows of data and processes, and c) App GUI Components are defined as the elements that facilitate hybrid data acquisition and visual representation in GUI-enabled applications. They also encompass the necessary software that enables connectivity to the various components of the Nostradamus ecosystem, such as data sources and platform backend services. In this context, Domain-specific Languages (DSLs) will be developed, based on model-driven principles, to enable the rapid, quality-aware and error-free development of the aforementioned application types. These DSLs will be accessible via the Nostradamus low-code development platform that provides a UX-driven and web-based GUI, among with Model-to-Model (M2M) and Model-to-Text (M2T) transformations, to finally transform DSL “code” to executable software of the applications. For example, in the case of the Edge Components, the user may be able to describe their edge devices characteristics, as well as the sensors they are equipped with, so as to automatically generate software for the embedded devices that will handle data acquisition and dispatching to the cloud. Furthermore, the Low-code platform will incorporate an AI assistant to streamline the development process utilizing the aforementioned DSLs. This integration will also enable the creation of models, and thus applications, through verbal descriptions in textual form.

ID: 0052

A COMPARATIVE STUDY OF NDVI, SVM, AND NEAREST NEIGHBOR ALGORITHMS FOR EFFECTIVE LAND USE LAND COVER CLASSIFICATION

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Keywords: NDVI, SVM, Nearest Neighbhur, LULC, Landsat

Abstract: The Land Use Land Cover (LULC) classification problem is a critical area of research aimed at accurately mapping and monitoring land use and land cover changes. This study leverages advanced geospatial and machine learning techniques to enhance classification accuracy and reliability. The Normalized Difference Vegetation Index (NDVI), Support Vector Machine (SVM), and Nearest Neighbor classification methods are applied to multi-temporal satellite image datasets to assess their effectiveness in LULC classification.For this study, datasets from the Landsat Collection are utilized, focusing on eight satellite images from the years 1988, 1995, 1999, 2004, 2009, 2014, 2019, and 2024. The primary objective is to evaluate LULC changes over time and compare the classification accuracy of NDVI, SVM, and Nearest Neighbor methods. Classification accuracy is assessed using an error matrix, which provides a comprehensive evaluation of each method's performance, ensuring a quantitative measure of LULC classification accuracy.

ID: 0053

APPLICATION OF THE GAEZ METHODOLOGY FOR ASSESSMENT OF AGRO-ECOLOGICAL PRACTICES IN NORTH AFRICA

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Keywords: Agro-ecology, Global Agro-Ecological Zoning, Google Earth Engine

Abstract: Despite agricultural land expansion and intensification, which has led to ecosystem degradation and biodiversity loss, North African countries become increasingly more food-import dependent, due to climate change repercussions and increasing demand for food consumption. To reconcile sustainable food security, agroecology emerges as a promising approach that simultaneously promotes natural resources preservation, while supporting higher crop productivity. Yet scaling these practices presents various challenges due to diverse environmental conditions and local inconsistent adaptive strategies.

This study, performed in the framework of the NATAE project, funded by the Horizon Europe program, aims to provide a comprehensive spatial assessment of current farming status of major crops within Maghreb countries and Egypt, by employing the agroecological zoning (AEZ) methodology developed by the International Institute for Applied Systems Analysis (IIASA) and Food and Agriculture Organization for the United Nations (FAO) over the last decade. Multi-source remote sensing datasets were employed as a foundation of the analysis, preprocessed and downloaded from Google Earth Engine (GEE) platform, including TerraClimate for climatic variables, NASADEM for terrain characterization and Copernicus Global Land Service (CGLS) latest land cover. Additional soil and crop-specific datasets were also integrated in the model. The AEZ analysis was implemented using Pyaez library in Google Colab, enabling efficient computational processing.

Results identified zones with similar agricultural potentials and constraints, based on the assessment of the agroclimatic and terrain characteristics, while considering the specific crop requirements and soil conditions, which significantly influence crop productivity. While this study serves as the initial steps towards suggesting appropriate agro-ecological practices, it provides limited insights into activities such as agroforestry and forest activities. Future research should leverage advanced analytical techniques and higher resolution remote sensing data, in conjunction with higher quality soil data, to develop deeper local insights into north African agricultural systems.

ID: 0054

BUILDING CLIMATE RESILIENCE IN MOUNTAIN REGIONS

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Keywords: Mountain resilience; Climate adaptation; Cascading effects; Community of Practice (CoP); Extreme weather events

Abstract: Mountain regions face distinct climate-related challenges that differ from those encountered in lowland areas. Changes in temperature, precipitation patterns, and extreme events impact ecosystems, water resources, and local livelihoods in ways that require targeted adaptation strategies. In this study, resilience-building efforts in the Troodos region are examined, with a focus on available indicators, identified gaps, and the role of Community of Practice (CoP) meetings in fostering collective responses. Through the ClimEmpower initiative, existing resilience indicators have been assessed within a broader conceptual framework encompassing climate risks, socio-economic factors, and governance structures. Although some indicators related to water scarcity, wildfire impact, and temperature fluctuations provide insight into regional vulnerabilities, significant gaps remain in exposure and vulnerability data, hindering the development of effective adaptation policies and resilience measures.

The role of participatory approaches in resilience-building has been analyzed, emphasizing how stakeholder engagement contributes to localized climate adaptation strategies by facilitating the rapid identification of key challenges faced by a region. CoP meetings have been identified as an essential platform for knowledge exchange, co-creation of solutions, and policy dialogue. Through qualitative analyses, stakeholders have highlighted the need for policy advocacy, capacity-building initiatives, and interdisciplinary collaboration, which have been underscored as crucial elements for strengthening resilience.

The findings hold significance beyond the Troodos region, as mountain areas worldwide share similar vulnerabilities and require tailored adaptation approaches. Compared to lowland areas, mountain communities experience unique challenges, including increased exposure to extreme weather events, heightened water scarcity, and a faster spread of wildfires, resulting in greater burnt areas. The importance of region-specific resilience indicators and participatory decision-making processes is emphasized, with lessons drawn from this study offering valuable insights for other mountainous regions facing climate-related uncertainties.

The methodological approach and governance insights presented can inform adaptation strategies in other regions, including those in Central and Northern Europe. As climate change continues to impact mountain environments in distinct ways, addressing resilience gaps through participatory mechanisms remains essential. The findings of this study provide a pathway for strengthening climate adaptation efforts not only in Cyprus but also in other mountain settings where similar challenges are encountered.

ID: 0055

RARE OPPORTUNITY TO COMPARE TOPSIDE IN-SITU ELECTRON DENSITIES FROM SWARM SATELLITES WITH IONOSONDES

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Keywords: Ionosphere, electron density, Swarm, ionosonde

Abstract: The ESA Swarm mission comprises a constellation of three identical satellites (Swarm A, B and C) at low-altitude polar orbits operating since 2014. The initial orbit heights were at ~465 km (Swarm A and C) and ~520 km (Swarm B) at an inclination of 87.35° for Swarm-A/C and 87.75° for Swarm-B. The mission has provided a long-term in-situ electron density dataset from Langmuir probes on each of the three satellites. Since the constellation operates in the topside ionosphere it is impossible to compare these electron density values with established bottomside electron density profile monitoring techniques such as ionosondes which are considered as the most widely

used ground-based instruments for ionospheric monitoring. However, occasionally during severe geomagnetic storms, due to the dramatic uplift of the F-region, the altitude scope of ionosondes can be extended to cover the orbit altitude of such satellite missions as Swarm. Such an example was the geomagnetic storm on May 10–13, 2024, known as the Mother's Day geomagnetic superstorm. In this study we attempt a comparison based on a limited dataset of electron density values from ionosondes at Swarm orbit altitude to examine the level of agreement between these two techniques

ID: 0056

COMPARISON BETWEEN AUTOMATICALLY AND MANUALLY SCALED IONOSPHERIC CHARACTERISTICS OVER CYPRUS

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Keywords: Ionogram, ionosonde, scaling

Abstract: The challenge for provision of accurate operational nowcasting and short-term forecasting ionospheric services based on ionogram-derived products has greatly increased during the last decade with a clear future trend to evolve into real time assimilation services. This fact, coupled with internet bandwidth expansion and enhanced capabilities of modern ionosondes to operate on a high time resolution (a significant number of Digisonde ionospheric sounders contributing to GIRO -Global Ionospheric Radio Observatory provides data at 5 min resolution) has significantly increased the demand for reliable and consistent automatic scaling for the purpose of determination of ionospheric characteristics derived from ionograms (Reinisch et al., 2011). This demand has been constantly driving the development and continuous improvement of existing programs in order to provide accurate automatically scaled data. The ARTIST software developed at the University of Lowell, Center for Atmospheric Research, is an automatic scaling program widely used and has undergone several upgrades (Galkin et al., 2008). This study attempts to quantify the quality of all the key ionospheric characteristics scaled automatically from ionograms from the low to mid latitude Nicosia ionosonde in Cyprus by performing a comparison with manual scaled values.

ID: 0057

A MULTIPURPOSE PLATFORM FOR PASTORAL FARMERS AND STAKEHOLDERS

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Keywords: Information and Communication Technologies, sustainability, e-learning, small businesses, extensive livestock

Abstract: Pastoral farmers are usually linked to ancestral practices that are beneficial to the environment and human societies, but also lack a connection with technology and adequate access to innovative solutions. Further work is needed to change the current perspective of pastoral livestock systems in order to increase the awareness of the general public regarding their benefits. Considering that a high proportion of the population have social media accounts, including farmers, the project "Innovative models for sustainable future of Mediterranean pastoral systems" (PASTINNOVA) developed a multipurpose digital platform to enhance the flow of information among pastoral farmers, dairies, researchers, academia, policy makers, consumers and other stakeholders. The platform aims to enhance the transfusion and fermentation between TEK (Traditional Ecological Knowledge) of field operators and academic knowledge as a research output

within a unified, inclusive, and cohesive digital environment that fosters interactions. The platform envisages to enhance the exposure, outreach, and extroversion of pastoral products, thus complementing traceability, direct connections between pastoralists and consumers, and consumer awareness of the nutritional value and ethics of pastoral products. In parallel, the different functions of the platform familiarize the greater audience with the principles of open-source technology in an effort to advocate for the democratization of technology and to make it more accessible and further utilized by users that otherwise would lack access to its benefits due to limited resources or capacity. The platform features several functionalities that allow users to actively interact as if using a social media account: user profile, communities, activities, library, and products. These features were developed based on the responses obtained through a questionnaire that was designed to collect information regarding 1) Digital literacy & overall familiarity with digital tools of pastoralists and other main stakeholders of pastoral systems, across various cultural, geographical, and socioeconomic contexts. , 2) usage of technological tools and 3) expectations from a digital platform. The questionnaire's responses led to the development of a gamified platform where users collect points and earn badges depending on their use of the platform's different features. Especially with regards to pastoral products, the platform aims to improve farmers' and dairies' exposure regarding their practices and quality of their products. For researchers, academia and policy makers, the platform offers a dedicated space for the submission of relevant resources and the creation of networking communities, also supported by a function relating to citations of publications from universally acknowledged research portals such as Google Scholar and/or ResearchGate. Another feature of the platform is a space for e-learning modules about pastoral systems and their interaction with natural ecosystems. The platform also integrates interoperability with widely used Social Media platforms, including sign-up/in mechanisms via existing credentials on Facebook, LinkedIn, Google+, etc., and shortlinks for simultaneous publication to these platforms, but also encourages users to link their interests and areas of work with the Sustainable Development Goals, to highlight the interlinks between pastoral farming practices and the global sustainability targets.

In the actual early stage of platrofm use, the platform has around 30 active users, but PASTINNOVA aims to triplicate this number by attracting more dairies to use the platform to disseminate information about their products' properties and sales points, to support small businesses who are seeking to expand their sales through other channels. Further efforts are necessary for the promotion of the PASTINNOVA platform among interested stakeholders to increase the benefits from a space dedicated to extensive livestock.

ID: 0058

AN EMPIRICAL COMPARISON OF MACHINE LEARNING ALGORITHMS FOR GROUNDWATER QUALITY CLASSIFICATION

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Keywords: water resources management, groundwater management, artificial intelligence, agriculture, irrigation.

Abstract: Groundwater quality classification is vital for agricultural sustainability, affecting both crop selection and livestock health across farming communities. Groundwater salinization is a significant threat to primary productivity industry, as high salinity levels can result in reduced cultivations' productivity and soil health degradation. Including parameters correlated with salinity

into groundwater quality assessments is important on machine learning model training for quality classification tasks. Recent advancements in artificial intelligence have facilitated the classification of groundwater quality. In this study, an open dataset, retrieved from Kaggle includes in-situ sampling data from Telangana, India during the post-monsoon period. Different physiochemical parameters such as pH, electrical conductivity, total dissolved solids among others are utilized for the training of various machine learning models (e.g., Random Forest, Support Vector Machines, XGBoost, k-Nearest Neighbors, etc.) and evaluate their predictive power on groundwater quality classification. Moreover, feature importance and Explainable Artificial Intelligence techniques are used in this study to identify the influence of physiochemical parameters on models' accuracy. Our findings aim to identify the most effective algorithm for groundwater quality classification, thereby contributing to more informed decision-making in water resources management.

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ID: 0059

SMOKE OPTICAL PROPERTIES: LIDAR OBSERVATIONS IN CYPRUS DURING 2021-2023

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Keywords: sustainable land management, soil erosion, drone technology, climate change adaptation, olive orchards

Abstract: Soil erosion represents one of the most pressing environmental challenges in Mediterranean regions, driven by the synergistic effects of climate change and unsustainable agricultural practices. Inappropriate techniques, such as plowing and herbicide application, combined with extreme weather events, including extended droughts and intense rainfall, accelerate water erosion, leading to soil degradation. These processes reduce soil fertility, decrease agricultural productivity, and increase flood risks, threatening both ecosystems and local livelihoods. Olive orchards situated on sloped terrains are particularly vulnerable due to their location and reliance on traditional farming methods. Thus, developing precise methodologies to monitor and mitigate soil erosion is critical for promoting sustainable agricultural practices and adapting to a changing climate.

In collaboration with local stakeholders, we investigated an olive orchard in Messenia Peloponnese, Greece with a 16% average slope. A Randomized Block Design (RBD) has been implemented to compare three agricultural treatments: herbicide application, mowing natural vegetation, and seeding cover crops. Nine experimental plots (100 m² each) were equipped with surface runoff collection systems to monitor soil loss and sedimentation. Metal sheet boundaries and canals guided runoff into buried tanks, allowing sediment capture after rainfall events.

To enhance field measurements, drone-based Digital Elevation Models (DEMs) generated with a LiDAR-equipped DJI MATRICE 350 RTK were used to map soil displacement before and after rainfall events. The Difference of DEMs (DoD) methodology, achieving millimeter-level accuracy, validated

sediment data collected from experimental subplots. By capturing high-resolution topographic changes, this technique enabled precise quantification of soil displacement, offering a comprehensive view of erosion dynamics in response to varying agricultural practices and the influence of precipitation patterns on runoff and soil loss.

The findings reveal significant variations in soil erosion rates across the three soil treatments, highlighting the critical influence of land management practices on soil stability. Herbicide application resulted in the highest soil loss due to the lack of vegetation cover, whereas seeding cover crops effectively reduced erosion by stabilizing the soil and enhancing water retention. Mowing natural vegetation provided intermediate results, offering a balance between erosion control and practical farm management. The study demonstrates that combining cutting-edge drone technology with robust field experiments provides valuable insights into soil erosion processes. This integrated approach not only advances the precision of erosion monitoring but also supports the development of sustainable strategies to mitigate soil degradation, preserve biodiversity, and enhance the resilience of Mediterranean olive orchards under the pressures of climate change.

ID: 0060

EVALUATING CARBON FARMING PRACTICES FOR SUSTAINABLE SOIL MANAGEMENT IN CITRUS CULTIVATION

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Keywords: Carbon farming, soil quality, carbon sequestration, citrus cultivation, sustainability

Abstract: Oranges (citrus) stand out as a fruit of global nutritional and consequently commercial importance, serving as a crucial export product for many countries. Their cultivation in Mediterranean climates requires careful management of soil and water resources, where maintaining fertile and healthy soils is vital for ensuring productivity and fruit quality. Carbon sequestration in soils of citrus orchards represents a significant opportunity for climate change mitigation. Research work demonstrates that cover cropping, reduced or no-tillage, pruning residue incorporation, and biochar / compost application significantly improve soil quality and can increase carbon sequestration. In addition, both biochar and compost, improve soil properties by increasing Cation Exchange Capacity (CEC) and balancing pH, thereby enhancing nutrient availability for plants. These amendments aid in rehabilitating degraded soils, improve aeration and moisture retention, and support extensive root systems, which assist in carbon sequestration. The CARBONICA project is actively studying innovative solutions for sustainable soil management and carbon sequestration in citrus cultivation.

ID: 0061

DETECTING AND MAPPING BIOCRUSTS IN THE NAMIB DESERT INCORPORATES SPECTRAL INDICES BASED ON PHYCOBILIN, CHLOROPHYLL, AND CELLULOSE

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Keywords: Biological soil crusts, Namib Desert, spectral indices, remote sensing, Satellite Cellulose Absorption Index (SCAI)

Abstract: Biological soil crusts (biocrusts), including lichens, play a vital ecological role in arid environments by stabilizing soil, reducing erosion, and influencing nutrient and water cycles. Remote sensing has become an indispensable tool for mapping biocrusts because it can efficiently analyze extensive and inaccessible areas. This study focuses on detecting and mapping lichens in the hyper-arid Namib Desert, using a combination of spectral indices that highlight key iophysical components: phycobilin, chlorophyll, and cellulose that characterize biocrusts. The study includes laboratory hyperspectral analyses, wetting experiments, PLS-DA, PLS-R, and satellite data from Sentinel-2 to examine spectral reflection and absorption features in visible, near-infrared, and shortwave-infrared (SWIR) regions. Alongside the well established Crust Index (CI) and normalized Difference Vegetation Index (NDVI), we introduce the Satellite Cellulose Absorption Index (SCAI). The latter novel index utilizes the SWIR1 and SWIR2 bands to identify lichens in hyper-arid landscapes, showing significant differentiation between lichens and bare substrate under dry conditions. Spectral analyses confirm that phycobilin reflection in the blue band, chlorophyll absorption in the red, and cellulose absorption in SWIR2 are the key biological indicators of biocrusts, and combining them provides complementary insights. Satellite-based indices exhibit a declining spatial trend in lichen density from the coast inland, correlating with fog and moisture availability. These findings underscore the potential of remote sensing tools to assess biocrust distribution and dynamics on a landscape scale. The proposed SCAI, which is sensitive to moisture, provides a scalable solution for mapping biocrusts, offering new opportunities for monitoring arid ecosystems under the impending changing climate.

ID: 0063

ASSESSING MEDITERRANEAN FRUIT FLY INFESTATION RISK WITH SATELLITE AND GROUND-BASED MONITORING

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Keywords: Remote Sensing, Ceratitis capitata, Integrated Pest Management, Citrus, Phenology

Abstract: Remote sensing technologies have become a fundamental tool in precision agriculture, offering substantial insights into crop health. Remote sensing methods are suitable for monitoring pests causing significant damage in the foliage of plants, which result in changes of spectral signatures of the affected areas. However, many key pests attack the fruits, causing mild symptoms that are not detectable from satellite imagery. The Mediterranean Fruit Fly (Medfly), Ceratitis capitata, is a key agricultural pest that attacks more than 200 crops. Female flies lay their eggs in maturing and mature fruits, causing a small discoloration at the oviposition site, not detectable with space-based remote sensing. The current work proposes the combination of remote sensing with ground-based monitoring to track the infestation risk of citrus fruits by the Medfly. We combine crop phenology and temperature data derived from Sentinel-2 and Sentinel-3 satellites, respectively, and pest population data from traps to develop a preliminary Medfly infestation risk index. Specifically, Sentinel-2 multispectral data with a spatial resolution of 10 m are used to monitor crop phenology and detect spectral changes related to fruit maturation. We apply remote sensing indices including the Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), Leaf Area Index (LAI), Chlorophyll Index (CI) to detect changes associated to fruit color break stage, which is linked to the onset of the Medfly oviposition suitability period. Conventional and smart traps are used to quantify the Medfly population size, while Sentinel-3's Land Surface Temperature (LST) is used to describe the attack potential of the populations, as temperature plays a defining role in insect activity and oviposition. This approach provides a preliminary framework for quantifying the pest pressure by the Medfly by developing the Medfly infestation risk index in citrus and potentially other crops.

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ID: 0064

EXPLORING WITH TIME-SERIES SATELLITE DATA NUCLEAR POWER CERNAVODA ENVIRONMENT

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Keywords: remote sensing satellite data, nuclear power plant environment, Cernavoda, Romania

Abstract: Nuclear power plants (NPP) are well recognized as reliable sources of clean energy, with extended operational life and low greenhouse gas emissions. However, the radioactive discharges in the atmospheric, aquatic, and terrestrial environments within a defined 30 km radius, maybe a real concern for their potential impact on health and the environment. Cernavoda NPP, near the Danube River in Romania, has two CANDU-6 units in operation and provides approximately 20 % of the country's total energy production. Despite the proven record of safety performance and high capacity factors, thermal discharges may have impacts on environmental biogeophysical parameters and spatiotemporal changes. For the spatiotemporal thermal plume analysis in the NPP hydrological system, and its relationship with biogeophysical environmental variables have been used MODIS Terra/Aqua, Landsat TM/ETM+/OLI, and NOAA AVHRR time series satellite data,

statistical correlation during the 2000-2024 period. Thermal discharge from two nuclear reactors' cooling systems is dissipated as waste heat in the Danube-Black -Sea Channel and Danube River. This study found that during the winter season, the thermal plume was localized to an area of a few km of NPP, and the mean temperature difference between the plume and non-plume areas of about 1.8 oC. was higher than in summer and fall seasons when the derived mean temperature difference between the plume and non-plume areas was of about 1.4 °C. The thermal plume area was extended up to 4 - 10 km far along the Danube Black Sea Channel. The results of this study provide valuable insights into the thermal impact of the nuclear power plant Cernavoda and highlight the significance of considering seasonal variations under climate warming and long-term monitoring to ensure environmental sustainability.

ID: 0065

ASSESSMENT OF CLIMATE CHANGE IMPACTS ON CARPATHIAN MOUNTAINS FOREST VEGETATION THROUGH TIME-SERIES SATELLITE IMAGERY

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Keywords: Climate changes, forest vegetation, MODIS Terra/Aqua, Sentinel 2 and Landsat TM/ETM/OLI satellite data, Prahova Valley, Romania

Abstract: Carpathian Mountains forests in Romania have several ecological, environmental, and socioeconomic values that provide unique habitats for many endemic species. During the last few years, these ecosystems have been under increased pressure from climate extreme events and anthropogenic factors, with winter storms and heat waves being the key climate risks, particularly in pre-alpine and alpine areas. Knowledge of spatiotemporal changes in forests is needed for their protective management. To address this knowledge gap, this study used MODIS Terra/Aqua, Landsat TM/ETM/OLI, and Sentinel 2 satellite remote sensing data to investigate changes in biophysical parameters and primary productivity within the forests of the Southern Carpathian Mountains in Romania, for Prahova Valley test case area, where climate events and simultaneously land cover changes have been recorded during the past two decades. Through analysis of the time series MODIS-derived Normalized Difference Vegetation Index (NDVI), Leaf Area Index (LAI), and Net Primary Productivity (NPP) have examined trends and seasonality in forest vegetation as well as identified the impacts of human disturbances (clearcutting, etc. during 2000-2024 period. Statistical rank correlation analysis between climate parameters (air temperature, relative humidity, atmospheric pressure, surface solar irradiance) with vegetation biophysical parameters demonstrated the high impact of climate changes on forest vegetation. The response of forest vegetation land cover to climatic factors in the Carpathian Mountains, Romania varies in different seasons of the years, the diverse vegetation feedback to climate changes being related to different vegetation characteristics and meteorological conditions. This study clearly illustrates the high importance of freely available satellite data for providing spatiotemporal information about large-scale and long-term changes in forest ecosystem functioning.

ID: 0066

HOW CAN REMOTE SENSING BE A MODERN SOLUTION FOR MONITORING XYLELLA FASTIDIOSA BACTERIUM THAT THREATENS OLIVE TREES: A REVIEW

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Keywords: Drought, Soil Moisture, Climate Crisis, Water Resources Management, Remote Sensing

Abstract: Crop productivity is highly influenced by the extreme drought events in recent years caused by climate change. Due to its strong link to food security, which is endangered by global warming and the anticipated future expansion in the human population, agricultural drought is gaining more attention. Limited precipitation events causing atmospheric drought to have a significant impact on water resources by limiting its availability and causes water depletion in catchment areas. The aim of this research is to identify drought events in the semi-arid island of Cyprus and its relationship with soil moisture at different depths using Remote Sensing data. The data used for the current research derived from Standardized Precipitation Evapotranspiration index (SPEI) based on 3 months period and GLDAS datasets for soil moisture depths of 0-10cm, 10-40cm, 40-100cm and 100-200cm. A correlation analysis was performed to observe the relationship of SPEI with the different soil moisture depths. The relationship of volumetric water content in soil with drought events is strong and presents a linear trend.

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ID: 0067

NEAR REAL TIME MONITORING OF ILLEGAL ARCHAEOLOGICAL EXCAVATIONS THROUGH REMOTE SENSING TECHNIQUES

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Keywords: Remote sensing, Vegetation Index, Looting, Archaeology, Monitoring

Abstract: Satellite technology has shown great potential in analysing archaeological looting through various studies worldwide.

As part of the EU funded ENIGMA Project, an Earth Observation (EO) toolkit is being developed for monitoring endangered sites. This toolkit aims to provide early warnings to relevant authorities by leveraging optical satellite images through advanced processing techniques, including Vegetation Indices calculation and Change Detection.

Vegetation indices are designed to analyse vegetation health, density, and dynamics across a range of ecosystems, using spectral reflectance. They have been increasingly used in the detection of archaeological looting, as changes in vegetation cover or anomalies in soil reflectance can indicate

looting and plundering. In this study, a diverse set of vegetation indices was employed to address various challenges in vegetation monitoring.

The developed EO toolkit performs a series of preliminary operations to generate vegetation indices and change detection heat maps.

The process begins with defining the Region of Interest (ROI). Using the Planetscope API, satellite imagery is downloaded and once retrieved, the imagery undergoes satellite image clipping to isolate the specific portion corresponding to the ROI.

Depending on the land cover of the area, the toolkit selects and computes the most appropriate vegetation indices. These indices are processed to highlight any possible ground anomalies produced by vegetation man-made disturbance. The toolkit then performs a multitemporal analysis by comparing satellite images from different time periods. This step identifies changes in vegetation or surface patterns over time, which might suggest potential disturbances caused by illegal excavation activities.

The results are then visualized providing clear and actionable insights into vegetation dynamics and converted into a shapefile for seamless integration and visualization within GIS. This user-driven approach ensures that the analysis is both contextually relevant and scientifically robust, allowing for effective monitoring and decision-making.

This study examines two archaeological sites with distinct climates and environments: Apamea (Syria) and Chersonesos Taurica (Ukraine).

In Apamea, Transformed Soil Adjusted Vegetation Index (TSAVI) was used to highlight alterations in vegetation and land cover. The results clearly show significant land use changes and damage, due to the internal turmoil and the activities of ISIS during the Syrian conflict (2013-2014) which led to extensive plundering.

In Chersonesos Taurica, located on the Crimean Peninsula, satellite imagery from 2016 and 2024 were analysed to assess changes in the landscape in and around this historic site. The analysis employed the Soil-Adjusted Vegetation Index (SAVI), with results revealing significant disruptions, potentially linked to the occupation of Crimea by Russia. These changes may be associated with looting and plundering activities. However, a ground-truth field survey should be conducted to confirm the change detection results.

The Earth Observation toolkit is designed to automate the detection of illegal archaeological excavations through advanced remote sensing techniques. The workflow integrates image processing methods, remote sensing techniques and Change Detection algorithms, which could collectively support a responsive alarm system to enable rapid intervention by authorities. The increasing revisit frequency of modern satellite providers further strengthens the toolkit's capability to respond effectively to emerging threats and protect archaeological sites.

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ID: 0068

UNMANNED AERIAL SYSTEMS FOR EARLY DETECTION OF DOWNY MILDEW IN TOBACCO FIELDS: ENHANCING FINANCIAL OUTCOMES THROUGH PRECISION MONITORING

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Keywords: Parallel Computing, Doppler Estimation, Ocean Currents, SAR

Abstract: Unlike optical sensors, synthetic aperture radar (SAR) operates independently of weather conditions and sunlight, making it highly effective for persistent maritime surveillance and oceanographic studies. However, high-resolution SAR data processing for marine applications is computationally demanding due to large memory requirements. In this context, parallel computing emerges as a promising solution for accelerating real-time SAR image processing and physical parameter estimation.

This study introduces a novel parallel computing approach for SAR image clustering by leveraging MATLAB's distributed computing capabilities to achieve fast and precise SAR image segmentation. We utilize this efficient parallel computing framework to perform Doppler centroid estimation (DCE) using both the correlation Doppler estimator (CDE) and sign Doppler estimator (SDE). An onboard tiling method partitions the SAR scene into tiles of the SAR image, enabling localized estimation of the baseband Doppler centroid component \(f_{\text{DC}} \). These estimates are unwrapped across range and azimuth while preserving resolution.

Rigorous quality control ensures clarity of image, allowing us to exploit Doppler signatures to retrieve ocean surface currents (OSC) with the help of the radar imaging model (RIM), which is particularly useful for monitoring eddies, rip currents, and strong currents such as those associated with hurricanes. The proposed parallel computing approach reduces computational load by 32 times, enabling near-real-time OSC estimation suitable for operational SAR-based ocean monitoring systems. Furthermore, statistical indicators show negligible bias and higher correlation coefficients with aligned slopes; these results validate the effectiveness of proposed parallel-computed SAR data processing for marine applications.

ID: 0069

HABITAT TYPES MAPPING USING REMOTE SENSING TECHNIQUES IN CYPRUS

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Keywords: remote sensing, seagrass, habitat mapping, google earth engine

Abstract: Oceans cover 75% of the Earth's surface and account for 99% of the planet's living space by volume. They are home to around 200,000 known species, with Posidonia oceanica meadows being among the oldest. These habitats play a crucial role in coastal ecosystems, providing vital services such as habitat for marine life, coastal protection, and oxygen generation. Despite their importance, seagrass meadows, including Posidonia oceanica, face significant threats, including degradation and loss, with slow regeneration rates. As a result, their monitoring and conservation are essential for maintaining biodiversity and the health of marine ecosystems. This study presents an innovative approach for mapping and monitoring seagrass meadows in the western Cyprus using the Google Earth Engine (GEE) platform. Leveraging freely available satellite data from the Copernicus Program, we demonstrate how Earth observation tools can be utilized to map the spatial extent of seagrass meadows and other significant habitat types. This approach supports the

monitoring efforts of the European Union's conservation frameworks and aligns with the United Nations' Sustainable Development Goal (SDG) 14, focusing on the conservation of marine life. The integration of GEE for seagrass mapping offers a scalable and efficient method to track habitat changes, contributing to more effective conservation strategies and ensuring the sustainable use of coastal ecosystems.

ID: 0070

UAV-BASED MULTI-ANGULAR DATASET COLLECTION FOR BRDF ESTIMATION

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Keywords: UAV, BRDF, surface reflectance

Abstract: The use of Unmanned Aerial System (UAS) for Reference in-situ dataset collection is recently receiving increasing attention for the advantages offered in terms of costs, scalability and accuracy of the system as compared to other devices commonly used, such as ground-based instruments, which perform observations at any viewing angle but their measurement process is complex, time-consuming and expensive, and satellite-based instruments, which can observe a large area and access to remote regions, but their limitation lies in a low spatial, temporal and angular resolution for the needs of a precise surface reflectance characterization. In this context, we developed a UAS offering capabilities in collecting multispectral and multi-angular dataset, which can be exploited for the characterization of surface BRDF (Bidirectional Reflectance Distribution Function) [1] or other reference measurements on any land cover type. The UAS system here described is a hexa-rotor drone which has the advantage of being able to perform multi-angular observations with high spatial, temporal and angular resolution, it can cover an extended observation area, and it can be programmed to perform automatic and repeatable flights. In particular, the system can fly for up to 20 minutes carrying a maximum weight of about 8 kg. It is equipped with the MAIA S2 multi-spectral camera [2] which provides high-resolution images at 9 bands in the same spectral range (433-875 nm) of the sensor onboard the ESA (European Space Agency) Sentinel-2 satellite. The system is also equipped with an Incident Light Sensor (ILS) which measures the downwelling irradiance at all the MAIA wavelengths at the exact time of the shooting for each image. The FOV (Field of View) of the MAIA camera is 35° horizontal and 26° vertical, with an image size of 1280 pixels × 960 pixels.

We implemented a UAS protocol for the BRDF reference in-situ data collection which consists in circular paths of way points where the drone stays in hovering and acquires images looking at the center of the target area with a specific camera tilt. The system is tested over various surface types, both natural and anthropic, in clear-sky conditions [3], and we are currently preparing our next mission for the coming winter season on a snow cover. The survey strategy consists in performing multi-angular measurements covering a range of VAA (View Azimuth Angle) from 0° to 360° with a step of 30°/45° and a range of VZA (View Zenith Angle) from 0° to 60° with a step of 10°. Then, we used the collected multi-angular dataset to invert the standard BRDF models – in this study the Ross-Li-Maignan [4] has been used - to retrieve the normalization coefficients to be used then to simulate reflectances at different viewing and illumination geometries. Moreover, the multi-angular dataset can be also used to create new models, for example we are working on a NN architecture taking as inputs the viewing and illumination geometries and giving as output the reflectance value at that specific geometric configuration.

ID: 0071

NOSTRADAMUS: HARNESSING DATA CUBES AND MULTIPLE SOURCES OF DATA FOR SUSTAINABLE AGRICULTURE AND FOOD SECURITY

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Keywords: Food Security; EU independence; Digital Solutions; Agricultural Sector; Data Cubes

Abstract: The Nostradamus project focuses on addressing the critical challenges of food security, sustainability, and agricultural resilience in the European Union (EU) by leveraging digital solutions for resilient agriculture and independence from agrochemical inputs. This Horizon Europe project aligns with the EU Green Deal, the Common Agricultural Policy, and the EU Data Strategy, as well as EU energy-related initiatives, promoting open-source data ecosystems and tools to enhance agricultural resilience and sustainability. Central to the project is developing a Data Ecosystem comprising five national Data Cubes spanning Cyprus, Germany, Serbia, Slovenia, and Switzerland and a Catalog for geospatial and non-geospatial datasets. Interconnectedly, the Data Ecosystem

serves as a one-stop-shop for data aggregation by integrating Earth Observation, IoT, socio-economic, and other relevant datasets, establishing robust pipelines for collecting, processing, and analysing data across multiple hybrid sources. By providing all actors with comprehensive, accessible, and interoperable digital solutions, the Nostradamus project will empower informed decision-making and policy-shaping to enhance the agricultural sector's competitiveness and productivity while minimizing environmental impact.

The project's overarching objectives are: (1) to serve as a data-driven backbone for the EU's food security and independence, and (2) to enable low-code development of scalable, open-source digital applications through Open Calls tailored to address the complexities of modern agriculture. These applications will tackle pressing challenges such as drought monitoring, crop yield prediction, soil fertility management, and sustainable pest control. By employing machine learning techniques, these tools support stakeholders in optimizing farming practices and resource allocation, reducing dependency on agrochemical inputs, and ensuring resilience against disruptions. Nostradamus adopts a gender-sensitive multi-actor approach, fostering collaboration among diverse stakeholders. This inclusive strategy ensures the solutions are co-created and validated across various biogeographical and socio-economic contexts. The project's five demonstration sites, located in distinct biogeoclimatic regions, act as hubs for testing and showcasing innovations, enabling the transfer of knowledge and best practices across the EU.

Recognizing the challenges posed by digital inequity, particularly in regions with limited connectivity, Nostradamus integrates cloud, edge, and mixed solutions to ensure accessibility and scalability. Additionally, the project provides a suite of ready-to-use templates that facilitate seamless development and integration of modular digital applications for solving specific challenges while benefiting from standardized, interoperable foundations. Through tailored capacity-building, the project empowers end-users to utilize digital low-code tools and fully adopt data-driven decision-making practices. The project also emphasizes the importance of data interoperability and transparency, laying the foundation for the evolution of agriculture in the EU. Beyond its technical contributions and support for EU policy frameworks and engaged actors, including AKIS platforms, Nostradamus actively supports upscaling the impact of ongoing EU projects by addressing critical gaps in data requirements and consolidation.

By bridging state-of-play technological innovations with a stakeholder-centric development approach, Nostradamus represents a paradigm shift in the EU's agricultural digital transformation; outputs ensure the sector remains resilient, competitive, and aligned with long-term sustainability goals. The project exemplifies how data-driven solutions can create a more secure, sustainable, and equitable future for the EU agricultural sector, setting a benchmark for global initiatives in agricultural innovation.

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ID: 0072

LANDSHIFT: CO-CREATING LIVING SPACES TO RESOLVE LAND-USE CONFLICTS FOR CLIMATE-RESILIENT LANDSCAPES

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Keywords: LULUCF; Living Spaces; Climate-neutral land use sector; New European Bauhaus; Nature-Based Solutions

Abstract: To work towards climate neutrality, the European Union (EU) has established a new target within the revised Regulation on land, land use change and forestry (LULUCF) aiming to achieve a net removal of 310 million tons of CO2 equivalent by 2030 through land-based actions. The LandShift project represents a transformative approach to land-use planning and management, addressing the complex challenges of climate change, biodiversity loss, and unsustainable practices in various terrestrial ecosystems, including forests, farmlands, peatlands, and wetlands. Aligning with the EU Green Deal, forthcoming Soil Monitoring Law, and New European Bauhaus (NEB) principles, among other initiatives, LandShift aims to achieve a climate-neutral land-use sector through the establishment of five interconnected Living Spaces (LSs) located in France, Greece, Italy, Poland, and Ukraine. These regions will serve as hubs for co-creation, innovation, and co-governance of sustainable solutions that integrate ecological and socio-economic dimensions. At its core, LandShift leverages digital technologies, including Earth Observation and Artificial Intelligence to optimize land-use strategies and enhance climate actions by providing actionable insights into carbon sequestration, ecosystem resilience, and biogenic emissions through a holistic approach. Additionally, the LandShift data ecosystem, built around five regional Data Cubes, acts as a comprehensive resource for stakeholders, offering harmonized data to support informed decision-making. By integrating the Living Earth framework and Multi-Criteria Decision Analysis, LandShift systematically evaluates trade-offs among climate mitigation, food and biomass production, biodiversity conservation, and socio-economic objectives.

The project's innovative approach integrates Nature-Based Solutions (NBS) with NEB principles, emphasizing aesthetic value, inclusivity, and sustainability to facilitate the operationalization of regional strategies. Through co-creation activities and a digital library of NEB-aligned NBS, LandShift promotes practices that enhance ecological balance while bridging the gap between top-down policies and on-the-ground realities. LandShift also addresses the urgent need for robust monitoring, reporting, and verification frameworks, which offer the capacity to measure the impact of implemented solutions while integrating environmental considerations with financial incentives, such as Environmental Impact Bonds. A distinguishing feature of LandShift is its emphasis on inclusive collaboration among all key stakeholders from the Quintuple Innovation Helix framework through a multi-actor approach. Policy and Community Labs will facilitate co-design processes, ensuring that solutions are context-specific and aligned with the unique needs and priorities of each LS while fostering co-ownership through crowd-sourcing and crowd-funding mechanisms. The project integrates behavioral analysis of dietary preferences for targeted strategies while implementing efforts to transform Data Cubes and Living Earths into Knowledge Cubes. Tailored capacity-building empower stakeholders to adopt and co-implement these solutions effectively. This ensures that the LSs become Lighthouses of regionally socio-economic and environmentally responsible strategies for achieving a climate-neutral land-use sector.

LandShift integrates with over 15 EU strategies, leveraging synergies with complementary programs to enhance scalability, promote transdisciplinary collaboration, and strengthen contributions to overarching EU objectives. Its holistic, data-driven approach establishes a benchmark for sustainable land management, offering replicable and scalable solutions across Europe. By bridging the gap between policy and practice, LandShift envisions resilient, sustainable, and inclusive landscapes, transforming land-use planning and management to deliver enduring benefits for communities and ecosystems.

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ID: 0073

AFROGROW: CO-CREATING LIVING LABS FOR SUSTAINABLE AGROFORESTRY AND CLIMATE RESILIENCE ACROSS AFRICA

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Keywords: Agroforestry; Living Labs; African Union; Climate Change; Multi-Actor Approach

Abstract: Africa, while contributing minimally to global greenhouse gas emissions, disproportionately bears the burden of climate change impacts, including declining agricultural productivity, threats to food and water security, and biodiversity loss. Agroforestry offers a holistic solution to these challenges, providing ecological, economic, and social benefits. However, the implications of agroforestry for planetary health, societal well-being, and ecological stability remain underexplored. To address the interconnected challenges of climate change, land degradation, and socio-economic inequalities, AfroGrow promotes sustainable agroforestry systems across the African Union (AU) by establishing six interconnected Living Labs (LLs) in Botswana, Côte d'Ivoire, Ethiopia, Kenya, Senegal, and Zambia. These LLs serve as dynamic, real-world co-creation environments that foster innovation, facilitate knowledge exchange, and promote stakeholder collaboration, unlocking the potential of agroforestry to enhance climate resilience, improve livelihoods, and support ecosystem health.

AfroGrow integrates traditional knowledge with innovative agroforestry management practices, ensuring that solutions are tailored to local communities' needs and priorities. The project adopts a multidimensional, multi-actor approach to agroforestry challenges by fostering collaboration among all key stakeholders from the Quintuple Innovation Helix framework. These efforts are guided by a gender-sensitive strategy, ensuring that decision-making processes actively address inequalities and promote social innovation. Socio-ecological experiments, carbon farming business models, and establishing an AU Agroforestry Hub envisioned as a centralized platform for knowledge exchange and strategic coordination, are central to the project's vision. In addition, AfroGrow advances an existing e-learning platform tailored to local contexts, empowering communities with accessible training resources and fostering capacity-building. AfroGrow also tackles barriers to agroforestry adoption, such as resource limitations and policy constraints, by engaging stakeholders through participatory workshops, surveys, and co-creation activities. Complementary to these, the project emphasizes communication strategies incorporating local languages, customs, and contexts, ensuring effective dissemination and communication.

The project develops comprehensive databases cataloging plant species, animal breeds, and agroforestry practices adapted to specific local contexts. These databases are complemented by dynamic regional suitability maps, which identify optimal locations for specific plant and animal species based on soil, climate, and biodiversity conditions. By aligning community-driven needs with market demands while considering ecological, cultural, and socio-economic contexts, the project advances ecologically sustainable and economically viable agroforestry systems. In addition, AfroGrow emphasizes the long-term impact of the established LLs, ensuring they serve as hubs for innovations, collaboration, and knowledge dissemination. Robust monitoring frameworks and digital tools further amplify AfroGrow’s impact by assessing the effects of agroforestry systems, sustainable land management, and carbon farming practices on ecosystem services, biodiversity, and human well-being. Consequently, these solutions contribute to adaptive management strategies that enhance resilience to climate change and align with Africa’s socio-economic priorities, ensuring that the outcomes of AfroGrow’s LLs are sustainable and scalable over time.

AfroGrow aims to transform Africa's agroforestry sector by co-creating scalable, sustainable solutions with local communities and integrating them into policy frameworks. The project enhances climate resilience approaches while setting a global standard for agroforestry through innovation, collaboration, and inclusivity. AfroGrow ensures its long-term impact and scalability in addressing environmental and social challenges by fostering enduring Africa-EU partnerships and knowledge exchange.

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ID: 0074

CROP TYPE MAPPING BY OPTICAL AND RADAR REMOTE SENSING DATA

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Keywords: Remote sensing, crop type area, Google Earth Engine, Sentinel 1 and 2 combination

Abstract: Identifying Earth phenomena is one of the important issues in the management of urban development, agriculture, natural resources and the environment. Annual land cover maps are needed to monitor land cover changes and proper planning. Due to the cost and time consuming traditional method of land surveying, satellite data is used. Preparing an accurate map with the appropriate modern method has become a key issue. In the past, common classification methods were performed on conventional images such as Landsat and MODIS. With the emergence of new satellites and new classification methods such as machine learning, which is growing exponentially in the world, it is hoped that the classification operations will be done better. Images with high spatial and spectral resolution help a lot in accurate identification of features. The Sentinel-2 satellite, with a pixel score of 10 meters, is one of these. In this research, in order to estimate the cultivated area of crops, multi-temporal images of Sentinel-2 and 1 were used from the random forest machine learning classification method in the Google Earth Engine cloud computing platform for the crop year 1403-1402 and their accuracy in estimating the cultivated area was compared with each other. The accuracy of extracting different plans in the results shows that: (1) When only Sentinel-1A images were used, the extraction accuracy improved by accumulating images during the growth period. The extraction accuracy on SAR images throughout the growth period can basically meet the needs of preparing a map of the cultivated area of crops, OA and Kappa were 80.1% and 0.733, respectively. (2) When only Sentinel-2 images were used, the extraction accuracy in crop images after winter was much higher than that of crop images before winter, and OA in crop images after winter was much higher. 86.7% after merging images before winter and after winter, the extraction accuracy improved with different degrees. This is consistent with the result that the cultivated area of crops was extracted by merging SAR images from multiple growth periods. (3) By using integrated Sentinel images for classification, the extraction accuracy was improved compared to what was obtained using images of one type of sensor. After merging all images, OA and Kappa were 92.7% and 0.902, respectively. OA was 12.6% higher than that obtained using SAR images throughout the growth period, which shows that a more accurate spatial distribution map of crops was obtained.

ID: 0075

UAV PHOTOGRAMMETRY FOR THE PROTECTION OF CULTURAL HERITAGE: METHODOLOGIES, CASE STUDIES AND APPLICATIONS

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Keywords: UAV photogrammetry; 3D modelling; 3D reconstruction; cultural heritage; Structure from motion

Abstract: The use of UAV photogrammetry has significantly enhanced the geometric documentation of cultural heritage sites, by providing – in a cost-effective way – high-resolution image datasets for accurate mapping and 3D modelling, monitoring, risk assessment and digital preservation. This paper explores the methodologies, applications and challenges of UAV photogrammetry, emphasizing its growing role in protecting endangered archaeological and historical sites.

The paper begins by outlining UAV photogrammetry methodologies, with a focus on data acquisition (including both imagery datasets and ground survey), image matching procedures, image orientation and sparse reconstruction through Structure from Motion (SfM) procedures, multi-view stereo pipelines for 3D point cloud creation and 3D model generation, digital surface model production and orthophoto creation. Additionally, the paper discusses the integration of UAV photogrammetry with other technologies, like LiDAR sensors as well as remote sensing imagery, while it gives information related to further processing of photogrammetric products via machine learning algorithms. In fact, UAV LiDAR sensors or terrestrial laser scanners may improve high-resolution 3D modelling and mapping, while multispectral and hyperspectral imaging enable the extraction of information related to the materials of the cultural heritage sites and possible surface degradation, thus aiding in conservation strategies. Moreover, machine learning algorithms may be used for several automated applications, like feature extraction, change detection and structural damage identification. Additionally, the combined use of the photogrammetric results with GIS (Geographic Information Systems) and BIM (Building Information Modelling) is another significant aspect. The paper presents several case studies across cultural heritage sites in Greece, where UAV-based 3D modelling has been applied, demonstrating the potential of UAV photogrammetry and multi-image reconstruction procedures in efficient and accurate cultural heritage documentation of sites of varying characteristics with complex geometry.

Beyond documentation, UAV photogrammetry plays an important role in cultural heritage site protection efforts, providing reliable photogrammetric products for sites vulnerable to environmental and anthropogenic threats. The generation of accurate 3D models, orthophotos and digital terrain models supports multiple risk management applications, including multi-hazard risk assessment and structural damage monitoring, enabling efficient decision-making in cultural heritage management, ensuring risk mitigation and long-term preservation of cultural heritage sites. Furthermore, UAV-based photogrammetric 3D models support virtual reality and augmented reality applications though immersive experiences and citizen engagement.

Despite its many advantages, UAV photogrammetry also includes challenges for cultural heritage site documentation, which could affect the completeness and accuracy of the outputs. Nevertheless, many of its limitations are being addressed by ongoing developments in sensor technology, photogrammetric processing workflows and AI algorithms, which open the door for more accurate and effective geometric documentation pipelines that improve further the protection of cultural heritage sites.

ID: 0076

ADVANCED GPR ALGORITHM FOR HIGH-RESOLUTION DETECTION AND MAPPING OF UNDERGROUND UTILITY NETWORKS

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Keywords: ground penetrating radar; GPR; utilities

Abstract: We evaluated the accuracy of mid-frequency Ground Penetrating Radar (GPR) for detecting and mapping subsurface utilities within critical infrastructure environments, including refineries and gas storage facilities. By testing various methodological approaches and hardware

configurations, we aimed to identify the optimal strategy for improving detection reliability and operational efficiency in these complex settings.

In this study, we present a novel GPR-based approach that delivers rapid and accurate subsurface imaging with minimal reliance on extensive post-processing. The proposed methodology enhances on-site decision-making by providing real-time, high-fidelity data, significantly improving the efficiency and reliability of underground utility mapping in high-risk industrial environments. Experimental results demonstrate the approach's potential for reducing survey time while maintaining high detection accuracy, making it a valuable tool for infrastructure assessment and maintenance.

ID: 0077

DESIGNING XR-BASED LEARNING SOLUTIONS FOR SURVEYING ENGINEERING: INSIGHTS FROM LITERATURE REVIEW AND USER REQUIREMENTS

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Keywords: Extended reality; Remote sensing; Photogrammetry; Earth observation; Virtual reality

Abstract: The use of extended reality (XR) applications in educational contexts has already demonstrated that virtual technologies have a lot of potential to improve student interest and engagement in the educational process. Among others, recent studies have linked virtual (VR), augmented (AR) and mixed reality (MR) technologies to enhancements in students' motivation and academic performance, as well as their social and teamwork abilities and their psychomotor and cognitive skills. To maximize the benefits related to the integration of XR applications into learning settings, pedagogy and learning goals must be considered during the design phase in order to avoid deficiencies in the implementation, and operation. During the development process, unclear or poorly specified requirements can cause miscommunications and misinterpretations, which could result in an application that falls short of user expectations.

The aim of this contribution is to present the steps undertaken for the design of a robust educational solution to enhance learning outcomes for Surveying Engineering students, as part of the SURE-VFT (Immersive Exploration and Data Acquisition: XR Virtual Field Trips for 3D Photogrammetry and Remote Sensing) project. This project aims to enhance the learning experience of Surveying Engineering students through the development of three immersive virtual field trips (VFTs), based on a toolset available on an innovative, sustainable, on-demand education platform developed by the Horizon Europe's XR4ED (Accelerating innovation in learning and education through EdTech and XR) project.

The design of the VFTs relies on a depth review of state-of-the-art literature to evaluate and document best practices and tools in surveying engineering education and a broad-audience survey conducted through a web-based questionnaire to gather user requirements, focusing on simplicity, clarity, and relevance.

Key design considerations highlighted in prior studies include intuitive user interfaces, modular learning units, realistic yet efficient 3D modelling, and feedback mechanisms (e.g., simulated measurement errors, scoring for data accuracy), emphasizing that XR applications must strike a

balance between graphical realism and system performance. Furthermore, they should accommodate various hardware setups—from low-end desktops to specialized headsets—to reach a broad user base.

The findings of the user requirements survey confirm a strong demand for XR-based Surveying Engineering training that combines usability, guided workflows, and relevant data export functionalities. By integrating the best practices uncovered in the literature with the user requirements (especially from novice learners), the SURE-VFT project will create VFTs that are effective, technically accessible, and scalable across different institutional and commercial contexts. This alignment will be instrumental in advancing the XR4ED platform and driving adoption of XR methodologies for Surveying Engineering education in Europe and beyond.

ID: 0078

SPECTRAL ANALYSIS AND MAPPING OF UNREGULATED AND REGULATED LANDFILLS IN BULGARIA

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Keywords: Drought, Remote Sensing, Agriculture drought, Satellite data drought

Abstract: Drought is among the most important natural hazards in a global scale, having adverse effects on the ecological balance of natural systems, public health, as well as economic sectors such as agriculture, energy, industry, fishery, forestry, tourism and recreation. There are several factors, both climatic and human, that drive the evolution of this complex phenomenon, requiring the collection, analysis, and interpretation of multiple sources of datasets with different types and resolutions. This study quantifies the temporal characteristics of drought-related indicators in Yermasoyia dam, located in the southern part of the Republic of Cyprus, based on satellite data, particularly Sentinel-2 images. Daily data of CDI have been collected for period 2000 to 2024 to estimate long-term trends and anomalies of the combined drought indicator (CDI). Time series of climatic parameters, particularly precipitation, evapotranspiration, have been also collected from TerraClimate dataset for the same time period, whereas hydrological data have been collected from the water authorities (monthly inflow rates and storage volumes in Yermasoyia dam). Linear (Pearson) correlation analysis is conducted using time lags up to 3 months among the selected parameters to identify association and patterns. Graphical tools are used to visualize the connections among the parameters and the strength of linear associations. The proposed methodology is expected to provide valuable input to the national water authorities for revising the drought management plans.

ID: 0079

HYPERBOLA: AI-POWERED CLOUD MASKING FOR ON-BOARD HYPERSPECTRAL DATA PROCESSING

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Keywords: Hyperspectral imaging, cloud masking, AI

Abstract: Cloud and cloud shadow masking in hyperspectral (HS) remote sensing remains a key challenge, particularly for on-board processing in spaceborne platforms. Traditional methods rely on Convolutional Neural Networks (CNNs) and Support Vector Machines (SVMs), which struggle to capture complex spectral-spatial dependencies efficiently. To address these limitations, we propose HYPERBOLA (HYPerspEctRal onBOard cLoud AI), an advanced AI framework integrating Vision Transformers (ViTs), Spectral-Spatial Graph Neural Networks (GNNs), and Hybrid CNN-

Transformer models to enhance cloud and cloud shadow masking accuracy. Our approach exploits the unique strengths of each model: ViTs capture long-range dependencies in spectral bands, Spectral-Spatial GNNs exploit pixel-wise relationships in HS data for improved classification, and hybrid CNN-Transformers combine local texture analysis with global pattern recognition. This multi-model integration surpasses conventional single-model approaches, offering higher accuracy and robustness in cloud masking.

A key innovation of HYPERBOLA is its focus on efficiency for resource-constrained spaceborne environments. To enable real-time, power-efficient processing, we apply structured pruning, 8-bit quantization, TensorRT inference acceleration and Dynamic Voltage and Frequency Scaling (DVFS), optimizing computational load while maintaining accuracy. By integrating advanced AI models within an optimized, lightweight framework, HYPERBOLA sets a new benchmark for cloud and cloud shadow masking in on-board HS data processing. This research advances AI-driven remote sensing, enabling more accurate and efficient real-time hyperspectral data analysis for spaceborne applications.

ID: 0080

IONOSPHERIC MONITORING USING LOW-COST GNSS RECEIVERS

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Keywords: Ionospheric Monitoring Using Low-Cost GNSS Receivers

Abstract: The Earth's ionosphere, is a layer of the atmosphere ranging within an attitude range 50 to 1000 km, formed by free electrons that are separated from atoms, when ultra-violet radiation coming from the sun is absorbed. The free electrons impose refraction on radio waves travelling through the ionosphere at a level, which is proportional to the electron density. Total electron content (TEC) (defined as the total number of electrons along a path between a satellite radio transmitter and a ground receiver) is greatly affected by space weather which includes a wide range of solar driven phenomena such as solar flares and Coronal Mass Ejections that generate ionospheric storms. One of the principal techniques for ground-based ionospheric monitoring is based on Global Navigation Satellite System (GNSS) receivers. TEC can be estimated from differences in the group delay and the phase advance of multi-frequency ionosphere-traversing electromagnetic signals propagating from a GNSS satellite to a ground GNSS receiver, enabling remote sensing of ionospheric medium that has a vast impact on our understanding of the dynamics and morphology of ionosphere. Recently, the availability of low-cost commercial GNSS modules encouraged their exploitation in the frames of several positioning engineering applications. The aim of this study is to compare low-cost GNSS chips and antennas in ionospheric monitoring with high-grade receiver and antennas with clear advantages in cost, size and power consumption. A comparative study between high-grade geodetic and low-cost receivers is undertaken to explore the potential of the low-cost devices for sensing the ionosphere during measurement campaigns characterized by quiet and disturbed geomagnetic conditions. The housing and operation firmware of the low-cost receivers was developed by Cloudwater Ltd.

ID: 0081

THE IMPACT OF SOIL QUALITY ON AGRICULTURAL LAND PRICES IN UKRAINE

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Keywords: Soil Quality; Agricultural Land Prices; Ukraine Land Market; Geospatial Analysis (GIS); Normative Monetary Valuation

Abstract: This study examines the link between soil quality and agricultural land prices in Ukraine's emerging land market. Soil quality influences productivity, valuation, and investment, yet its impact on land prices remains underexplored, especially after recent reforms. Focusing on the Lviv region, the research quantifies this relationship using spatial data analysis and statistical modeling.

The study relies on data from the StateGeoCadastre, covering approximately 8,000 land transactions involving 6,700 parcels. Soil quality data were obtained through official requests, and a single-parameter approach was employed, using soil quality scores as the primary variable. A key challenge was obtaining spatially accurate data due to restrictions on automated land registry access during martial law, but we managed to get the correct cadastral data.

Results indicate a strong positive correlation between soil quality and land prices. The determination coefficient (R^2) is 0.4586, meaning that 45% of price variation is explained by soil quality scores. The correlation coefficient is 0.6772, confirming a statistically significant relationship. Regression analysis reveals that the market price per hectare increases by 1,413.7 UAH (32 EUR) per soil quality point. Further analysis compares these results with normative monetary valuation (NMV), which remains a strong influence on land prices due to state regulations. The correlation coefficient between NMV and market price is 0.6599, with market prices averaging 1.76 times higher than the official valuation. Additionally, a high correlation (0.9664) exists between NMV and soil quality scores, reinforcing the role of soil quality in official land assessments.

NMV of the land parcel is a minimal sell price of an agricultural land parcel in Ukraine. So, we tried to find out, how these two values vary and if there is a strong connection between them. As we can see, the determination coefficient is 0,4355 (Fig.2) and the correlation coefficient is 0,6599 and it means that NMV significantly affects sell price of agricultural land parcels and the regression equation shows that market value is 1,76 times bigger than NMV, but decent amount of land parcels is sold or at least registered as sold for its minimal price.

The findings show soil quality strongly affects land prices, but the market remains transitional, with values mostly driven by NMV. As it evolves, soil quality's influence may decline if prices become more aligned with dynamic economic factors instead of rigid state-imposed metrics. However, updated assessments and broader factors could better shape future valuations. Meanwhile, reliance on outdated soil data, often from the 1980s, constrains pricing accuracy.

This study underscores the need to update such data and account for logistics, infrastructure, and post-purchase use in future pricing models. An advanced semiparametric approach could significantly improve predictions, providing policymakers with superior tools for sustainable land market regulation.

ID: 0082

A GIS-BASED MULTI-CRITERIA DECISION ANALYSIS FRAMEWORK FOR LANDSLIDE RISK ASSESSMENT: A CASE STUDY IN AMATHOUNTA, LIMASSOL, CYPRUS

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Keywords: GIS, Multi-Criteria Decision Analysis, Analytic Hierarchy Process, Landslide Risk Assessment, Predictive Modeling, Hazard Zonation.

Abstract: Landslides pose a significant threat to both the environment and infrastructure; thus, risk assessment and management must be efficient. This study employs Multi-Criteria Decision Analysis (MCDA) alongside Geographic Information System (GIS) technology to examine susceptibility to landslides within the Amathounta municipality in Limassol, Cyprus. Critical elements including geology, slope gradient, hydrological impact, proximity to faults, road network and land use were studied to determine high-risk zones. These parameters were selected based on their established role in slope stability and were derived from multiple sources. A Digital Elevation Model (DEM) at 5-meter spatial resolution, from the Department of Lands and Surveys of Cyprus, was used to extract geomorphological characteristics such as slope, aspect, relief, and stream networks. Lithological and fault data were obtained from the Geological Survey Department of Cyprus and precipitation data for the period 2011–2020 was sourced from the Meteorological Department of Cyprus. Road network information was acquired from the Department of Lands and Surveys, and land use classification was based on open-source ESA WorldCover 2021 (10-meter spatial resolution) data. Remote sensing and spatial analysis techniques were employed to delineate high-risk zones, while the Analytic Hierarchy Process (AHP) was applied to determine the relative weight of each factor based on expert judgment and previous studies. The weighted criteria were combined using an overlay approach in ArcGIS Pro to generate a comprehensive landslide risk map for Amathounta, Limassol. The resulting map classified the study area into five hazard levels which include; very low, low, moderate, high and very high susceptibility. The model output was validated against landslide inventory and was found to be highly correlated in terms of the areas identified as having high landslide risk. This level of agreement supports the methodology proposed in this paper. The findings of the study are important in contributing to disaster risk reduction and the results can be used as a scientific input in determining land use planning, infrastructure development and hazard mitigation measures in Amathounta municipality. These results can be used by authorities and policy makers to target their interventions in the most susceptible areas and thus minimize economic losses and protect people. Furthermore, the method presented in this paper can be extended to other areas with similar geophysical conditions, and therefore the method can be used for landslide risk assessment on a larger scale. Future research can refine this model into the whole island of Cyprus and even into by integrating additional factors such as socio-economic activities, soil properties, and real-time monitoring data to enhance predictive capabilities.

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ID: 0083

PROACTIVE DISASTER NOTIFICATION: UTILIZING SMART HOME NETWORKS FOR EMERGENCY RESPONSE

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Keywords: Smart Homes, Emergency Notifications, Disaster Preparedness, Early Warning Systems.

Abstract: The increasing intensity and occurrence of natural disasters such as fires, earthquakes, and floods, necessitate the design of more effective emergency notification systems. Conventional alarm systems, such as sirens, and SMS alarms, are often insufficient to address issues such as slow response times and the provision of warnings of limited accuracy. By providing near real-time, localized notifications, a more proactive strategy that makes use of smart home technologies could improve disaster preparedness. This study focuses on the contribution of smart home environments to emergency alerting systems with Cyprus used as the pilot study. Cyprus is vulnerable to natural hazards, highlighting the need to develop more reliable and efficient warning technologies. Compared with traditional systems, the potential to develop a distributed alert system that increases the precision and promptness of warnings by utilizing sensors that are frequently present in smart homes, such as temperature, smoke, and flood monitoring, will be explored. Data will be collected from several households and used to evaluate the ability of the proposed concept to reduce false alarms while guaranteeing pertinent notifications. The feasibility of this approach is also discussed in terms of key design principles, challenges, and installation issues. The integration of this approach with existing emergency response frameworks, scalability, and user adoption is also considered since this is a crucial factor for the success of such systems. The outcomes of this analysis provide a foundation for further research and practical evaluation, contributing to broader discussion on how smart technologies can be leveraged for enhanced disaster resilience and public safety.

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ID: 0084

HOLISTIC MULTICRITERIA FRAMEWORK TO ASSESS FLOOD RISK IN GARYLLIS RIVER BASIN, CYPRUS

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Keywords: Hydraulic modelling; multi-criteria decision analysis; escape routes; refuge areas.

Abstract: The increasing occurrence and intensity of flood events at the European scale has urged the policymakers and water planners to invest time and funds for the design and implementation of effective flood management strategies that address major stages of disaster risk reduction, namely preparedness, response, recovery and mitigation. The optimal incorporation of these stages in the management plans is especially important in hydrological networks that intersect urban units since these networks are highly vulnerable to flash floods. As part of the collaborative activities between the ERATOSTHENES Centre of Excellence (ECoE) and BE-YOND/IAASARS/NOA, a holistic multicriteria framework is presented that estimates the spatiotemporal distribution of flood risk levels in the Garyllis River basin, which is located in the southern part of the island of Cyprus. Multiple types of data have been collected, including satellite services, governmental portals, in-situ measurements, and historical records, at different resolutions. For instance, a digital elevation model (DEM) with a 5 m resolution was provided by the Department of Land and Surveys of Cyprus to model the terrain elevation of the case site, the most recent land use/land cover map (2018) was extracted from Copernicus Land Monitoring Services, whereas daily precipitation data from nearby ground-based rainfall stations were provided by the Department of Meteorology. The collected data have been verified and improved via field visits and discussions with relevant actors, harmonized in terms of spatial and temporal resolution, and used as inputs to conduct two-dimensional hydraulic simulations (HEC-RAS) to estimate the evolution of flood hazard depth on the basis of water depths for different return periods.

The vulnerability levels of the study area are estimated by multiplying the weights and standardized scores of relevant factors, such as population age, population density and building properties, according to the most recent official governmental reports. In addition, the flood exposure was estimated on the basis of the land value. For each flood component, all factors are assigned equal weighting coefficients. Consequently, the flood risk indicator is estimated at each location by multiplying the hazard, vulnerability and exposure indicators. The validity of the proposed methodology is tested by comparing the critical points that were identified during the on-site visits with the estimations of the flood risk levels. Consequently, escape routes and refuge regions were recommended for the worst-case scenario.

Overall, this study is expected to help water authorities further align with the EU priorities and strategies, particularly Floods Directive 2007/60/EC, support social awareness regarding the actions that need to be taken, and recommend appropriate mitigation measures.

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ID: 0085

A FUTURE CENTRE FOR CLIMATE AND WEATHER RESEARCH IN THE EASTERN MEDITERRANEAN: THE ATARRI PROJECT

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Keywords: European project, Horizon2023, remote sensing, aerosols, clouds, radiation

Abstract: The ATARRI "Atmospheric and radiation research and innovation in eastern Mediterranean project" is a European project in the framework of Horizon2023 that has the aim to expand the Earth Observation and modelling capacities of the Eratosthenes Centre of Excellence (ECoE) with the final goal to create a centre for frontier climate and weather research and services in the Eastern Mediterranean. To achieve this, the ECoE, has aligned forces with four leading institutions in Europe, namely the Barcelona Supercomputer Centre (BSC/CNS), the ARMINES association (the contractual research arm of the Mines Paris – PSL Research University and its affiliated entity Ecole Nationale Supérieure des Mines de Paris (ENSMP), the FCIENCIAS UL.ID (FC.ID) (a private non-profit entity through which FCUL and other institutions develop their contractual research and European projects.) and its affiliated entity, the Faculty of Sciences of the University of Lisbon (CIENCIAS UL), the Physikalisch-Meteorologisches Observatorium Davos/World Radiation Center (PMOD/WRC) and GRASP SAS SME. The main objective of the ATARRI is to exploit the full potential of the ERATOSTHENES CoE, CARO National Facility and Solar Network towards scientific excellence and application development in the atmospheric research enchasing the Earth Observation R&I and modeling capacities of the Centre.

A better understanding of atmospheric processes in the East Mediterranean and development of applications for climate, energy and environmental services are needs of ATARRI project and are based on the improvement of atmospheric remote sensing measurements and the potential synergy with the currently non-existing atmospheric modelling component. ATARRI goals will be achieved through a series of transfer of knowledge actions (workshops, seminars, technical information and software/model exchange, expert visits) by experienced partners towards ECoE, including mostly science related but also scientific management aspects. In addition, a research experimental project is foreseen in the last year of the ATARRI, dealing with dust intrusions, aerosol characterization, interactions with solar radiation and various related scientific and socioeconomic effects for the Cyprus area. To enhance scientific capacities of the ECoE technical workshops will be organised, on the 4 scientific Domains of the project: 1. Dust modelling and forecasting; 2. Aerosol microphysics characterization; 3. Dust radiative effect and solar radiation and 4. Solar energy applications. Furthermore, mobility actions will take the form of two types of exchanges: on-site short-term visits from leading institutions at ECoE premises and short-term staff exchange from ECoE to BSC/CNS, GRASP SAS, ARMINES, FC.ID, and PMOD/WRC-WRC premises. The research project of the last year called "The role of Dust to the climate" will use the ground-based instruments of CARO observatory in Limassol (Cyprus) and the newly gained capacity in atmospheric modelling, retrievals, and synergy analysis. The main scientific question addressed by this exploratory scientific project revolves around the impact of the dust storm (or strong dust

intrusions), on microphysics retrievals, aerosol modelling, solar energy and radiation, as well as validation of space observations against ground-based ones.

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ID: 0086

SEASONAL WIND ANALYSIS IN LIMASSOL, CYPRUS, USING THE GROUND-BASED DOPPLER LIDAR OF THE CARO NATIONAL FACILITY

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Keywords: PBL; Doppler LiDAR; Wind Analysis; EMMENA region

Abstract: Cyprus Atmospheric Remote-Sensing Observatory (CARO) is a ground-based station (GBS) located in the coastal city of Limassol, Cyprus, which offers complete insights for improving our understanding of the atmospheric dynamics, for the monitoring of the atmosphere, and advancing climate research as a whole. CARO is a National Facility for atmospheric research based on remote sensing techniques and since January 2023 it has been equipped with the HALO (Snoopy) Doppler LiDAR. This state-of-the-art active remote sensing instrument has the ability to provide high-resolution, both spatial and temporal, vertical and horizontal wind profiles and thus offers an unprecedented view of wind dynamics in the region. The research spans two full years of wind data, from February 2023 to January 2025, analyzing the variability of the horizontal wind across diurnal, seasonal, and synoptic scales. It focuses on identifying monthly and seasonal patterns of wind speed and direction, while simultaneously estimating the Mixing Layer Height (MLH) using advanced remote sensing techniques, such as calculations of the vertical wind variance, therefore providing valuable insights into the dynamics of the planetary boundary layer and its seasonal evolution.

The findings suggest the existence of seasonal patterns that reveal pronounced diurnal variations in wind speed and direction, with distinct characteristics detected between them, that get influenced by the regional meteorology, local topographical factors such as the Troodos Mountains, and the Mediterranean Sea. Additionally, some of the months and seasons exhibited some common patterns which led to their grouping and distinction into two periods; the warm one and the cold one. Similarly, diurnal and seasonal patterns were found for the case of the estimated extent of the mixing layer, showcasing the impact that the incoming solar radiation and the consequent heating of the Earth's surface have on atmosphere's dynamics. Overall, these findings highlight the complex interactions shaping the wind, contributing to the growing understanding of its climatology and intra-annual variability in the Eastern Mediterranean, while improving the weather models.

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ID: 0087

HETEAC-FLEX MODEL: COMPARATIVE EVALUATION OF 6 FORWARD MODEL CONFIGURATIONS FOR DUST CASES USING GROUND-BASED LIDAR OBSERVATIONS IN LIMASSOL

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Keywords: HETEAC-Flex, Dust Cases, Aerosol Characterization, Lidar, Limassol

Abstract: The Cyprus Atmospheric Remote Sensing Observatory National Facility (CARO NF) of Eratosthenes Centre of Excellence plays a key role in atmospheric research and the characterization of atmospheric conditions in the Eastern Mediterranean.

Equipped with cutting-edge remote sensing instruments including a PollyXT Polarization Raman Lidar, a Cloud Radar and a Solar Infrastructure, CARO provides critical observations for studying aerosol properties, cloud dynamics, and radiative processes.

Its advanced capabilities make it an essential ground-based station for satellite validation studies, particularly in the context of the EarthCARE mission (ESA/JAXA).

To ensure compatibility between ground-based observations and satellite measurements, the HETEAC-Flex model, introduced by A. A. Floutsi et al., 2024 have been applied for the aerosol layer classification. This model was created to validate the aerosol classification of ATLID (ATmospheric LIDar) measurements, onboard EarthCARE, by providing a robust comparison framework. Based on an Optimal Estimation Method (OEM) HETEAC-Flex provides six forward retrieval modes, each incorporating different sets of optical properties including Particle linear depolarization ratio at 355, 532 nm, Lidar ratio at 355, 532 nm, Extinction-related Ångström exponent at 355/532 nm and the Backscatter-related color ratio for 532/1064 nm.

The typing scheme enables the identification of four aerosol components of aerosol mixtures, absorbing and less-absorbing fine-mode particles and spherical and non-spherical coarse-mode particles (FSA, FSNA CS, CNS, respectively).

CARO's PollyXT lidar in Limassol can retrieve all the optical properties needed for the utilization of all the 6 retrieval modes. In this study, we apply the HETEAC-Flex model to several dust cases recorded in Limassol between the period 2021-2024, aiming to determine which retrieval mode is the most optimum for the characterizing dust aerosol layers.

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ID: 0088

AN APPROACH OF NOVEL CFAR ALGORITHM FOR MOVING SHIP MADE OIL SPILL DETECTION

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Keywords: CFAR, SAR, Sentinel-1, moving ship, oil spill detection, marine ecology

Abstract: This article presents preliminary results from the development of a new approach of using CFAR to detect oil spills on the sea surface caused by moving ships. Data from the Sentinel-1 satellite constellation, and in particular for the Black Sea aquatory, were used for the algorithm development and the research activities.

A lot of times, seagoing vessels have been detected to pollute the marine environment with petroleum products. In some cases, this is caused by accidents on board of the ship, but in some cases, it is a deliberate action of the crew related to cleaning the ship's tanks. Unfortunately, in some maritime areas, usually areas outside of coastal surveillance systems range, this has become a regular activity. Thanks to constellations of radar satellites, such as Sentinel-1, these illegal activities can be detected and tracked. On Figure 1 is shown the output of the proposed novel CFAR algorithm approach to detect simultaneously the suspected ship and the caused from she oil spill pollution.

ID: 0089

AGRI-FOOD MODELLING: SOCIO-ECONOMIC DATA AND DATA-GAPS

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Keywords: data-driven agriculture; food systems; socio-economic modelling; socio-economic data; agricultural data gaps; policy and farm management

Abstract: Socio-economic models in the agricultural sector serve as essential tools for policymakers, land managers, and researchers, enabling the analysis and improvement of agricultural markets as well as the socio-economic conditions of farmers and rural communities. However, these models often face limitations due to data gaps, which restrict their accuracy and applicability. This paper identifies these gaps in data availability across a selection of agricultural models and introduces an initial framework for the Nostradamus module, designed to enhance analytical capabilities for both policy formulation and farm-level decision-making.

A snowball literature review was conducted to compile a dataset of 108 economic models relevant to agriculture, focusing on their data coverage, consumption patterns, and inherent limitations. Our analysis categorizes the primary data requirements into three groups that are needed for model processing: (1) data explicitly noted as missing in model limitation sections, (2) data collected through surveys due to absence in existing databases, and (3) the minimum data requirements for complex, data-intensive models.

This study provides a comprehensive overview of data utilization in modern agricultural modelling tools, offering valuable insights for developers of future databases. It highlights the specific data needs of policymakers, land managers, and researchers worldwide, facilitating the creation of more robust and data-driven socio-economic models for agricultural applications.

ID: 0090

BYZANTINE FORTIFICATIONS WITHIN THEIR LANDSCAPE AND ENVIRONMENTAL CONTEXT: A GIS AND A REMOTE SENSING APPROACH

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Keywords: Crete, Byzantine fortifications, GIS, Remote Sensing, Landscape Archaeology

Abstract: Until recently, traditional archaeological approaches treated Byzantine fortified sites as static entities, established solely for defensive purposes in remote and inaccessible regions. However, contemporary research has significantly broadened this perspective, shifting the focus from isolated military structures to dynamic elements that continuously interacted with and were shaped by their environment, society, and historical events. Such interactions have led to the adoption of an interdisciplinary archaeological approach, therefore enhancing our understanding of fortresses as integral and multifaceted components of Byzantine society.

This paper focuses on Crete—a strategically situated island in the Aegean and the Eastern Mediterranean—to explore key aspects of fortifications during the Middle Byzantine Period (late 10th to early 13th centuries AD). By combining archaeological and historical methodologies with advanced spatial analysis tools, such as Geographic Information Systems (GIS) and satellite remote sensing, this study aims to reconstruct the ancient landscape and evaluate human-environment interactions over time. The study focuses on the former prefecture of Kissamos located in the northwestern region of Crete, where three Middle Byzantine fortifications, varying in type and scale have been identified: Rokka, Malathyros, and Polyrrhenia. This study presents a comprehensive analysis of their spatial relationships, examining the strategic choices taken to place these fortresses within the larger landscape. Particular attention is given to their proximity to critical natural features, such as water sources, arable land, grazing areas, and coastal access, as well as their alignment with key trade routes and settlement patterns. The methodology employed here acknowledges the complexity of Crete's topography and the many environmental factors that shaped the development of its Byzantine fortifications.

The application of GIS technology enables the analysis of these sites not as isolated fortifications, but as interconnected nodes within broader networks of military, economic, and social interactions. This approach highlights the fortifications as cultural products shaped by the political, social, and economic dynamics of their time. Special attention is given to mobility and visibility patterns, considered key factors in understanding the strategic logic behind the placement and function of these sites (Viewshed analysis, Least Cost Path).

Furthermore, remote sensing techniques are employed to create a land use land cover map, facilitating the study of interactions between the three fortified sites and their immediate surroundings. Land use land cover analysis offers valuable insights into past human activities, allowing inferences about historical land use, environmental changes, and resource management strategies. By examining present-day vegetation, soil conditions, water bodies, and terrain, it becomes possible to reconstruct the environmental context in which these fortifications operated. By placing these fortifications within their environmental and socio-economic contexts, the research highlights how these sites operated not only as military strongholds but also as integral entities of regional governance, resource management, and economic networks. It refines our understanding of how these fortresses functioned within their landscapes, their strategic significance, and how historical patterns of land use influenced their construction, functionality, and long-term survival.

ID: 0091

A TOOLKIT FOR AMBULANCE DISPATCH AND ROUTING OPTIMIZATION USING AI AND GIS

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Keywords: Ambulance Response Time, Ambulance Routing Optimization, Ambulance Dispatch Management, Artificial Intelligence, Emergency Medical Services, Prehospital Healthcare support

Abstract: Ambulance Response Time is one of the main key factors that affect both the incident handling outcome, and the quality of services provided. It is also closely monitored to ensure compliance in regard to regulatory requirements and the global standards for emergency medical services (EMS) and ambulance healthcare. Here we present the ongoing work of SmartPLAIGO, a project funded by the Cyprus Research and Innovation Foundation (RIF), that aims to optimize the handling of a. the Ambulance Fleet, and b. the resources allocation, in order to improve Ambulance Response Time. The proposed workflow is based on the development of an optimization platform based on Artificial Intelligence (AI) and Geographic Information System (GIS), which will be then integrated with the existing Emergency Response digital system, currently managing the Ambulances of the State Health Services Organization (SHSO) in Cyprus, in real time, named 'AVARIS'. The goal of SmartPLAIGO is to establish a comprehensive decision support Toolkit for Ambulance Dispatch and Routing nationwide, while using the latest technological advancements to address a variety of persisting operational issues, such as the efficient resource (ambulance) allocation, the rapid accurate location acquisition, and the efficient navigation to the scene. SmartPLAIGO will process live data simultaneously, such as traffic levels, the severity of incidents, and the availability of ambulances, enabling fast decisions on dispatch of resources, in a dynamic manner. The SmartPLAIGO Project will employ advanced optimization techniques, including heuristic and evolutionary algorithms, to both allocate and route the available ambulances in a time-effective and secure manner. These algorithms will be incorporated into the existing system (AVARIS) and provide the Emergency Medical Dispatch Nurses (EMDNs) responsible for call handling and evaluation, with decision support, by pinpointing the appropriate ambulance crew to be dispatched to the incident site, according to travel time, Ambulance status, and Incident Severity. In addition, the platform will suggest the most suitable Hospital to accept the incident, along with the Estimated Time of Arrival (ETA) and the most efficient route, based on the current traffic status, the weather and the road conditions. This work is expected to achieve a reduction in the average Ambulance Response Time and reduction in the average travel time to emergency scenes, as well as improvement in the communication efficiency between the EMDNs, the Ambulance Crews, and Citizens. Ultimately, SmartPLAIGO aspires to improve the operational efficiency of Ambulances nationwide, paving the way for a faster and optimized patient management and care.

ID: 0092

EARTHCARE SATELLITE MISSION: CALIBRATION AND VALIDATION ACTIVITIES IN THE CYPRUS REGION

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Keywords: EarthCARE; Cal/Val; CARO; ATLID products; CARDINAL

Abstract: Clouds, aerosols and radiation are key parameters for understanding the climate. Compared to the previous report (AR5) of IPCC, significant progress has been made in understanding cloud processes. However, incorporating clouds, aerosols, and precipitation into climate change prediction models remains a major challenge. The joint European Space Agency (ESA)–Japan Aerospace Exploration Agency (JAXA) Earth Clouds, Aerosol and Radiation Explorer (EarthCARE) satellite mission has been launched on 28 May 2024 to assess how these key parameters are represented in weather and climate models and to improve our understanding of their role in the climate system. Four primary instruments are on board the EarthCARE satellite: the ATmospheric LIDar instrument (ATLID), the Cloud Profiling Radar (CPR), The Multi-Spectral Imager (MSI) and the Broad-Band Radiometer (BBR).

For the EarthCARE mission to be successfully operated, various calibration/validation (cal/val) activities will take place. Cyprus is also participating in these cal/val activities, which are coordinated by the Cyprus Atmospheric Remote Sensing Observatory (CARO) Team of ERATOSTHENES CoE. The CARO station is a National Facility (NF) specializing in the remote sensing of aerosols and clouds, located in Limassol (34.677˚ N, 33.0375˚ E) and is equipped with a 35-GHz cloud radar (MIRA-35), a microwave radiometer (HATPRO), a multiwavelength polarization Raman lidar (PollyXT), a wind lidar (Streamline-XR), a ceilometer (OTT/LUFFT CHM15k), and an optical precipitation disdrometer (OTT Parsivel). In this study, we will focus on the aerosol/cloud ground-based measurements provided by the PollyXT lidar which will be used to validate the Level1 and Level2 products of the ATLID instrument. To achieve this, the ground-based measurements must be converted into ATLID-like profiles using a simulation tool called “CARDINAL campaign tool”. This simulator ensures the retrieval of Level 1 products—attenuated particulate (Mie) backscatter, attenuated molecular (Rayleigh) backscatter, and attenuated cross-polar backscatter—based on the same atmospheric scene as ATLID's calculations. In addition, the PollyXT aerosol profiles will be used to validate the Level 2-aerosol optical parameters. The validation approach will be presented and discussed for two selected cases: a dust layer observed up to 4 km height and a cloud layer detected between 8 and 12 km.

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ID: 0093

MULTI-PARAMETER FLOOD RISK ASSESSMENT METHODOLOGY FOR FLASH FLOODS IN URBAN RIVER BASINS: CASE STUDY IN MANDRA, GREECE

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Keywords: flood risk assessment, flash floods, multi-parameter methodology, disaster risk reduction, Earth Observation.

Abstract: Accurate flood risk assessment information is crucial for decision makers in order to support them towards efficient flood risk management. This should cover all the disaster risk reduction stages (preparedness, response, recovery and mitigation), and also address the highly dense urban river basins, especially those prone to flash floods. In the context of a Programming Agreement with the Prefecture of Attica in Greece, NOA/IAASARS/BEYOND in cooperation with NTUA/ITIA designed and applied a holistic multi-parameter flood risk assessment methodology in five river basins at high spatial resolution (2m-50m). First, all available data were collected, including spatial data and data from technical studies. Detailed field visits were conducted, and the terrain was modified accordingly. Earth Observation data were processed and spatial parameters were obtained, such as DEM and land cover, which were used both for the rainfall-runoff model (HEC-HMS) and the hydraulic model (HEC-RAS 2D). Flood hazard was assessed by hydraulic modelling for different scenarios. Vulnerability was considered as a weighted estimation of population density, population age, and building characteristics, according to the latest available national Population-Housing Census. Exposure was estimated using the land value. Flood risk was assessed as a combination of flood hazard, vulnerability, and exposure. Furthermore, critical points, identified from the field visits, were cross-checked with the flood inundation maps. Eventually, refuge areas and escape routes were recommended for the worst-case flood scenario. This innovative methodology was implemented in the Mandra river basin and validated with the findings of the fatal flash flood in November 2017. This event affected both the urban and suburban area of Mandra and resulted in 24 recorded fatalities and extensive damages to properties and infrastructure, making it the deadliest flood in Greece over the last 40 years. BEYOND created a user-friendly web GIS platform, where input and output data, including flood risk maps, critical points, refuge areas and escape routes are uploaded. This work supports the decision-making authorities in improving disaster resilience by raising awareness, organising civil protection exercises, implementing flood risk mitigation measures, prioritising flood protection interventions (both short-term and long-term), and improving rapid response during the flood event. This also supports the implementation of the EU Floods Directive 2007/60/EC, the Sendai Framework for Disaster Risk Reduction, the UN SDGs, as well as the UN Early Warnings for All initiative. Currently, this flood risk assessment methodology is transferred, adapted and applied in the Garyllis river basin in Cyprus, in the framework of the EXCELSIOR project, by the ERATOSTHENES Excellence Research Centre for Earth Surveillance and Space-Based Monitoring of the Environment.

Acknowledgements: The authors acknowledge the “EXCELSIOR”: ERATOSTHENES: Excellence Research Centre for Earth Surveillance and Space-Based Monitoring of the Environment H2020 Widespread Teaming project. The “EXCELSIOR” project has received funding from the European Union’s Horizon 2020 Research and Innovation Programme under Grant Agreement No 857510,

from the Government of the Republic of Cyprus through the Directorate General for the European Programmes, Coordination and Development and the Cyprus University of Technology.

ID: 0094

THE CO2-SOLUTIONS LIVING LAB: ADVANCING CARBON FARMING AND NATURE-BASED SOLUTIONS FOR CLIMATE RESILIENCE

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Keywords: Carbon farming, climate resilience, soil health, nature-based solutions

Abstract: The CO2-Solutions Living Lab is an agricultural Living Lab dedicated to advancing the first EU-wide voluntary framework for certifying high-quality carbon removals. It focuses on nature-based solutions that enhance carbon farming practices within regenerative agricultural systems. This initiative supports the Soil Mission by conserving and increasing soil organic stocks, reducing soil pollution, and enhancing soil biodiversity. Hosted by the Interbalkan Environmental Center (I-BEC) and a member of the European Network of Living Labs (ENOLL) since 2023, the CO2-Solutions Living Lab emphasizes:

- Enhancing carbon sequestration and soil health through Nature-Based solutions.
- Promoting innovative carbon farming practices and technologies.
- Reducing agriculture's carbon footprint.
- Supporting climate-smart and nature-based solutions.

By integrating sustainable practices into agriculture, our Living Lab contributes to climate change mitigation, fostering both environmental and community resilience. Operating under the Quadruple Helix (QH) model, our Living Lab engages diverse stakeholders:

- Business stakeholders, including certification bodies, consultants, agri-tech companies, and environmental NGOs.
- Farmers, landowners, and cooperatives, directly involved in pilot projects.
- Academic institutions and research organizations, contributing expertise and driving innovation.
- Regional authorities and municipalities, ensuring policy alignment and implementation.

Key activities include supporting the carbon farming certification process, implementing nature-based solutions, conducting research, developing MRV tools, and fostering stakeholder collaboration. Regular workshops, webinars, and training sessions are organized for capacity building, reinforcing the initiative's value proposition. Additionally, the CO2-Solutions Living Lab aligns with key policies such as the Climate Law, Nature Restoration Law, and Biodiversity Law.

We implement carbon farming solutions across five pilots with different crop types and over 10 demonstration sites in diverse pedoclimatic zones. These sites are pivotal for testing and evaluating practices, assessing their impact on soil health, carbon sequestration, and biodiversity. They also serve as educational hubs, hosting on-farm events to disseminate knowledge and practical solutions. This emphasis on real-life engagement ensures that solutions are practical, effective, and tailored to the specific needs of farmers and landowners. This involves interviews, surveys, pilot projects, field demonstrations, trainings, and workshops throughout all phases of the innovation cycle. This inclusive approach fosters ownership and ultimately maximizes the impact of the initiative.

The CO2-Solutions Living Lab is making a substantial impact by sharing valuable information and innovations through various channels and fostering connections among diverse stakeholders to

drive meaningful environmental change. Its mission to expand reach and impact is achieved by standardizing practices using tools like the Field Diagnostic Toolbox (FDT) and MRV protocols, fostering cross-sector collaboration through networking events, local community engagement, and research projects, expanding geographically with new demonstration sites, and replicating effective tools and carbon sequestration methods. A key goal is to establish lighthouses of innovation—exemplary pilot sites that inspire replication across regions and sectors, amplifying the initiative's positive environmental and social effects. Ultimately, our Living Lab is committed to educating communities, equipping them with the knowledge to adapt to climate change and implement preventative measures for a more climate resilient future.

Acknowledgements

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ID: 0095

INCREASING SOIL ORGANIC CARBON STOCKS THROUGH NATURE-BASED SOLUTIONS FOR CLIMATE MITIGATION AND AGRICULTURAL SUSTAINABILITY

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Keywords: Nature-based solutions (NBS), carbon sequestration, tillage/no tillage, crop residue incorporation, restorative land use

Abstract: The deprivation in soil organic carbon (SOC) stocks have a major impact on atmospheric carbon accumulation. Enhancing SOC stocks through sustainable agricultural management practices can play a crucial role in climate mitigation. Increasing SOC levels not only improves soil fertility by enhancing its physical and biological properties but also mitigates the adverse effects of agricultural intensification and land-use changes. Nature-based solutions (NBSs) offer an innovative approach to addressing these challenges by promoting carbon sequestration and ecosystem resilience. This article explores the role of NBSs in increasing SOC stocks and their application in the CARBONICA HORIZON project [1].

ID: 0096

AN APPROACH OF SDR SENSORS NETWORK DEVELOPMENT FOR COMMERCIAL DRONE DETECTION AND TRACKING

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Keywords: software defined radio (SDR), Raspberry Pi5, sensor network, detection, tracking, drone

Abstract: This article presents preliminary results from the development of a new approach of application of software defined radio (SDR) sensor network for detection and tracking of commercial drones. Different models of DJI drones were used for the approbation and accuracy testing of the proposed SDR drone detection and tracking sensor network.

In recent years, the use of commercial drones has grown rapidly expanded in a variety of domains. Unfortunately, the intentional or unintentional use of drones for various illegal activities is also on the rise, such as flying over critical areas or infrastructures, filming people without their consent, etc. These circumstances motivated us to develop a low-cost network sensor system for detecting and tracking of drones that are freely available in the market or so-called commercial drones. The DJI are one of the most common drones of this domain. For the development of the system, we have used various types of single-channel and dual-channel SDRs, operating in the frequency bands from 100kHz to 2GHz and from 100kHz to 6GHz. The application of embedded system as Raspberry Pi-5 is also experimented.

ID: 0097

MACHINE LEARNING-BASED LAND USE CLASSIFICATION WITH MULTITEMPORAL SENTINEL-2 IMAGERY

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Keywords: Land Use Classification, Artificial Intelligence, Multi-Temporal Analysis, Remote Sensing, Random Forest

Abstract: Land use classification is crucial for understanding and managing both natural and human-modified landscapes, as it supports environmental monitoring, sustainable agricultural practices, and urban development planning. Its importance is highly underscored by the Land Use, Land-Use Change, and Forestry (LULUCF) framework, which is central to European Union climate policies, as it directly impacts carbon stock changes, greenhouse gas (GHG) fluxes, and overall ecosystem resilience. Satellite-based remote sensing provides a cost-effective and scalable means of monitoring land use changes over large areas. However, distinguishing between similar land cover types—especially within agricultural landscapes dominated by small parcels—remains a challenge due to spectral similarities and seasonal variations. To address this, advanced machine learning (ML) techniques offer a powerful approach to enhance classification accuracy by integrating multispectral reflectance patterns, topographical data, and temporal trends. This study aims to utilize ML algorithms to improve land use classification using Sentinel-2 data. By applying various preprocessing techniques, exploring different sources and types of ancillary data to expand the feature space, and evaluating multiple ML models, we aim to develop a methodology that enhances classification accuracy and provides a reliable tool for land monitoring.

ID: 0098

GRADA: AN INTEGRATED SYSTEM TO ENSURE QUALITY IN TABLE GRAPES

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Keywords: Grape diseases, smart agriculture, disease risk, weather data, deep learning

Abstract: Table grape production and quality is highly influenced by environmental conditions, with abrupt weather changes increasing the risk of vineyard diseases. The integration of smart agriculture technologies enables early detection and effective management of these threats, improving crop quality and yield. This work proposes the GraDA system, a data collection and grape disease risk assessment system, consisting of three main components, namely the GraDA platform, a mobile application and an AI-driven grape disease risk prediction model. The mobile application is responsible for collecting images of grapes and leaves, while the AI-driven disease risk prediction model processes multi-modal input data—grape images, leaf images, and meteorological data—to achieve enhanced grape disease risk prediction accuracy. Finally, the GraDA platform is concerned with the collection and visualization of imaging and meteorological data through a web-based interface, enabling agronomists and farmers to monitor in real-time the weather conditions and the estimated disease risk scores, as well as manage farming activities, thus facilitating data-driven decision-making for vineyard health optimization. The proposed AI model's accuracy was evaluated in a multi-modal dataset, achieving a performance above 93% in grape disease risk estimation, while the usability of the overall GraDA system was assessed through questionnaires distributed to agronomists and farmers, leading to a score of 79.83% in the SUS scale, indicating excellent usability and user satisfaction from the proposed system. Finally, a pilot study of the GraDA system was performed to assess the applicability of the system in real-life scenarios.

ID: 0100

ON-BOARD CONVOLUTIONAL AUTOENCODER-BASED MULTISPECTRAL IMAGE COMPRESSION: BENCHMARKING ANALYSIS ON VPU AND FPGA

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Keywords: on-board AI, image compression, FPGA, VPU

Abstract: This paper presents a benchmarking study and an optimized Convolutional AutoEncoder (CAE) model for multispectral image compression on hardware accelerators, addressing data management challenges in resource-limited spacecraft like CubeSats. Specifically, Φsat-2, an ESA CubeSat launched in August 2024, tests onboard CAE-based compression to optimize bandwidth usage. The proposed 2D and 3D CAE models are optimized for deployment on Intel Neural Compute Stick (NCS)

The benchmarking evaluates the models on Intel NCS2 (Movidius Myriad X) and Field Programmable Gate Array (FPGA) AMD Xilinx Kria KV260, exploring synchronous and asynchronous inference modes. OpenVINO optimizes the encoder for NCS/NCS2, while Vitis AI adapts the model

for FPGA deployment through quantization, compilation, and Cross-Layer Equalization (CLE). Performance is assessed by measuring latency and throughput under single-thread and multi-thread configurations, demonstrating trade-offs between processing speed and efficiency. The results highlight the feasibility of deploying AI-based image compression in space, offering a scalable solution for future Earth Observation missions.

Comments:

ID: 0101

CONCEPTUAL DESIGN OF VIRTUAL WORLD FOR MONITORING AND STORYLIVING OF CULTURAL HERITAGE

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Keywords: virtual worlds, cultural heritage, earth observation, monitoring, storyliving

Abstract: Recently, there have been a variety of technological solutions to help cultural heritage (CH) stakeholders design, monitor, and understand the digital CH ecosystem, including advanced visualization and sensory technologies, wi-fi, bluetooth devices, video cameras, geographic information system applications, three-dimensional (3D) scanners, computed tomography scans, and heat map visualizations. CH professionals leverage the potential of architectural design, computing science, and cultural management to strengthen the cultural experience. Earth observation through satellite infrastructures and services such as Copernicus, and Galileo, or airborne methods, like drones, provides innovative representations and meaningful information in selected areas of CH interest. Virtual exhibitions and immersive experiences provide remote access and meaningful engagement with CH content. Digital twins have led to the development of advanced near-real-time visualization, data collection, and integration to facilitate easy-to-use, adaptable, and practical solutions. However, the forthcoming era of the metaverse and virtual worlds offers a unique challenge to combine emerging and cutting-edge technologies for holistic and interdisciplinary monitoring of CH through accessible and inclusive storyliving virtual worlds.

This study aims to conceptualize a framework for developing cultural heritage virtual worlds that use a broad spectrum of technologies and disciplines to provide advanced toolkits for holistic monitoring and understanding of CH. More specifically, earth observation and geoinformatics define the spatial context of any heritage site. Through available open-source platforms and APIs, one may acquire the data needed to identify possible risks such as soil erosion in the surrounding area, degradation effects of salinity or salt sprays, which, with the aid of winds, affect the sites that are nearby, as well as possible fire outbursts and propagation that might expand quickly due to vegetation and moderate to strong winds. Artificial intelligence and machine learning approaches, in particular, offer huge potential for applications in the fields of digitisation, optimization, study, conservation, and restoration works of CH. For instance, carefully planned interventions can be developed and applied to restore destroyed parts of artworks or other CH artefacts via digital inpainting. Paintings, historical maps, and building reconstructions are some of the potential CH digitised artefacts that may exhibit certain flaws or damaged areas due to, e.g., folding, inefficient reconstruction or damage from ageing. Virtual worlds combine heterogeneous datasets and information through universal platforms such as game engines. Immersive technologies of extended reality, adopt accurate and photorealistic 3D representations of CH assets. Innovative human-computer interactions can be developed to offer easy-to-use and accessible and multisensory experiences. The scattered cultural information from different sources and repositories can be shaped into meaningful and interconnected stories through the use of explainable AI and virtual museology. Moreover, the obsolete storytelling approach needs to be

updated into storyliving methodology that will transform users from passive observators to active protagonists in the virtual worlds.

This conceptual framework is expected to be adopted by various CH and educational stakeholders interested in the preservation and promotion of cultural heritage assets, while ensuring at the same time a risk assessment methodology that can easily be adapted in other worldwide case studies.

ID: 0102

USING SAR DATA FUSION FOR NEAR REAL-TIME APPLICATIONS TO IMPROVE MARITIME SITUATIONAL AWARENESS IN THE EASTERN MEDITERRANEAN

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Keywords: Maritime Situational Awareness, Synthetic Aperture Radar (SAR), Near Real-Time (NRT), Ship Detection, Data Fusion.

Abstract: The Maritime Situational Awareness (MARSIAWA) demonstration project under EXCELSIOR, led by the German Aerospace Center (DLR), investigated the potential of synthetic aperture radar (SAR) data to improve maritime surveillance in the eastern Mediterranean Sea. A demonstration application was created to produce various maritime information products, such as ship positions, wind speeds, wave heights, and sea state conditions, using SAR data processed by DLR's SAINT processor. This information, derived from the Copernicus Data Hub and DLR archives, enabled the identification of hazardous conditions while providing a detailed spatial perspective of maritime activity. DLR's operational ground system was used to link and analyze SAR data for near real-time (NRT) applications. Sentinel-1 and Automatic Identification System (AIS) data were employed for ship detection, wind speed estimation, and wave height analysis. The ERATOSTENES Centre of Excellence (ECoE) supported the management, preservation, and protection of maritime security through this strategy. The study focused on mission planning, real-time data collection and processing, level 2 data fusion and validation, and the development of fe, asible satellite-based solutions for NRT maritime situational awareness. The initiative highlighted the importance of SAR-based technology in enhancing regional maritime surveillance and decision-making.

ID: 0103

BRIDGING THE SKILLS GAP IN REMOTE SENSING AND GIS: INSIGHTS FROM THE RESENSE PROJECT

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Keywords: Vocational Trainings, Remote Sensing, Earth Observation, GIS

Abstract: Identifying Geographic Information Systems (GIS) and Remote Sensing (RS) as indispensable tools underscores the critical demand for skilled professionals in land-use mapping, urban morphology analysis, vegetation monitoring, and disaster management.

Despite this demand, the lack of experts limits the effective application of these technologies in both academic and professional contexts. The Remote Sensing Technology Training (ReSENSE) project, funded by Erasmus+, aims to bridge this gap by providing targeted vocational education and training in Cartography, RS, GIS, Copernicus Services and Image Processing including emerging technologies such as cloud computing, the Internet of Things (IoT), Machine Learning (ML), and Artificial Intelligence (AI).

This study presents key findings from a comprehensive survey conducted in Cyprus and Greece, assessing the training needs of professionals in environmental and governmental sectors. To address these challenges, ReSENSE offers accessible, hands-on training opportunities both in person and remotely to meet the growing demand in industry. Moreover, it provides customized workshops and educational resources, empowering professionals with theoretical knowledge and practical skills that are crucial for success in a rapidly evolving, data-driven workforce. It is vital to enhance participants' educational experience through upskilling and reskilling. By making these resources widely available, the project enhances professional competencies, fosters career advancement, and expands opportunities in sectors that increasingly rely on GIS and RS technologies.

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ID: 0104

LEVERAGING MACHINE LEARNING FOR WILDFIRE RISK ASSESSMENT USING MULTIMODAL GEOSPATIAL AND CLIMATE DATA IN CYPRUS

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Keywords: Wildfires, Remote Sensing, Machine Learning, Earth Observation, Cyprus, Disaster Risk Reduction

Abstract: Wildfire detection is a critical issue for authorities. There are various causes of fire events with the most common being human influence. Predicting fire risks through the analysis of geo-environmental and climate data is essential for early warning systems and effective fire management strategies. This study focused on Cyprus Island, which features a predominantly mountainous terrain and a Mediterranean climate. The island experiences dry, hot summers typically lasting from May to October, with temperatures ranging from 30°C to 40°C, significantly increasing fire ignition risks. The research leveraged a multimodal dataset comprising data from 2001 to 2023, encompassing anthropogenic, environmental, meteorological, topographic, and fire-related features. Key anthropogenic features included road density and locations for picnics and camping, while topographical factors encompassed slope, elevation, and aspect. The environmental factors considered were land cover, vegetation indices, and the forest-agriculture interface. Additionally, meteorological data such as temperature, wind speed and direction, and precipitation were included in the analysis. The Random Forest classifier was implemented for this study to predict the fire risk. Prior to implementing the algorithm, some pre-processed actions were applied to the dataset to address missing values (NaN) and

normalize features to a common scale to ensure consistent performance across different data types. Hyperparameter tuning was conducted using the RandomizedSearchCV approach, and model robustness was ensured through GroupKFold cross-validation. Various metrics, including precision, recall, F1-score, and AUC, were employed to assess model accuracy during tuning. Due to the significant class imbalance, where the no-fire class greatly being substantially larger than the fire class, recall values were prioritized during model selection. The top-performing models demonstrated balanced recall rates exceeding 70% for both classes over a two-month evaluation period, indicating promising potential for real-world application. Continuous monitoring and fire predictions may serve as a commercial service. Future research will include comparative analyses among various models, such as Decision Trees, Support Vector Machines, and Artificial Neural Networks, to enhance wildfire prediction reliability.

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ID: 0105

PROXY REMOTE SENSING AND DATA FUSION FOR THE PROTECTION OF CULTURAL HERITAGE MONUMENTS

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Keywords: Cultural Heritage, Data Fusion, Salinity, Climate Change

Abstract: Heritage monuments and sites constitute invaluable assets that embed profound historical and cultural significance. However, they are increasingly threatened by environmental factors due to climate change agents. Coastal sites are prone more than others to soil erosion and salinity, which may affect their structural integrity over time. This research endeavour aims in monitoring and evaluating the impact of salinity on the monument and the proximate areas by utilizing the NDSI (Normalized Difference Salinity Index), and analysing possible thermal fluctuations through the Land Surface Temperature (LST). The enhancement of the environmental risk evaluations is realised by applying multitemporal remote sensing data, with a particular emphasis on biannual assessments to interpret the seasonal variations.

The methodological framework consists of 5 pivotal phases:

• Initially, satellite imagery from Sentinel-2 and Sentinel-3 was collected for the prior decade, focusing specifically on winter and summer periods for selected cultural sites that share different geomorphological features.

• The NDSI, and LST indices were calculated to assess vegetation vitality, salinity levels, and to monitor temperature fluctuations, respectively.

• Bayesian data fusion techniques were employed to integrate the aforementioned indices, thus alleviating uncertainties and enhancing the reliability of the evaluations.

• Temporal changes in NDVI and NDSI were analysed to identify trends and potential risks,

• while statistical methodologies were utilized to derive significant metrics including mean, standard deviation, and trend analysis.

The current study builds on the development of proactive conservation approaches, while it attempts to provide a robust framework, where the utilisation of satellite data along with data fusion techniques and statistical analyses demonstrate the capacity of enhancing available cultural risk assessment strategies.

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ID: 0106

MONITORING PINE PROCESSIONARY MOTH (THAUMETOPOEA PITYOCAMPA) DEFOLIATION IN PAPHOS FOREST, CYPRUS USING SENTINEL-2 AND GOOGLE EARTH ENGINE

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Keywords: Thaumetopoea pityocampa; Pine processionary moth; Sentinel-2; PlanetScope; Forest Defoliation

Abstract: The Pine Processionary Moth (PPM) or Thaumetopoea pityocampa is a major defoliator of Mediterranean pine forests, posing a significant threat to forest health and biodiversity. The early detection of PPM-induced defoliation is crucial for effective forest management and mitigation strategies. This study investigates the potential of Sentinel-2 multispectral data and Vegetation Indices (VIs) to detect defoliation in Pinus Brutia Forest in the Paphos Forest, Cyprus. The study utilises pre and post infestation Sentinel-2 images acquired during February- March 2021 (pre-infestation) and February-March 2023 (post-infestation), capturing monthly spatial changes associated with infestation. A difference-based approach was employed, calculating changes in multiple vegetation indices, including the Normalised Difference Vegetation Index (NDVI), Moisture Stress Index (MSI), Chlorophyll Red-Edge Index (CIred-edge), Normalised Difference Infrared Index (NDII), Ratio Vegetation Index (RVI) and Normalised Burn Ratio (NBR). The changes between pre and post infestation images were analysed to identify significant spectral indicative of defoliation. To enhance the robustness of the detection method, Otsu's thresholding algorithm was applied to each VI to define optimal separation thresholds for infested and non-infested pixels automatically. Additionally masking steps were incorporated to refine detection accuracy. The study filtered results to exclude non-Pinus brutia areas by incorporating forest species distribution maps. Moreover, a Bare Soil Index (BSI) was computed to eliminate pixels corresponding to bare ground, ensuring defoliation detection was not misclassified due to soil exposure rather than infestation. All analyses were conducted in the Google Earth Engine (GEE) platform, leveraging cloud computing to process high-resolution satellite imagery over the study area efficiently. To validate the identifies defoliated areas, a time-series analysis conducted utilising Sentinel-2 and high-resolution PlanetScope imagery with 10m and 3m spatial resolution respectively. This validation assessed whether the detected regions were indeed affected by PMM infestation by analysing temporal changes in vegetation indices. This study contributes to the development of

remote sensing-based methods for monitoring PPM-induced defoliation providing a framework for integrating spectral analysis with time-series validation.

ID: 0107

SEDIMENTS DYNAMICS AND TRACEABILITY TOOLS OF GREEK STEVIA IN THE SPERCHIOS RIVER BASIN

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Keywords: Sedimentology; Stevia; Isotopes; Traceability; Agriculture.

Abstract: Stevia cultivation has expanded globally, with Greece emerging as a distinctive producer of high-quality European stevia. The cultivated fields of Greek stevia in the Sperchios River Basin are defined by the geochemical environment shaped by unique geological, geomorphological, and hydromorphological characteristics. This study focuses on the sedimentological analysis of stevia products and the assessment of strontium isotope ratios (87Sr/86Sr) of soils on different cultivated areas. During the 2023-2024 sampling campaign, soil samples were collected from 12 sites across the Sperchios River Basin and analyzed for their grain size and geochemical signatures. Particles larger than 2 mm were analyzed using the mechanical sieve method and a set of sieves at half-phi (φ) intervals. Following the removal of organic matter with a 10% H_2O_2 solution (Trautmann et al., 2000a, b), the finer fractions were analyzed through laser diffraction with a Malvern Master Sizer Hydro 3000. The grain size statistical parameters were computed using Gradistat software (Blott & Pye, 2001), applying the Folk and Ward (1957) method. The granulometric indices, Mean grain diameter (Mz), Skewness (SkI), Sorting (σI), and Kurtosis (K.I.), were also calculated, and the grain size distributions were visualized through cumulative and frequency curves. Unlike chemical analysis, isotopic methods preserve the geological signal from soil to plant without being altered by metabolic processes. The isotopic composition of strontium in soils primarily reflects rock weathering, erosion mechanisms, and sediment deposition—processes influenced by tectonic activity and the river's dynamic flow. These factors collectively form a distinct sedimentary basin that directly affects the chemical and isotopic profile of the crops cultivated in the area. Isotopic analysis highlights the significance of underlying lithology and sediment transport dynamics in shaping the unique fingerprint of agricultural products. While factors such as marine aerosols and agricultural fertilization can introduce variations in the isotopic signature, the dominant signal is determined by the cultivation zone's geological identity. As a stable geographic marker, the 87Sr/86Sr ratio remains unaffected by food processing or biological transformations, making it a reliable "geological fingerprint" in the food chain. This research aims to establish an initial isotopic database of soils from other stevia cultivation areas, enabling the authentication of their geographical origin and ensuring traceability across supply chains.

ID: 0108

WILDFIRE EVENT DETECTION USING SOCIAL MEDIA AND EARTH OBSERVATION DATA

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Keywords: Wildfires, social media, Earth Observation, early warning

Abstract: Wildfires increasingly threaten the Attica region in Greece due to climate change, prolonged droughts, and rising temperatures. Their growing frequency, intensity, and proximity to urban areas endanger human lives, infrastructure, and biodiversity, leading to severe

environmental and economic consequences. This highlights the need for improved detection methods and optimized resource allocation to enhance situational awareness and real-time fire monitoring, ultimately strengthening emergency response efforts.

With this study we explore the feasibility of integrating social media data with Earth Observation (EO) data for near real-time wildfire detection and monitoring. We analyze geotagged social media posts related to historical wildfire events and, by correlating them with satellite data, assess the effectiveness of this fusion approach in improving wildfire detection accuracy and response times. Leveraging crowdsourced social media data as a complementary source to EO detection methods offers timely and spatially explicit information on wildfire events, improving the accuracy and speed of wildfire detection. By enhancing early warning systems, this study enables emergency responders to detect, assess, and manage wildfires more efficiently. Overall, with this study we aim to support authorities, raise public awareness, and provide recommendations for improved wildfire preparedness and response.

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ID: 0109

ASSESSING WILDFIRE IMPACTS IN LOS ANGELES USING VIIRS AND LANDSAT-9 TIRS IMAGERY

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Keywords: Wildfires, Remote Sensing, Vegetation Health, Burn Severity, Visible Infrared Imaging Radiometer Suite (VIIRS), Landsat 9 (NASA-USGS).

Abstract: Wildfires are a growing and significant challenge in Los Angeles, California, exacerbated by climate change, land use alterations, and increasing human activity in fire-prone areas. This study investigates the dynamic challenges of wildfires by leveraging advanced satellite data from the Visible Infrared Imaging Radiometer Suite (VIIRS) and Landsat 9 to assess active wildfires and their impact on vegetation and burn severity in the region. The research employs normalized difference vegetation index (NDVI) and normalized burn ratio (NBR) methodologies to quantify changes in vegetation health and evaluate ecological damage post-wildfire. Results indicate a substantial average NDVI reduction of 0.25 following wildfire events, with approximately 150 square kilometers experiencing significant ecological degradation. The analysis further demonstrates that the total burned area exceeds 120 square kilometers, particularly highlighting high fire intensity in chaparral ecosystems, where around 70% of affected areas fall within high-severity classification. The implications of these findings are critical, given the increasing frequency and intensity of wildfires in the United States, which, according to the National Interagency Fire Center (NIFC), burned over 58,000 wildfires and approximately 7 million acres in 2022. Such events threaten not only lives and property but also biodiversity, air quality, and community health, leading to substantial economic burdens associated with firefighting and recovery efforts. The study's methodology involves defining a region of interest (ROI) focused on Los Angeles and utilizing Google Earth Engine (GEE) for data processing. By analyzing VIIRS data to detect active fire spots and Landsat 9 imagery for pre- and post-fire conditions, the research provides a comprehensive assessment of vegetation health and burn severity. NDVI was employed to evaluate the vitality of vegetation, while NBR quantified the extent of burn severity. A marked decrease in NBR values from approximately 0.45 pre-fire to 0.25 post-fire indicates significant carbon stock loss and extensive fire damage across vital habitats. Distinct burn severity patterns were documented, especially in vegetation types such as chaparral, where fire intensity has particularly severe impacts. Additionally, NDVI change layers and water masking techniques refined the analysis, ensuring accurate evaluations by excluding aquatic areas. The findings highlighted an overall area

of approximately 85 square kilometers significantly affected by wildfire, necessitating targeted management interventions for recovery. This research underscores the urgent need for real-time monitoring and the integration of satellite-based remote sensing technologies into wildfire management frameworks. By providing precise data on vegetation health, land management agencies can develop more effective ecosystem resilience and recovery strategies. Continual research and technological advancements are essential to address the escalating wildfire challenges, particularly as climate change drives increased fire risks in vulnerable landscapes.

ID: 0110

MULTI-INSTRUMENT PLATFORMS FOR INVESTIGATING THE AEROSOL-CLOUD-DYNAMIC INTERACTION IN EASTERN MEDITERRANEAN

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Keywords: EXCELSIOR project, ERATOSTHENES Centre of Excellence (ECoE), Cyprus Atmospheric Remote Sensing Observatory (CARO), Multi-instrument observatory, aerosol-cloud-dynamic interaction.

Abstract: In the context of the EXCELSIOR project, the ERATOSTHENES Centre of Excellence (ECoE) has acquired a research infrastructure for the observation of clouds and aerosol in Cyprus. The Atmospheric Cluster of the Department of Climate and Environment of the ECoE, coordinates the Cyprus Atmospheric Remote Sensing Observatory (CARO). CARO is a national facility for atmospheric research and consists of a state-of-the-art dual field of view PollyXT Raman lidar (since October 2020), a Doppler wind lidar (since February 2023), a ceilometer and a disdrometer-Parsival2 model (since January 2024), a 35 GHZ cloud-radar and microwave radiometer (since July 2024). Meanwhile, long-term aerosol observations have also been provided by the CUT-TEPAK AERONET sun-photometer, since 2010. CARO is located at Limassol, a coastal city of Cyprus (34.677°N, 33.0375°E, 2.8 m above sea level) and is planned to become the reference observatory in the East Mediterranean, north Africa and the Middle East (EMMENA region). The CARO is in unique geographical location as the air masses affecting the site originate from the surrounding areas of EMMENA, as well as from south-eastern Europe. CARO is part of the ACTRIS-ERIC Aerosol and Cloud remote sensing observational platform, EARLINET (European Aerosol Research Lidar Network), and the PollyNET (Network of automated Raman-polarization lidars). Furthermore, CARO actively participates in the EarthCARE satellite validation through the CORAL project (Cyprus Observation for EarthCARE validation), providing ground-truthing observation of the atmosphere's vertical structure. The CARO ground-based high-quality infrastructures with the addition of the new knowledge on modelling related and satellite based atmospheric research through the ATARRI project (ATmospheric and solAR Research and Innovation in the Eastern Mediterranean), will allow a measurement– modelling synergistic approach dealing with major environmental and atmospheric research and innovation aspects.

This multi-instrument platform is unique with the latest modern standard that is only available in few regions globally. CARO aerosol and cloud observational platform gives the advantage to investigate the complex impact of different aerosol mixtures on cloud formation, in addition to study the direct and indirect effects of aerosols on radiative transfer and dynamic precipitation generation. A lidar–radar methodology can be used to investigate the role and impact of aerosol

particles on ice formation in atmospheric clouds and on subsequent precipitation processes and present valuable closure studies.

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ID: 0111

ASSESSING THERMAL STRESS ON CULTURAL HERITAGE IN LIMASSOL: A MULTI-SCALE REMOTE SENSING APPROACH USING SENTINEL-3 AND LANDSAT 9 LAND SURFACE TEMPERATURE DATA

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Keywords: Climate change, Sentinel-3, Landsat 9, Urban Heat Island, Cultural Heritage

Abstract: Cultural heritage buildings and archaeological sites in urban environments are increasingly at risk from exposure to thermal stress driven by climate change. This study examines the impact of thermal stress on heritage structures in Limassol's historic district using Land Surface Temperature (LST) images from Sentinel-3 and Landsat-9 satellite remote sensing data. Sentinel-3's broader coverage at a 1 km spatial resolution allows for a city-wide survey of thermal anomalies, enabling the identification of extensive heat pockets and urban hotspots. In parallel, Landsat 9's finer 30 m resolution provides detailed thermal distributions that highlight localized thermal gradients around individual heritage sites, archaeological areas and listed neoclassical buildings, which are more sensitive to small-scale environmental changes.

By correlating data from both satellites, this research constructs a thermal risk map, revealing the interplay between large-scale urban heat trends and site-specific vulnerabilities. The results demonstrate that areas with high concentrations of cultural heritage assets that consistently show elevated thermal stress levels face increased risks of material degradation, weathering and accelerated decay in historic structures. These findings underscore the importance of proactive conservation strategies, such as targeted microclimate interventions or adjustments to urban planning and landscaping to mitigate localized heat buildup.

This multi-scale remote sensing approach not only elucidates current patterns of thermal stress related to the urban heat island effect in Limassol but also offers a replicable framework for other Mediterranean cities facing similar climatic pressures. Integrating broader-scale monitoring via Sentinel-3 with site-focused assessments from Landsat 9 provides a robust toolset to inform heritage preservation policies, prioritize restoration efforts, and guide climate-resilient urban development. Ultimately, the study highlights how the use of satellite LST data can serve as a critical resource for safeguarding historical sites against the escalating impacts of climate change and the urban heat island effect.

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ID: 0112

MACHINE LEARNING FOR IDENTIFYING DAMAGE PATTERNS ON CULTURAL HERITAGE – CASE STUDY THE TOMB OF THE KINGS IN PAPHOS, CYPRUS

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Keywords: Climate change, Sentinel-3, Landsat 9, Urban Heat Island, Cultural Heritage

Abstract: Safeguarding cultural heritage sites is a pressing concern as artefacts, monuments and sites are increasingly exposed to environmental and human-related deterioration. A timely identification of worsening effects or structural threats becomes of paramount importance for a correct preservation and management.

The proposed research focuses on the development of a methodology able to identify and classify damage typologies exploiting an AI-driven approach and 360-degree camera images. The developed workflow has been tested on the archaeological site of the Tomb of the Kings in Cyprus and two deterioration classes on the site's surface were selected: honeycomb weathering and cracks.

The camera that was utilized was a GoPro fusion. Videos of an approximate duration of 90 seconds each, recorded the interior spaces of the Tombs 5 and 7 with a resolution of 2704 x 2624 and 29.97 frames per second (fps). As an initial point, the approximate rate of the number of images that were exported from each video were 2700 and projected into equirectangular view.

A detailed dataset of high-resolution panoramic images has been collected, documenting the site's surface conditions, and used as training dataset for a machine learning (ML) model. The latter is expected to automatically detect and classify damage patterns. If the amount of the images is not enough for this purpose, we will use augmentation techniques to increase the size of the trained dataset.

The ML framework will employ image analysis and deep learning algorithms, ensuring its capability to generalise to other heritage sites.

The proposed pipeline aims to create a reliable, and non-destructive tool for monitoring and automatically identify and classify damages of heritage structures across various contexts and heritage assets typology.

Acknowledgements: The authors acknowledge the 'EXCELSIOR': ERATOSTHENES: Excellence Research Centre for Earth Surveillance and Space-Based Monitoring of the Environment H2020 Widespread Teaming project (www.excelsior2020.eu). The 'EXCELSIOR' project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 857510, from the Government of the Republic of Cyprus through the Directorate General for the European Programmes, Coordination and Development and the Cyprus University of Technology.

ID: 0113

ASSESSING WATER LOSS AND SEDIMENT DEPOSITION AT MAVROKOLYMPOS DAM USING MULTIMODAL METHODS: TLS, UAV, AND SATELLITE IMAGERY

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Keywords: Dam, water, Remote Sensing, TLS, UAV, Sentinel-2, PlanetScope, Cyprus

Abstract: The climate zone of Cyprus is characterized as semi-arid climate followed by hot, dry summers and mild winters with low rainfall. For addressing water scarcity during the dry summer months, the Cypriot government implemented a policy of constructing reservoir dams across the island. Most of these dams were built after 1960 and are now ageing. The sudden water evacuation of the Mavrokolympos Dam in Paphos, Cyprus, due to a ventilating system failure provided a rare opportunity to provide a more reliable estimate of the volume of water lost and sediment transport within the reservoir over time and the outflow sentiment volume during the water loss event. This study integrates terrestrial laser scanning (TLS), unmanned autonomous vehicles (UAVs), and a time series of Sentinel-2 and PlanetScope satellite images to analyze pre- and post-evacuation conditions focusing on the initial water body mass just before and immediately after the event occurred. The satellite images were used to delineate the waterbody's extent before and after drainage, enabling volume estimation of the lost water. TLS and UAV surveys captured high-resolution topographic data of the emptied reservoir, validating satellite-derived volume estimations through a Digital Elevation Model (DEM). Additionally, the sediment layer deposition in the reservoir was quantified providing insights into the waterbody mass of the dam at full capacity in recent years, also allowing for an assessment of sediment displacement towards the river mouth. This multimodal approach enhances our understanding of reservoir dynamics, water resource management, and sediment transport processes following abrupt drainage events.

ID: 0114

REMOTE SENSING CAPABILITIES FOR THE ESTABLISHMENT OF A FOOD SAFETY AND FOOD SECURITY OBSERVATORY IN EUROPE

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Keywords: Monitoring, Extreme Weather Events, Food Systems, Biodiversity, Food Hazards.

Abstract: Food security is affected by the presence of food safety hazards in agri-food commodities. The ECO-READY observatory includes a real-time surveillance system for food related hazards, with an eye on monitoring food security and biodiversity. Remote sensing can provide real-time assessments of crop yield and quality conditions, the presence of crop pests, and the potential presence of food hazards. Also, remote sensing can provide real-time information of weather, directly or indirectly affecting food security and safety.

This study aimed to obtain an up-to-date overview of remote sensing applications for food security, food safety, and biodiversity. A literature review was held using various journal databases, which were queried for search terms like “remote sensing”, “food security”, “food safety”, “biodiversity” and “machine learning”. Papers from the period 2006 to 2025 written in English language were included. In total, 139 scientific publications were found, of which 60 were deemed relevant.

Our review showed that remote sensing was used for the monitoring of crops, weather, soil, water, biodiversity, detection of pests and disease, and for developing strategies to adjust to environmental changes. Our review also showed that extreme climate events like floodings and droughts affect food security and food safety, and are estimated to occur more frequently with climate change. Moreover, the food safety of biodiversity positive food systems was widely understudied.

Floodwater may contain hazards (e.g., biological, chemical), which can pollute agricultural water sources, production fields, and post-harvest processing areas. Remote sensing studies used the Synthetic Aperture Radar (SAR) to estimate the extent of flooding and crop damage, and combined this method with satellite data and machine learning to assess flooding characteristics and flood damage.

Drought directly affects crop growth but also affects food safety of crops in storage facilities and intensifies the use of pesticides. Remote sensing has been applied to model crop vegetation, and climatic parameters such as temperature and precipitation indices. These models were not generalizable between locations, highlighting a challenge for the ECO-READY observatory overseeing all of Europe. Current research utilizes deep learning for real-time monitoring of climatic parameters with the aim to anticipate extreme events in crop management.

To conclude, remote sensing can be used to monitor climate and extreme weather events, and in applications to estimate food security and food safety. By using remote sensing, the ECO-READY observatory will be able to monitor food security in Europe.

ID: 0115

AI-POWERED ECONOMIC FORESIGHT MODELLING FOR GLOBAL WHEAT PRODUCTION: A SCENARIO-BASED MAGNET-AI STUDY

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Keywords: MAGNET;AI Model; Scenario Modeling; Economic Foresight; Wheat Production

Abstract: Artificial intelligence has been meeting promising expectations in environmental and agricultural economics by delivering values driven by advances in availability of relevant data, computation and algorithms; yet the question how broad AI can be deployed along (or as a replacement to) the scenario-based models such as MAGNET (a Computational General Equilibrium Framework, CGE) in providing reliable economic foresights, is an intriguing concept to be explored. To address this question, this study has benchmarked the power of AI against that of the established MAGNET model in developing economic projections under the shared socioeconomic pathways (SSPs). Foreseeing the percentage changes in the Global Wheat Production has been selected as a pivot study to leverage AI's power in simplifying the complex modelling process and in producing more accurate projections. This approach provides the opportunity in upholding the role of AI in scenario-based modeling and to lay down a more generalized framework. To that aim, the data for wheat production of 19 countries from MAGNET database (year 2017) together with data spanning 1973-2019 from other sources (mainly FAO-STAT) has been collected. Harvested area, export, population, GDP, year and import have formed the AI input set which were nominated through expert-driven feature selection process and justified by machine learning methodologies to add to the interpretability of the model.

AI model confirms to be a powerful instrument in capturing the underlying variability in the outcome variable (reflected through the R2 which is above 90%) in most of the countries under study in comparison to MAGNET, which is more conservative in pursuing the existing patterns (Please see the Figure below).

While AI proves its flexibility in following the non-linear relationships, this approach does not strictly surpass the performance of MAGNET in accuracy within the scope of our study. This limitation can be attributed to two primary factors: a) the AI model has been trained on the information from 19 countries while MAGNET's results are based on the information from 141 regions b) the input space for the AI model is rather restricted in comparison to the indicators that build up the MAGNET structure. Targeting these limitations, provides avenues in enhancing the current approach towards laying a framework.

First, the scope of the study can be extended by incorporating data from more regions and including more explanatory power through additional input variables such as trade statistics, sectoral linkages or policy measures. Second, the study can be more inclusive by focusing on indicators beyond wheat production which is an exclusive part of the interconnected MAGNET network.

The methodology introduced in this study, sketches the foundation of a more comprehensive integrated MAGNET-AI approach across multiple economic sectors.

Changes in MAGNET, AI, and observed data of wheat production in 2019 compared to 2017.

ID: 0116

BRIDGING PAST AND PRESENT: ADVANCING CULTURAL PRESERVATION THROUGH 3D DIGITIZATION

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Keywords: cultural heritage, 3D printing, 3D digitization, preservation, museums

Abstract: The preservation of cultural heritage has always been a delicate balance between maintaining fragile artefacts and granting public access. Recent advances in digitization and reproduction technologies now offer innovative solutions to this challenge. This paper details an approach whereby historically significant antiquities, such as the statue of Aphrodite from the Paphos District Archaeological Museum, are precisely digitized using high-resolution 3D scanning techniques and then reproduced via 3D printing. By creating true-to-scale, highly detailed replicas, museums can share their collections across multiple venues without endangering the original masterpieces.

Central to this work is the Eratosthenes Centre of Excellence, which utilizes state-of-the-art equipment to ensure that nuanced surface textures and structural details of artefacts are accurately captured and preserved. In addition to safeguarding fragile and rare pieces, this approach broadens the global reach of cultural treasures, enabling more inclusive public access, enhancing educational opportunities, and fostering greater appreciation for history and the arts. By placing a replica of the Aphrodite statue in the Sea and Culture Museum in Polis Chrysochou, the public gains the chance to view and learn about this ancient piece in a new context, all while the original remains protected in its home institution.

This initiative was a part of the larger upgrade of the Cyprus Ports Authority Warehouses in Latsi in the Municipality of Polis Chrysochous into a Sea and Culture Multipurpose Venue project. Through this effort, additional exhibits from the Paphos District Archaeological Museum were digitized to develop replicas and an Augmented Reality (AR) application, enriching the visitor experience at the new venue. The AR component provides interactive, immersive exploration of each exhibit, bridging the gap between physical and virtual realms. Ultimately, the workflows and technologies presented here constitute a holistic model for preserving cultural heritage and expanding the reach

of museum collections, ensuring that history can be shared safely, sustainably, and engagingly with future generations.

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ID: 0117

ON THE IMPLEMENTATION OF LULUCF MONITORING PLATFORMS IN THE CONTEXT OF AFOLU SECTOR AND REGENERATIVE AGRICULTURE (RA)

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Keywords: LULUCF, AFOLU, Regenerative Agriculture, Collect Earth, GEE

Abstract: Within the Land Use, Land Use Change, and Forestry (LUCF/LULUCF) framework, innovations like Collect Earth (CE), supported by data collection platforms such as Collect and Arena, have modified how land use data is collected, analyzed, and applied. In this scenario, the existing technical baseline deriving from these LULUCF tools proved to be developed with distinct objectives, focusing either on global-scale data extraction or specific functional GHG applications. However, their ability to holistically assess complex, context-specific scenarios remains limited. This aspect is already being overcome in existing frameworks such as Living Earth, which contributes to the refined FAO LCCS land use classification through environmental descriptors. In these regards, the LandShift project represents an applicative-driven transformation of the Living Earth framework into Knowledge Cubes. It defines a more integrative perspective on land-use monitoring, bridging the gap between top-down policies and on-the-ground realities, aligning with the EU, Green Deal, forthcoming Soil Monitoring Law, and New European Bauhaus (NEB) principles.

This aspect is furthermore exacerbated when dealing with the Agriculture, Forestry, and Other Land Use (AFOLU) mitigation strategies. However, some mitigation measures have been suggested to not compete with other land uses, while also having multiple co-benefits, including adaptation capacity and potential synergies with some Sustainable Development Goals (SDGs).

In this context, Agroecology (AE) including Regenerative Agriculture (RA) initiatives aimed at improving soil health or increasing biodiversity utilize both qualitative small-scale methods, such as community-led surveys or transect monitoring of ecological successions, and large-scale tools like ground sensors and satellite imagery. RA can contribute to LULUCF mitigation, by adopting site-specific Land Restoration techniques.

In this study, we conducted on-field trials in the Ecosystem Restoration Community Camp Altiplano in the Murcia Region (Spain) aimed to support monitoring and analysis of RA trends. By restructuring the LULUCF geographically explicit Survey approach to collect on-ground observations and RA monitoring indicators, coherently within the Arena on-field survey structure approach and R environment, the outputs have provided a clearer depiction of phenological dynamics and soil indicators over time, offering a baseline for feedback integration and refinement. Building synergies with satellite-based assessments, by using cloud-computed vegetation indices by bridging R and GEE (e.g., NDVI, EVI), the preliminary database structure provides a more integrated methodology for tracking restoration progress and informing evidence-based and context-specific decision-making.

To monitor the AFOLU sector mitigation pathways ensures to address intervention targets and achieve broader restoration goals effectively. The progression from Global to Local (GLocal) provides a robust mechanism for capturing insights across multiple dimensions—ecological, social, and cultural—while aligning with the FAO Land Degradation Neutrality (LDN) specific outcomes of interventions deriving from the combination of agricultural stallholders, soil conservation strategies, and regenerative land management.

ID: 0118

DIGITIZING THE CHURCHES OF LIMASSOL: PROCESSING PHOTOGRAMMETRIC POINT CLOUDS FOR CULTURAL HERITAGE PRESERVATION AND PUBLIC ACCESS

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Keywords: Photogrammetry, 3D Models, Cultural Heritage, Potree, Cyprus

Abstract: The documentation of archaeological and historical sites through active remote sensing technologies has expanded the possibilities for studying, preserving and presenting cultural heritage. This project focuses on the processing and visualization of photogrammetric point cloud models of churches in the region of Limassol (Cyprus) through interactive web browsers. The photogrammetry raw datasets underwent several post-processing steps before being digitally presented in an interactive online platform.

The post-processing pipeline includes but is not limited to removing noise through manual and automatic filtering, reconstructing missing parts which were missing due to the presence of occlusion and optimise RGB colours information.

The optimised models were then converted to into a Potree readable format. Potree is a web graphics library for rendering large point clouds, ensuring smooth visualizations. Finally, the models were uploaded on a web server, where users are able to navigate them, explore the structures and exploit a series of interactive tools for scientific analysis, providing a resource for research and education.

Through thedigital reconstruction, changes might occur in the churches' structure and its landscape, posing the challenge of creating smooth visualizations while maintaining accurate architecture and features. This adds considerations for creating clear distinctions between the physical and digital versions of the churches.

In conclusion, this project aims to provide a valuable tool to explore publicly accessible digitized material, for research, education and the general public. Furthermore, the developed platform allows public engagement with ecclesiastical heritage in an interactive way freeing the user from any installation and configuration issue. The project contributes to the broader field of digital archaeology while demonstrating how photogrammetry and web-based visualizations can enhance cultural heritage documentation, study and accessibility.

Acknowledgements: The documentation of churches is under the project entitled: "Ecclesiastical Cultural Heritage Digitization Pilots for the Churches of Cyprus and Crete" referred to as "Digital Aposphragisma (Imprint) of Hagionymous Islands" and is co funded by the European Regional Development Fund (ERDF) and by national funds of Greece and Cyprus, under the Cooperation Programme "INTERREG V-A Greece-Cyprus 2014-2020". The title / Acronym of the project in the Greek language is: "Πλοηγοί Ψηφιοποίησης Πολιτιστικής Κληρονομιάς Εκκλησιών Κύπρου και Κρήτης " / "Ψηφιακό Αποσφράγισμα Αγιωνύμων νήσων"

This work is carried out in the framework of the 'EXCELSIOR': ERATOSTHENES: Excellence Research Centre for Earth Surveillance and Space-Based Monitoring of the Environment H2020 Widespread Teaming project (www.excelsior2020.eu). The 'EXCELSIOR' project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 857510, from the Government of the Republic of Cyprus through the Directorate General for the European Programmes, Coordination and Development and the Cyprus University of Technology.

ID: 0119

MAINSTREAMING CARBON FARMING PRACTICES IN CYPRUS OLIVICULTURE: THE CARBONICA PROJECT

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Keywords: Carbon farming, soil health, carbon sequestration, oliviculture, sustainability

Abstract: Olive groves play a vital role in Mediterranean agriculture, not only as a cornerstone of local economies but also as potential carbon sinks. Sustainable soil management in these systems is key to enhancing productivity while mitigating carbon losses. The CARBONICA project is actively investigating practical, low-input carbon farming strategies suited to the semi-arid conditions of Cyprus. Among these, spontaneous cover cropping and the incorporation of pruned biomass have emerged as promising approaches due to their feasibility and positive impact on soil health. Research shows that olive pruning generates substantial biomass, often exceeding 1,300 kg per hectare annually, yet much of this carbon is lost through combustion. By shredding and reintegrating pruned material into the soil, carbon retention can be significantly improved while enhancing soil structure and nutrient availability. Similarly, managed cover crops help stabilize organic carbon, reducing erosion and improving moisture retention. However, timing and management are critical to prevent competition with olive trees, particularly in water-limited environments. At the Agricultural Research Institute's Achelia-Paphos site, experimental olive plots are testing the combined effects of pruning incorporation, cover cropping, and reduced tillage. These interventions aim to strike a balance between maximizing carbon sequestration and maintaining agronomic viability. The project employs field sensors, laboratory analysis, and remote sensing techniques to assess changes in soil organic carbon, soil structure, mineral content and soil CO2 emissions. By validating these methods, CARBONICA seeks to bridge the gap between scientific research and on-the-ground agricultural practices, ensuring that sustainable solutions are both practical and scalable for olive farmers.

ID: 0120

ENVIRONMENTAL MONITORING AND RISK ASSESSMENT FOR SUSTAINABLE RC BRIDGE MANAGEMENT

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Keywords: RC Bridge Management, Environmental Monitoring, Risk Assessment, Genetic Algorithm, Geoinformatics.

Abstract: This paper presents a methodology for managing reinforced concrete (RC) bridges sustainably. It merges environmental monitoring, risk assessment, and genetic algorithm (GA) optimization to support informed decision-making in bridge management. Advanced tools such as remote sensing, IoT sensors, and geoinformatics enable real-time monitoring of environmental factors, including CO_2 and chloride (Cl^-) levels, which can significantly affect bridge integrity. GA principles are applied to design an optimization methodology that enhances bridge resilience and extends structural lifespan through strategic management practices.

This study highlights the expected benefits of this methodology, emphasizing its potential to reduce maintenance costs and improve safety outcomes. The integration of advanced monitoring technologies with intelligent optimization techniques provides a comprehensive framework for sustainable RC bridge management.

ID: 0121

ARTIFICIAL INTELLIGENCE AND EARTH OBSERVATION TOWARDS DISASTER RISK REDUCTION: THE AI-OBSERVER'S RESEARCH EXPLORATORY PROJECT

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Keywords: Artificial Intelligence, Earth Observation, Disaster Risk Reduction, Environmental Hazards

Abstract: With AI-OBSERVER project being currently in its last year, the efforts of ERATOSTHENES Centre of Excellence (CoE) are focused on the development of 6 risk assessment models for multi-hazard monitoring and assessment in Cyprus on i) Earthquakes, (ii) Landslides, (iii) Coastal erosion, (iv) Forest fires, (v) Floods and (vi) Marine Pollution. These will be developed by applying the enhanced skills and scientific background ERATOSTHENES CoE's researchers acquired on the application of advanced Artificial Intelligence (AI)-based techniques on Earth Observation (EO) and geospatial datasets, via the various capacity building activities carried out during the project by the advanced partners, i.e., the German Research Centre for Artificial Intelligence (DFKI) from Germany, and the University of Rome Tor Vergata (UNITOV) from Italy. As a first step, the end user/stakeholder requirements were collected through numerous meetings with stakeholders, such as the Cyprus Civil Defence, the Geological Survey Department, the Public Works Department, the Department of Forests, the Water Development Department, etc. Based on these recorded needs, ERATOSTHENES CoE collected the data required as input to the EO Big Data AI management platform, developed by CELLOCK Ltd, that will be used for the risk assessment of environmental

hazards, exploiting various data sources. Meteorological data, geological maps, Digital Elevation Models (DEM), historical data, inventories, risk maps, etc., collected from local stakeholders, will be used to feed the AI-EO risk assessment models. Moreover, satellite optical and Synthetic Aperture Radar (SAR) images, provided freely by Copernicus (Sentinels), and other European Space Agency (ESA) Third Party Missions (Planet) are also used for the monitoring and calculation of other hazard contributing factors (soil moisture, slope, vegetation, etc.). Finally, other EO-based thematic services, such as the CORINE LULC and the ESA WorldCover, Copernicus Services (EMS, LMS, etc.) and Thematic Exploitation Platforms (F-TEP, G-TEP, etc.) are used to retrieve valuable information regarding some of the environmental hazards' contributing factors. The risk assessment models will then be integrated into an EO Big Data AI management platform, leading to the development of the first ERATOSTHENES CoE product integrating EO and AI for Disaster Risk Reduction. A route to market strategy will also be formulated for the exploitation of the project's outputs and developed platform, and the results will be presented to an open to public workshop with the attendance of all end users/stakeholders, to maximise the project's visibility.

ID: 0122

SPATIO-TEMPORAL DIFFUSION MODEL FOR SATELLITE IMAGERY

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Keywords: Artificial Intelligence, Diffusion Models, Earth Observation, Generative AI, Satellite Imagery

Abstract: Generative AI models have proven exceptionally useful for learning representations of the real world and creating novel data. While earlier methods such as Generative Adversarial Networks achieved considerable success in image generation, they often struggle to produce coherent sequences of images over time. Recently, diffusion models have emerged as a powerful alternative, adept at handling time-sequenced image generation. Despite their success in creative domains like art, image editing, and filmmaking, their potential for Earth observation and satellite imaging remains largely unexplored.

Satellite images differ significantly from regular images and image sequences as they can be multi-spectral and irregularly sampled over time. Existing diffusion models trained on web-based imagery are not equipped to handle these unique characteristics. The aim of this work is therefore the use of open-source data from satellites such as the Landsat and Sentinel series to learn the progression of landscapes over time under various influences and predict their potential future appearances using a diffusion model. Such a model can be invaluable for visualizing the progression of deforestation, urban development, glacier melting driven by climate change, and coastal erosion from rising sea levels, based on prior spatio-temporal data.

In specific applications, multi-spectral images—captured using bands beyond the traditional RGB spectrum, such as Near-Infrared (NIR) and Short-Wave Infrared (SWIR)—are employed to deepen the understanding of landscape imagery. For instance, vegetation loss can be effectively detected by analyzing the NIR and Red bands. Given the limited availability of text-based captions for satellite images, we utilize associated metadata, including geolocation, year, month, and other relevant numerical data such as the Normalized Difference Vegetation Index (NDVI), to provide conditioning information for historical images.

Currently, our methods are very experimental, as the climatic effects are non-repeating and unpredictable, and underlying geological information or human intentions are not available. As numerical data extracted from satellite images can be incredibly valuable for further analysis, we aim to enhance the model's capabilities to accurately visualize temporal progression while also

generating numerical insights (e.g., area of vegetation loss due to fire or logging, land erosion due to rising sea levels and precipitation, etc).

ID: 0123

MULTI-SCALE EARTH OBSERVATION AND GEOSPATIAL ANALYSIS FOR SUSTAINABLE VINEYARD MANAGEMENT IN THE MEDITERRANEAN

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Keywords: Remote Sensing; Geographical Information Systems; Precision Agriculture; Multi-criteria decision support; Climate resilience

Abstract: Viticulture in the Mediterranean region faces challenges due to climate change, manifesting both in extreme weather events and disruptions to plants physiology, combined with a degradation of agroecosystems resulting from non-sustainable farming practices. Reducing CO_2 emissions and adopting regenerative agriculture are essential strategies for enhancing vineyard resilience, improving soil quality and preserving rural landscapes. Spatial analysis, utilizing Earth Observation (EO) data, supports smart and precision agriculture by enabling real-time monitoring, early stress detection, and thus optimized resource use. Through the integration of remote sensing, Geographical Information Systems (GIS), IoT and machine learning, complex data is processed, and key information is timely provided enabling adaptive vineyard management under shifting climatic conditions. This research presents the results of various projects in Greece related to geospatial analysis of EO data for sustainable vineyard management across spatial scales.

Delineating natural terroir units in wine regions using geoinformatics demonstrated the importance of spatial modelling in viticultural terroir for addressing major environmental challenges, specifically terroir sustainability and the implementation of appropriate management strategies to achieve high quality wines. Furthermore, the evaluation of terroir suitability for potential vine cultivation in new areas was achieved using geographic multi-criteria decision support systems. The spatial analysis of data collected through precision viticulture tools, enabled understanding of soil variation and other abiotic factors at the field level, facilitating the delineation of management zones for precision fertilization. Thus, by enhancing resource-use efficiency, precision fertilization contributes to lowering the carbon footprint of viticulture. At the plant level, the study on the evaluation of smartphone apps for estimating Leaf Area Index (LAI, an indicator of leaf density) to enhance canopy state assessment in vineyards, revealed that while these apps offer a viable alternative to costly equipment, standardization of optimal atmospheric and lighting conditions is necessary. These findings may support disease prediction models and improve the confidence in decision making.

Future directions of vineyard management should focus on adaptation to the evolving environmental conditions. Using EO-based indicators and geospatial analysis, future land suitability for viticulture could be assessed under climate change scenarios, while the implementation of regenerative agricultural practices could be monitored and evaluated in selected vineyards. These approaches could strengthen resilience, optimize resource use, and support long-term climate

adaptation strategies, supporting the sustainability of Mediterranean viticulture in a changing climate.

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ID: 0124

FOREST SPECIES CLASSIFICATION USING HYPERSPECTRAL IMAGERY IN A MEDITERRANEAN FIR-DOMINATED ECOSYSTEM

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Keywords: Forest Species Classification Using Hyperspectral Imagery in a Mediterranean Fir-Dominated Ecosystem

Abstract: Hyperspectral imagery (HSI) is increasingly recognized as a valuable tool for environmental monitoring and management, thanks to its rich spectral information that supports a wide range of applications. However, classifying forest species remains challenging due to the spectral similarities among species of the same clade. Despite the wealth of spectral data provided by HSI, processing and distinguishing meaningful features for classification remains computationally demanding. This study aims to improve forest species classification using hyperspectral CASI imagery by employing dimensionality reduction techniques, focusing on the Pertouli Forest in Greece. A suite of dimensionality methods, such as Principal Component Analysis (PCA) and Minimum Noise Fraction (MNF), were applied to reduce data complexity while retaining critical information. These techniques are essential to optimize computational efficiency and improve the robustness of machine learning classification models. The preliminary results suggest that dimensionality reduction techniques can enhance the overall accuracy of forest species classification compared to raw multispectral and hyperspectral data. The anticipated results are expected to provide deeper insights into the effectiveness of these methods for forest management and environmental monitoring applications.

ID: 0125

SPATIO-TEMPORAL DIFFUSION MODEL FOR SATELLITE IMAGERY

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Keywords: Forest Disturbances, Remote Sensing, Satellite Imagery, Sentinel-2, ASTER GDEM, Machine Learning, Deep Learning, Random Forest, Forest Management, Carpathian Mountains, Ukraine, Conservation, Deforestation, Classification.

Abstract: Carpathian forests face increasing threats from climate change (e.g., droughts, insect infestations) and human activities, particularly illegal logging. This study employs satellite remote sensing to monitor forest disturbances within Skole Beskids National Nature Park. We analyzed time-series data from Sentinel-2, ASTER Global Digital Elevation Model (GDEM2), and harmonized Landsat-Sentinel-2 (HLS) data. Machine learning algorithms (deep learning and Random Forest) classified land cover, effectively detecting spatial and temporal variations in forest disturbances. High-resolution Sentinel-2 imagery enabled precise identification of deforestation patterns, with AI-enhanced classification improving accuracy. Significant forest loss was identified, especially in areas with intensive logging, including military-owned forests. Our findings demonstrate the cost-effective potential of satellite-based approaches for forest monitoring and early disturbance detection, aiding forest management and combating illegal logging. Future research will focus on refining classification techniques and integrating additional environmental data to enhance accuracy and develop a robust operational framework for forest monitoring in the Ukrainian Carpathians. This will provide a scalable and efficient tool for conservation and policy enforcement.

ID: 0126

DETECTION COSEISMIC DISPLACEMENT THE REGION CYCLADES

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Keywords: detection co seismic displacement the region Cyclades

Abstract: Our research interest is focused on detecting ground displacements after an exceptionally large number of earthquakes occurred in the Cyclades region. Recorded as a swarm of earthquakes clustered in one place, most of which have a magnitude between 3 and 5, and the strongest was on February 5 with a magnitude of 5.2. In the case of active seismic regions, the analysis of InSAR ground deformation data provides a valuable tool for seismic risk assessment. In addition, InSAR data can be used to assess the consequences of the earthquake and its associated events, landslides, collapses, the area of destruction. Earth Displacement of the region Santorini are certain based InSAR time-series data from the S1A satellite of the European Space Agency. The SAR dates from ascending orbit 29 and descending orbit 129 was used. The results of the InSAR analysis in the line-of sight (LOS) direction of the satellite demonstrate displacement rates between masters and slave. SAR images spans the period January - February 2025.Tectonic structures in the region where the Santorini earthquakes occurred (Aegean plate), along with the location of the Kolumbo submarine volcano are significant feature in the area. The seismic activity that developed northeast of the island Santorini was analyzed, and its implications were evaluated based on the available SAR data (January 24- February 16, 2025).

ID: 0127

PREDICTING YIELDS OF ORGANIC EINKORN BY UTILIZING OPTICAL AND SAR REMOTE SENSING DATA FROM COPERNICUS SENTINEL 2 AND SENTINEL 1 SATELLITES

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Keywords: Einkorn, Yield, Sentinel-2, Sentinel-1, Organic farming

Abstract: This study studies statistical relationships between satellite observations and organic einkorn yields. The most appropriate phase for using Sentinel-2 optical data was identified, as well as the most appropriate vegetation indices. Given the SAR data, two approaches were considered: calculating the multitemporal average of time series of acquired SAR and estimating polarimetric descriptors from the complex data of a single SAR measurement. Due to the higher sensitivity to the geometric parameters of the crop, the analysis showed a good correlation of the SAR observations, and the most appropriate phase of organic einkorn was identified. Multitemporal observations show higher stability concerning single SAR acquisitions. However, polarimetric features proved valuable in simultaneous statistical and correlation analysis. The dual radar vegetation index (dRVI) correlated well with optical NDVI, as reported in a previous study, as well as with degree of polarization (DoP) and entropy. These SAR indices are considered good predictors or parameters of yield. It was noted that in the correlation analysis, the standard deviation demonstrated a better use of the statistical mean by applying the multitemporal SAR products. The SAR measurements with precipitation showed a better radar sensitivity to the crop's physical parameters. This is because the SAR observations coincided with the spring transition period, which is characterized by heavy precipitation and variable environmental conditions. Organic einkorn yield is best estimated by integrating both SAR and optical data, rather than relying solely on optical or radar observations.

ID: 0128

INSECT BIODIVERSITY ACROSS DIFFERENT VEGETATION TYPES OF THE AKAMAS PENINSULA, CYPRUS

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Keywords: Bees, biodiversity, Akamas peninsula, sampling methods, EU Pollinator Monitoring

Abstract: The Akamas peninsula is a Natura 2000 site (CY4000010) on the western tip of Cyprus, hosting important endemic and indigenous flora and fauna species. Insect biodiversity in the Akamas peninsula remains highly unexplored, even for species-rich groups. A year-long study was conducted to assess pollinator biodiversity of hoverflies (Diptera: Syrphidae), butterflies and moths (Lepidoptera) and bees (Hymenoptera: Apoidea) in four locations with different vegetation types: Pine forest, mixture of maquis and riparian tall shrubs, Juniperus mattoral, and phrygana. Twelve (12) sampling surveys were conducted at each location from June 2023 to June 2024, with a monthly sampling frequency. Four different sampling methods were utilised at each location: i) linear transect walks i.e. visually recording and sweep-netting pollinators along linear transects of 300 m, ii) pan traps (blue, white, and yellow), iii) Malaise traps, and iv) light traps. Insects were identified to the lowest possible taxonomic level. In total, 180,242 insects were collected and classified, including 15,253 butterflies and moths, 1,064 bees, and 633 hoverflies. Malaise traps captured the highest number of individuals (145,665). Butterflies and moths were collected mainly by Malaise and light traps. Among the four different vegetation types, the highest number of insects was sampled in the Pine forest, followed by the mixed maquis and riparian tall shrubs, Juniperus mattoral and phrygana. Current work focuses on characterising the specific landscape type composition at each sampling location using satellite data, and investigating its potential effect on insect biodiversity. This study represents an initial effort to address knowledge gaps in insect pollinator diversity in both the Akamas peninsula and Cyprus as a whole, with the aim of informing the methodological development and implementation of the EU Pollinator Monitoring scheme in Cyprus.

ID: 0129

UNLOCKING SOIL HEALTH: CARBON DETERMINATION IN AGRICULTURAL SOILS

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Keywords: Soil carbon, soil health, organic carbon, lithogenic base, Black-Walkley method, quality assurance.

Abstract: By accurately measuring organic carbon, the method helps farmers and soil scientists understand soil health, fertility, and the carbon sequestration potential of the soil. It is an essential tool in developing sustainable agricultural practices, such as managing organic amendments and crop rotations, to improve soil quality and mitigate soil degradation.

The cost-effective Black-Walkley method is a widely used and effective technique for determining organic carbon in agricultural soils. While it mainly targets organic carbon, it provides critical insights into soil health, helping distinguish the biological contributions of carbon. When used in conjunction with other mineralogical techniques, it can help identify the role of lithogenic (inorganic) carbon sources and further enhance soil health assessments.

The method helps to isolate and focus on organic carbon, but when combined with mineralogical analyses (such as clay content or other geological markers), it can contribute to a clearer understanding of how much of the soil's carbon comes from biological processes and how much is influenced by the underlying lithogenic or mineral sources.

If the soil contains a significant amount of lithogenic minerals, such as carbonates from parent rock, these can impact the overall carbon content. However, the Black-Walkley method primarily targets the organic fraction, and the effect of lithogenic sources would need to be accounted for separately in some cases. This method helps quantify the organic carbon in the soil, which is a key indicator of soil fertility and microbial activity. Organic carbon is a critical component for improving soil structure, water retention, and nutrient availability, all of which affect soil health. The Black-Walkley method does not directly measure lithogenic carbon (inorganic carbon from parent rock), but it is useful for estimating the organic fraction of carbon in the soil, which is influenced by both biological processes and geological sources.

Soil samples were collected from the Ovce pole region, (eastern part of the territory of North Macedonia), including the landfill with the carbon farming practice (pilot site) as well. The method validation was improved with QA protocol in accordance with the ISO/IEC 17025:2017. Accuracy, precision, LOD, LOQ, reproductivity, reputability, measurement uncertainty and working range were included for the quality insurance of the method. The data normalization has been introduced using log-normal transformation, for excluding the outliers. Data matrix has been improved with bivariate statistics of correlation matrix and multivariate extraction of dominant variables.

ID: 0130

FOSTERING INNOVATION AND ENTREPRENEURSHIP IN CULTURAL HERITAGE: A BUSINESS WORKSHOP FOR YOUNG RESEARCHERS IN CYPRUS

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Keywords: Cultural Heritage, Entrepreneurship in Cultural Heritage, Business Models for Cultural Heritage, ENGINEER

Abstract: Innovation and entrepreneurship serve as essential drivers for sustainable and lasting development in cultural heritage. With the continuous advancement of research into heritage sciences, such innovations are underexplored and inconsistently commercialized in the European markets, a pattern even more evident in the Cypriot context. This paper will present the outcome of a specialized business workshop organized under the ENGINEER project with aim of developing the entrepreneurial skills of young researchers and academics. Emphasis will be placed on the transforming scientific and cultural narratives into business ventures that potentially bridge the gap between research and market applications.

The European frameworks' (e.g. Horizon Europe) policies encourage and support knowledge valorisation—specifically in technology transfer and entrepreneurship, which encompasses cultural heritage. However, despite the presence of relevant policy frameworks, early-career researchers often lack the necessary skills and support systems to navigate the transition from research to commercialization.

Responding to this gap, the workshop's objectives were to educate and inform young researchers about business modelling, intellectual property (IP), funding opportunities, and market validation

techniques, all within the context of heritage sciences and cultural heritage. This activity will be followed by incorporating live case studies or mini-projects where participants can implement the concepts learned, such as developing a business model linked to a specific cultural asset. Participants will also be mentored through a series of activities by local and European entrepreneurs who have successfully transitioned from academia to entrepreneurship within cultural heritage. The guest speakers will share their personal journeys, challenges, risks, and best practices in building relevant start-ups considering the local (Cypriot) and European legislations.

The workshop will be structured to implement different trainings in knowledge transfer, networking, and policy discussions which cover European funding programs (e.g. Horizon Europe, Digital Europe, EIT Culture and Creativity), incubation programs (e.g. Cyprusinno, European Innovation Council (EIC)), and the role of public-private partnerships. Additional hands-on development will engage the participants in business model canvas exercises, the development of proof-of-concept pitches, and feedback from the invited experts and entrepreneurs.

By integrating aspects of research with the modern business practises, the workshop not only highlights the market potential of cultural and heritage innovation, but also encourages building on cultural narratives in a local Cypriot and wider European landscape. As an outcome, the participants will be more informed about several procedures including the start-up process, the development of preliminary business models for research-based heritage innovations (e.g. digital heritage solutions, conservation technologies), and to identify key challenges (e.g. regulatory barriers, limited seed funding, financial risks).

ID: 0131

COPERNICUS SERVICES APPLICATION IN PUBLIC HEALTHCARE MANAGEMENT

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Keywords: Copernicus services, data fusion, prevention, public healthcare, management

Abstract: This paper represents an approach of mixing of different types of data sets of Copernicus services – Atmosphere, Marine, Land, Security, Emergency and Climate change for prevention and decision making support in public health domain.

Set of developed Copernicus services data fusion use cases in QGIS environment are presented. The most important are use cases in urban area with respect to so called 'heat islands' and air quality in areas close situated to factories.

ID: 0132

ESTABLISHING A 9M S/X/KA BAND ANTENNA IN CYPRUS: A STRATEGIC LEAP IN EARTH OBSERVATION

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Keywords: Earth Observation, S/X/Ka Band Ground Station, Remote Sensing, Cyprus, Infrastructure Development

Abstract: The Eratosthenes Centre of Excellence, in collaboration with Cyta and with the technical support of DLR within the EU EXCELSIOR project, are establishing a 9m S/X/Ka band Earth Observation (EO) ground station in Cyprus. This initiative marks a significant advancement in the region's capability to support satellite tasking and control, data reception, and near real-time Earth

Observation applications. The antenna, hosted by Cyta, will serve as a key infrastructure for scientific research, environmental monitoring, security, and commercial applications, enhancing regional and international EO data accessibility.

A series of critical preparatory steps were undertaken to ensure the successful deployment and long-term operational efficiency of the ground station. The site selection process involved an in-depth assessment of environmental, geographical, and radio frequency (RF) conditions to identify an optimal location with minimal signal interference. A comprehensive frequency survey was conducted to ensure spectrum availability and mitigate potential conflicts with existing communication networks. Additionally, a detailed soil survey was carried out to assess the stability and suitability of the terrain, ensuring structural integrity and long-term resilience of the antenna infrastructure.

The ground station will be located at high-quality premises designed to meet stringent operational and security requirements, ensuring uninterrupted functionality in both routine and extreme conditions. The involvement of Cyta's experienced personnel, with extensive expertise in satellite communication and ground station operations, will further ensure efficient management, maintenance, and troubleshooting.

A dual-redundant fiber link will be implemented to guarantee high-speed, secure, and resilient data transmission between the ground station and downstream processing centers. This redundancy is essential for preventing data loss, ensuring high availability, and enabling seamless integration with international EO networks. Further plans include to host third party antennas at Cyta's premises, to enlarge the number of antenna systems for redundancy and multi-satellite acquisition and to explore optical transmission as an innovative and secure communication link.

This strategic initiative not only strengthens Cyprus's role as a regional hub for satellite data reception and dissemination but also fosters scientific collaborations, technology transfer, and industry partnerships. It enhances the region's capability to support missions related to climate monitoring, disaster response, maritime security, and environmental sustainability, aligning with global priorities in space and EO applications.

ID: 0133

EFFICIENT LEAKAGE MONITORING THROUGH REMOTE SENSING OF WATER PARAMETERS IN WATER DISTRIBUTION NETWORK OF NESTOS AREA

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Keywords: Remote Sensing, Water Leakage, Hydraulic Modelling, SCADA, Water Distribution Network

Abstract: The efficient management of water distribution networks is critical, particularly in regions where climate change exacerbates water resource challenges. The Nestos area in Greece, and specifically the town of Chrisoupoli, experiences significant water losses due to an outdated distribution network and fluctuating water demand driven by seasonal tourism. The Municipal Enterprise for Water (DEYA Nestou) has addressed these challenges by integrating advanced monitoring technologies, focusing on remote sensing to enhance water leakage management.

This study employs a remote sensing approach to monitor key water parameters, leveraging satellite and aerial imagery, coupled with in-situ sensors, to gather real-time data on water quality,

pressure, and flow rates across the distribution network. The integration of Supervisory Control and Data Acquisition (SCADA) systems with DHI MIKE+ hydraulic modelling software enables the analysis of remote sensing data to detect anomalies indicative of water leakages. By deploying 22 Local Monitoring Stations (LMS) equipped with remote sensors, the system captures essential hydrological parameters that are processed to generate actionable insights.

Non-invasive methods offer a significant advantage over traditional manual inspections, providing broader coverage and enhanced precision. The collected data feeds into a Digital Twin of the water network, allowing for dynamic simulations and predictive maintenance strategies. The adoption of smart metering and Automatic Meter Reading (AMR) systems further enhances the granularity of data, contributing to a substantial reduction in the 62% water loss previously recorded in the area.

The findings demonstrate the efficacy of remote sensing in combination with advanced modelling tools in mitigating water losses. The study underscores the potential of integrating remote sensing with existing SCADA and hydraulic modelling frameworks to create a robust, real-time leakage monitoring system. This approach not only aids in immediate leak detection but also supports long-term water resource management strategies.

By bridging advanced remote sensing technology with traditional hydraulic modelling, this research presents a scalable and replicable model for other municipalities facing similar challenges. The success of this initiative highlights the transformative impact of remote sensing in enhancing the sustainability and resilience of water distribution networks, setting a benchmark for future applications in smart water management systems.

ID: 0134

A QUASI-SYNCHRONOUS APPROACH FOR MONITORING RENEWABLE ENERGY SOURCES IN EASTERN BULGARIA

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Keywords: quasi-synchronous approach, LST, TCT, renewable energy sources

Abstract: The present study is a comparative analysis and application of a quasi-synchronous approach to several sites with areas occupied by renewable energy sources (solar panels and wind energy parks) based on satellite data and methods for monitoring heat pollution on the territory of Eastern Bulgaria. The study analyzed various spectral indices such as Tasseled cap transformation (TCT), Normalized Differential Greenness Index (NDGI), Land Surface Temperature (LST) and other satellite-based data from Sentinel 2 Multi-Spectral Instrument (MSI), Sentinel 3 SLSTR Level-2, Landsat 8 OLI / TIR and Mobile Thermal Camera to assess the state and dynamics of the territories.

The interest in the sites is due to the fact that a large part of the sites are located near the Black Sea resorts of Varna and Burgas, where a high consumption of electricity, severe drying of the territories, and high temperature amplitudes were also recorded for the period of the last five years (2019-2024).

The results showed high values of heat pollution and changes in moisture and vegetation around the sites, which necessitates urgent measures in order to effectively manage two of the largest cities around the Black Sea, where the main infrastructure of the tourist sites is also located.

RSCy2025 WORKSHOPS

1. **Annual workshop / Meeting of Mediterranean Regional Information Network (MedRIN) - NASA - Excelsior**

2. **Workshop for ReSENSE Project: Remote Sensing Technologies Training is an Erasmus+ funded VET project.**

3. **Annual Workshop on "Earth observation applications and services in the Eastern Mediterranean, Middle East, and North Africa (EMMENA)": Earth observation business opportunities**

4. **Workshop in Advancing Climate Action, Environmental Sustainability, and Food Security through Synergies**

5. **CAMS user intelligence and user interaction: Cyprus and Malta | CEOPS:Mapping Public Sector Needs & Opportunities with Earth Observation in Cyprus**

6. **CEOPS: Mapping Public Sector Needs & Opportunities with Earth Observation in Cyprus**

7. **Excelsior Workshop**
   "Building synergies among researchers, decision makers and first responders:
   From flood risk assessment to operational flood risk reduction services"

8. **Stakeholder Dialogue: Carbon Farming Practices in Agriculture Organized by CARBONICA Project**

9. **Artificial Intelligence applications in Earth Observation and Geoinformatics Organized by ENFIELD Project**

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