II. Natural Hazards and Climate Change Conference

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Biodegradable plastics: A growing concern for early plant development

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Plant growth and productivity are adversely affected by various biotic and abiotic environmental stressors. In addition to traditional stressors, plastic pollution is becoming an increasingly serious problem due to its long-term negative effects on plant growth and ecosystem health. The growing popularity of biodegradable plastics (BDPs) as a sustainable alternative to conventional polymers raises new questions about their environmental impact, in particular their effects on agricultural ecosystems.

This study investigated the effects of two types of BDPs, polylactic acid (PLA) and an agricultural mulch film composite, on the germination and early root development of 15 plant species from different taxonomic groups under in vitro conditions. During the experiments, we used plastic fragments of different sizes and concentrations (0.5-1%), simulating environmentally relevant plastic pollution. Our results show that different plant species and plastic types respond differently to the treatments, with PLA significantly inhibiting germination of monocots, especially sorghum (Sorghum bicolor L.), and reducing early root growth in radish (Raphanus sativus L.). The composite agricultural mulch film significantly reduced germination of radish and flax (Linum usitatissimum L.), while having minimal negative effects on sorghum root growth and even slightly stimulating root growth of white mustard (Sinapis alba L.).

The results indicate that BDPs cause stress to early plant development in several species, pointing to potential agricultural risks from BDP residues in the soil environment. Further research is needed to better understand their long-term effects, particularly on agricultural productivity and ecosystem health.

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Lateral channel migration and riverbank degradation: A natural process or environmental threat?

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Contemporary research on fluvial process involves a comprehensive examination of the increasingly complex interactions between natural forces and human activities. Riverbank erosion, as a component of lateral channel migration, is therefore characterized as a continuous and highly significant geomorphological process in floodplains. The lateral bank erosion of meandering rivers is responsible for extensive agricultural land loss and landscape degradation. The genesis, direction, and intensity of lateral river channel migration exert significant pressure on various environmental aspects—ecological, social, economic, and demographic. Environmental transformation is inevitable: bank degradation results in the loss of land along the concave side of the river, while, conversely, the accumulation of eroded material occurs on the convex sides. This paper aims to identify the main consequences of riverbank erosion and assess the intensity of this process on the environment. Accordingly, optimal measures and activities to mitigate these consequences are proposed. The South Morava River (Republic of Serbia) was used as a case study, where previous research has documented intensive lateral migration and riverbank erosion. The results indicate significant consequences, particularly in terms of agricultural land degradation, as well as secondary economic and financial impacts. These findings could serve as a foundation for further research in the field of riverbank erosion and environmental degradation.

Urbanisation effect on the butterfly communities of river dikes

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Linear landscape elements (LLE), such as roads, ditches, and dikes, often have a vegetated part, which can support species-rich flora and fauna. These LLEs are becoming increasingly important for biodiversity conservation in human-modified, fragmented landscapes. In Hungary, species-rich meadows have developed on the slopes of river dikes over the last few centuries. These dike slope meadows provide valuable habitats for many insect groups, including butterflies. We aimed to study how urbanisation affects the butterfly communities of river dikes in four cities. Butterfly species abundance data were collected by visual observation along 300 m long dike sections in the center and at the edge of the cities and along reference dike sections outside the cities. We found differences in the abundance and species richness of butterflies between the center, edge and reference only in the largest city. In addition, among the studied species traits, the voultanism and host plant specificity of the species were influenced by urbanisation. We suggest that dikes have a great potential for biodiversity conservation.

1500 Years of Flooding in Romania: Climatic and Anthropogenic Influences

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This study integrates documentary, instrumental, archaeological, and sedimentological data to reconstruct periods of increased flooding in present-day Romania over the past 1500 years. The findings indicate a rise in flood frequency during the Medieval Climate Anomaly and towards the end of the Little Ice Age.

To explore the potential causes of these flooding events, reconstructions of seasonal air temperature, precipitation levels, and atmospheric circulation patterns were analyzed using various proxy records (stable isotopes from cave ice and speleothems, tree-ring proxies, etc.). The most extensive floods occurred between AD 1050 and 1250, primarily affecting the extra-Carpathian regions, and were linked to the influx of humid Eastern Mediterranean air masses. There is no definitive evidence regarding flood magnitude during the Migration Period; however, the limited available fluvial data suggests a lower intensity compared to the Medieval Climate Anomaly.

Over the past 500 years, the most geomorphologically impactful floods took place between 1770-1800 and 1880-1920, affecting the entire study area. These events were associated with an unstable climate, marked by intensified westerly Atlantic circulation and frequent northward incursions of Eastern Mediterranean cyclones. Recent floods (1990-present) have been primarily driven by warm, humid air masses from the Eastern Mediterranean and the strengthening of westerly Atlantic circulation at the onset of the Little Ice Age (1460-1470 and 1490-1530). In addition to climatic influences, floods in the last 500 years also exhibit a significant anthropogenic component, which has become more pronounced in the past 250 years.

Evaluating Levee Stability: Simulating Flood Scenarios Using Time-Lapse ERT for Improved Risk Mitigation

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Aging levees, particularly those with limited or undocumented construction histories, pose an increasing flood risk due to their deteriorating structural integrity. Subsurface leakage pathways, often concealed and difficult to detect, exacerbate this risk by compromising levee stability during high-water events. Real-time characterization of these pathways under flood conditions remains challenging due to insufficient field data and the inherent complexity of levee systems. To address these challenges, this study employed electrical resistivity tomography (ERT), a non-invasive geophysical method, in a large-scale experimental setup simulating flood conditions on a 40-meter artificial levee section near Békés, Hungary. Conducted in summer 2023, the experiment utilized time-lapse ERT measurements to monitor the evolution of potential leakage pathways within heterogeneous fluvial soils under both dry and saturated conditions. Core samples were analyzed to determine key physical parameters such as grain size distribution, hydraulic conductivity, porosity, density, and water content for validation of ERT results.

Using integrated 2D and 3D inversion techniques, the study successfully identified critical leakage zones, particularly where resistivity values dropped below 10 Ω·m, indicating saturated materials associated with water infiltration. Notably, three preferential water passage zones were detected along the levee crest and protected side, with water migrating laterally and toward the protected area. These findings highlight areas of significant concern for levee stability and provide insights into subsurface processes that compromise structural integrity.

This research demonstrates the potential of time-lapse ERT as a powerful tool for periodic levee health assessments. By simulating flood conditions and mapping subsurface vulnerabilities, this approach enhances understanding of levee behavior under stress, supporting safer and more efficient flood risk management strategies. The method facilitates data-driven decision-making, enabling improved protection of vulnerable areas through routine monitoring and targeted interventions.

Statistics on the frequency of rain and snow-rain floods on rivers of the Tisza basin within of Ukraine

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The purpose of the study is to conduct a detailed statistical analysis of the frequency of rain and snow-rain floods on the rivers of the Tisza River basin within Ukraine, which is the most humid and one of the most flood-prone. Floods occur here quite often throughout the year. The main factors of this are orographic (mountains and foothills of the Ukrainian Carpathians) and meteorological (characteristic long periods of precipitation of varying intensity).

The data for the observation period of 1946-2019 from the following hydrometric station were used: the Tysa River – Rakhov, the Rika River – Mezhhirya and the Latoritsa River – Mukachevo. At the first stage, the statistics of flood frequency were calculated using series of annual maximum discharges of rain floods for the warm period of the year and snow-rain floods for the cold period. At the second stage, a more complex statistical analysis was carried out, namely, the partial duration series. Such series are used to calculate the statistics of flood frequency for all values. In this case, the main criterion is the selection of peak values that exceed a certain threshold, which corresponds to the lowest value from the series of maximum discharges, in our case for the warm and cold periods of the year. The partial duration series have a larger number of members than series of maximum annual flood. They best describe minor floods with less than a 1–year return period. The flood frequency period is calculated using the inverse of the Weibull probability formula.

The conducted study allowed to estimate the probable values of floods in the Tisza River basin, which can form during a certain period of time and to estimate their recurrence. Practical interest - knowledge about potential floods can be used to assess the nature of such possible floods in the future.

Improving wind hazard assessment using high-resolution numerical weather prediction models and interpolation techniques in Hungary

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Extreme wind gusts are among the most impactful meteorological hazards in Hungary, frequently linked to frontal systems, cyclones, or convective storms. At the Hungarian Meteorological Service (HungaroMet), wind field maps used to assess wind-related damage are currently based solely on observed daily maximum wind gusts. To improve the spatial accuracy and objectivity of these maps, we investigate the integration of numerical model data as background information into the interpolation process.

This study focuses on the refinement of wind gust interpolation using the MISH (Meteorological Interpolation based on Surface Homogenized Data) method, which was developed for climatological and operational purposes. We incorporated surface observations along with background wind fields from high-resolution numerical weather predictions. The impact of two kinds of background information was investigated: AROME and AROME-RUC forecasts running at 2.5 and 1.3 km horizontal resolution, respectively. A series of case studies from 2024 and 2025 were selected, representing a wild range of meteorological conditions, including Mediterranean cyclones, cold fronts, and localized convective events.

The results show that both models correlate well with observations (with correlation values mostly between 0.8 and 0.9), while the AROME-RUC model, due to its finer spatial resolution and other developments, better captures spatial variability and peak gust values. However, localized convective wind events remain challenging to interpolate accurately, regardless of the model background.

Our findings highlight the potential of combining MISH interpolation with high-resolution model fields to enhance the representation of wind-related hazards. This approach contributes to the development of an automated wind hazard mapping framework that supports risk management, disaster risk reduction, and climate resilience strategies in a changing climate.

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Natural Hazards and Society in Croatia: Impacts and Public Health Interventions

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Croatia has faced significant natural hazards over the past decade, including earthquakes, floods, droughts, and wildfires. These events have caused widespread societal disruption, economic losses, and public health challenges, exacerbated by climate change. The country's geographical location and geological characteristics make it vulnerable to these hazards.

The aim of this study is to analyze the societal and public health impacts of natural hazards in Croatia from 2015 to 2025, identify gaps in disaster preparedness, and propose evidence-based public health interventions to enhance resilience.

The 2020 Zagreb earthquake caused extensive damage to healthcare facilities, schools, and residential buildings. Similarly, the Sisak-Moslavina earthquake displaced thousands and required large-scale humanitarian responses. These events highlighted gaps in structural resilience and emergency preparedness. Frequent flooding events disrupted livelihoods and caused significant agricultural losses. For example, floods in May 2023 affected multiple counties, leading to casualties and economic damages. Droughts in 2011–2012 caused over €600 million in agricultural losses. Rising temperatures have increased water scarcity risks. Coastal wildfires during the summer of 2022 burned over 30,000 hectares, endangering communities and ecosystems.

Public health interventions have included mental health support for disaster survivors, improved emergency healthcare systems, early warning systems for floods and wildfires, and vaccination campaigns to prevent disease outbreaks post-disaster. However, challenges remain in integrating these measures into a cohesive national framework.

Natural hazards have had profound societal impacts in Croatia over the past decade. While progress has been made in disaster risk management through national programs and international cooperation, significant gaps remain in long-term planning and public health preparedness. Strengthening infrastructure resilience, enhancing community-based disaster education programs, and integrating mental health services into disaster response plans are critical steps toward reducing vulnerability. Adopting a proactive approach aligned with global frameworks will be essential for safeguarding Croatia's future against natural hazards.

Investigating Mortality Trends in a Warming Climate with a special focus on urban population in Asia

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Climate change poses escalating health risks, particularly in urban environments where the urban heat island (UHI) effect intensifies summer temperature extremes. This study investigates the relationship between rising temperatures and mortality trends across various Asian cities over the past 40 years. By integrating climate data analysis with socio-economic and demographic variables, we assess the extent to which temperature variations influence mortality rates, particularly among vulnerable populations.

The research employs statistical and geospatial modeling to evaluate changes in heatwave frequency, intensity, and duration and their disproportionate effects on different socio-economic groups. Key factors such as population density, and adaptive capacity are examined to determine their role in exacerbating or mitigating heat-related health risks. Our preliminary findings highlight that urban areas undergoing rapid expansion and inadequate climate adaptation measures exhibit significantly higher mortality rates during extreme heat events.

This study underscores the urgent need for climate-resilient urban planning, targeted public health policies, and enhanced early-warning systems to minimize heatwave-induced fatalities. By providing a comprehensive analysis of climate-driven health risks, our research offers critical insights for policymakers, urban planners, and meteorologists seeking to develop sustainable adaptation strategies.

The influence of small canopy gaps and previous logging on understorey plant communities in topographic depressions

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Topographic depressions in karst landscapes (dolines) may act as microrefugia for biodiversity during anthropogenic climate change. They provide stable microclimatic conditions that are decoupled from the regional climate. However, their refugial capacity (i.e. their capacity to buffer against changes in the macroclimate) may be influenced by natural (e.g., formation of small canopy gaps) and/or anthropogenic (e.g., previous logging) disturbances. Here we studied the effects of forest age and the presence of small canopy gaps (50–200 m^2) on various environmental factors, as well as on the species composition of understorey plant communities in 12 dolines and on the surrounding plateau in the Mecsek Mountains, Hungary. We classified dolines into three types based on their canopy structure and previous forest management activities: 1) dolines covered by older forests (>80 years) with small canopy gap at the bottom, 2) dolines covered by older forests (>80 years) with closed canopy, and 3) dolines covered by younger forests (~50 years) with closed canopy. We found that all habitat types differed in most of the environmental variables studied and harboured distinct plant communities. For instance, the plateau was warmer, drier and had less resource-rich soils than the other habitats, while dolines with canopy gap were relatively cool and had the highest soil moisture levels. We identified 25 indicator plant species for the habitat types (e.g., Melica uniflora for the plateau, Chrysosplenium alternifolium for dolines with canopy gap, while no indicator species were found for dolines covered by younger forests). We can conclude that both natural and anthropogenic disturbances may have a strong impact on the vegetation in dolines, as forest age and the presence of canopy gaps influence the light regime, air temperature, soil characteristics, and plant species composition, thereby affecting their capacity to provide microrefugia for biodiversity.

Effects of natural and anthropogenic disturbances on microrefugia: the soil microbiota of dolines

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Dolines (local depressions in karst landscapes) serve as microrefugia for certain species during climate changes. However, there is limited information on the factors influencing the refugial capacity of dolines (i.e., their ability to decouple local microclimate from regional climate changes). In our study, we analyzed the impact of treefall gaps and previous logging as examples of natural and anthropogenic disturbances on the refugial capacity of dolines (Mecsek Mts, Hungary) by studying the patterns of soil microbiota, a previously understudied but biogeochemically important group of organisms in European karst depressions. We aimed to answer how previous logging and the presence of natural treefall gaps influence abiotic factors in dolines, and through these factors, the composition of soil microbiota, and how these parameters differ between dolines and the surrounding plateau. We studied the following doline types: dolines covered by mature forest (>80 years) with a canopy gap, dolines covered by mature forest (>80 years) with a closed canopy, and dolines covered by younger forest (50 years) with a closed canopy. We studied the following parameters at each site: air temperature, air humidity, soil moisture, soil nutrient content, pH, amount of deadwood, and canopy cover. We applied metagenomic analysis to taxonomically characterize the soil microbiota at each location. According to our results, the studied natural and anthropogenic disturbances have a significant effect on the local microclimate, the soil, and consequently, the patterns of soil microbiota. The composition of soil microbiota in dolines showed significant differences from that of the plateau, while no differences were found among the doline types. The distinct communities were distributed along sharp environmental gradients. Our study contributes to a better understanding of the refugial capacity of dolines, supporting the development of appropriate conservation measures and management strategies.

Advancing soil erosion mapping with Machine Learning: A comparative performance assessment

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This study integrates field investigations, remote sensing data, and advanced machine learning techniques including Random Forest, XGBoost, CatBoost, and LightGBM to model soil erosion in the loess-covered regions of Uri and Mende, Hungary. The primary objective is to evaluate the performance of these algorithms and identify the most influential geo-environmental factors using the Shapley Additive Explanation (SHAP) method, an emerging approach for model interpretability. A total of 13 key factors, including slope, aspect, elevation, lithology, NDVI, land use/land cover, plan curvature, profile curvature, topographic position index (TPI), topographic wetness index (TWI), stream power index (SPI), and distances from roads and streams, were selected for analysis. A dataset comprising 1000 points (500 erosion and 500 non-erosion) was used to develop a soil erosion inventory map. The dataset was randomly split into 70% for model training and 30% for validation. Prior to model implementation, multicollinearity and correlation analyses were conducted to detect and address collinearity issues, ensuring the statistical robustness of selected variables. The predictive performance of the machine learning models was assessed using 10-fold cross-validation, with key evaluation metrics including Root Mean Squared Error (RMSE), Mean Absolute Error (MAE), the Kappa coefficient, overall accuracy, and the Area Under the Receiver Operating Characteristic Curve (AUROC). Additionally, SHAP summary plots were generated to interpret the contribution of each geo-environmental factor across all models. By systematically comparing multiple machine learning approaches, this research enhances our understanding of soil erosion dynamics and offers a data-driven framework for improving erosion risk assessment. Identifying the most accurate model not only improves soil erosion prediction but also provides a benchmark for future studies, guiding researchers toward more reliable methodologies. Moreover, SHAP-based interpretation ensures transparency in machine learning applications, making these models more accessible and applicable in real-world environmental management. The findings may have significant implications for land management and soil conservation strategies, aiding policymakers and environmental planners in developing more effective mitigation measures.

Geospatial and Geomorphometric Analysis on Landslides based on UAV Remote Sensing and GIS – Case from the Crnik Landslide in North Macedonia

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This study presents a detailed geomorphometric and geospatial analysis of the Crnik landslide, the largest within the Crnička Reka catchment, North Macedonia, using high-resolution UAV-based surveys (0.1 m). The research evaluates the landslide's morphometric parameters, including volume, elevation changes, slope, aspect, and terrain ruggedness index (TRI). High-precision drones captured aerial imagery, which was processed using Agisoft Metashape to generate high-resolution DEMs for 2018 and 2024. A comparative analysis of these DEMs revealed minimal elevation differences, with mean values of 817.3 m in 2018 and 817.4 m in 2024, alongside localized variations ranging from -3 m (erosion) to +7.3 m (deposition). Erosion affected 31.8% of the landslide area, while 21% exhibited deposition, with an estimated total displaced material volume of 8,512.7 m^3 over 0.48 km^2. Slope analysis indicated predominantly moderate slopes (10–20°) covering 36.6% of the area, while aspect analysis revealed a dominance of north- (48.2%) and east-facing (42.0%) slopes, influencing slope stability. The TRI values ranged from 0 to 7.5 m^3/m^2, with 51.3% of the landslide area characterized by low ruggedness. UAV-derived models were validated using a 1-m LiDAR-based DTM from 2020, field surveys, and the Landslide Susceptibility Index (LSI). The LSI analysis confirmed that the Crnik landslide is within a very high susceptibility zone, highlighting its ongoing geomorphic activity and significant hazard potential. This study underscores the effectiveness of UAV-based DEMs in landslide monitoring by providing high-resolution spatial and temporal data critical for assessing slope stability and terrain dynamics.

Geospatial Modeling of Landslide and Wildfire Susceptibility Using GIS and Remote Sensing Data in Djerdap UNESCO Global Geopark, Serbia

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Landslides and wildfires are frequent natural disasters that cause major ecological, material, and human losses worldwide. Identifying vulnerable areas within protected areas is crucial for adopting adequate measures to protect the environment. The Djerdap Global Geopark is the first and only protected area of this type in Serbia. Due to its rich geodiversity and other natural and cultural values, in 2020, Djerdap received the international designation of a Global Geopark from UNESCO for an area of up to 1,330 km^2. In order to establish adequate geopark management measures, one of the main tasks is to identify locations vulnerable to wildfires and landslides. The study used geographic information systems and remote sensing to analyze eight natural and anthropogenic conditions for assessing the spatial distribution of landslides and nine criteria for spatial modeling of wildfires. Both natural and anthropogenic factors were analyzed: geological, geomorphological, climatological, hydrological, biogeographical, and distance from the settlements and roads. The results showed that 99.96 km2 of the area is highly susceptible to landslides, while 12 km^2 is very highly susceptible. Regarding wildfires, 268.18 km^2 of the area is designated as highly susceptible, while 30.23 km^2 of the Djerdap Global Geopark is very highly susceptible. Synthesis maps of landslide and wildfire hazards can be useful for decision-makers, protected area managers, spatial planners, and emergency management services in implementing landslide and wildfire protection measures. The study represents an integration of advanced remote sensing techniques and interdisciplinary research, offering a deeper insight into the natural hazard under investigation.

Landscape changes and remediation in illegal landfill near Sombor, Serbia (2015-2025): Environmental hazards and recovery

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Illegal waste disposal has become a growing issue in many developing countries, including Serbia. Such waste often contains hazardous materials that can lead to environmental disasters, such as glass bottles contributing to fires, plastics releasing microplastics into the surrounding environment, and construction debris causing air pollution. Monitoring these sites with remote sensing technology provides critical insights for disaster prevention. However, despite preventive efforts, disasters still occur, such as the landfill fire in Sombor, Serbia, during the summer of 2024.

Previously used as the main waste disposal site for the city of Sombor until 1990, this area was closed due to urban expansion toward the southeast. Despite its closure, the site has continued to receive illegal waste, including household trash and construction debris. In 2024, extreme temperatures and intense solar radiation ignited nearby vegetation, leading to a fire that burned a significant portion of the landfill and caused minor damage to nearby homes. Remote sensing methods, including drone and satellite imagery, offer valuable tools for tracking illegal waste and assessing disaster risks.

In this study, a DJI Mini 2 rotary drone was used to capture imagery of the landfill a few days after the fire. This data was compared to Serbian orthomosaics from 2015 and 2016 to analyze landscape changes. A follow-up survey was conducted in spring 2025 to assess vegetation recovery. The final results present comparative analyses of land use, including vegetation, waste, built-up areas, and burnt areas (2024) across the study periods.

Small canopy gaps increase the refugial capacity of karstic microrefugia in the face of anthropogenic climate change

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Topographic complexity plays a significant role in shaping local microclimates. Specific landforms, such as dolines, can maintain stable climatic conditions that offer safe havens for species during regional climatic changes. Canopy cover can also buffer regional trends and climatic extremes. However, canopy cover is not always continuous, as gaps of varying sizes may form due to both natural and anthropogenic disturbances. While research on the individual effects of topographic position and canopy gaps on local microclimates and vegetation patterns has expanded, knowledge of their combined effects remains limited. In this study, we compared four habitat types based on their environmental factors, trait composition, and the species and functional diversity of understory plant communities: (1) doline bottoms with a closed canopy, (2) doline bottoms with small canopy gaps, (3) plateaus with a closed canopy, and (4) plateaus with small canopy gaps. We found that topographic complexity and small canopy gaps significantly affect vegetation patterns and functionality in karst areas, supporting both taxonomic and functional diversity. Small canopy gaps played distinct roles across different habitats. In doline bottoms, for instance, they preserved species and functional traits that were rare or absent in other habitats, thereby increasing their refugial capacity. On the plateaus, however, small canopy gaps contributed to the natural forest dynamics and facilitated forest renewal. Based on our findings, the creation of small artificial canopy gaps in doline bottoms with closed canopy cover may be beneficial and could potentially contribute to the conservation of species and traits vulnerable to anthropogenic climate change.

Natural multihazards analysis in Hungary

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Due to the interrelationships of natural hazards, they often do not occur in isolation. They may be interconnected, if only in the sense that they appear at the same time and in the same space. In other words, they are not causally related, and their simultaneous occurrence is called compounded hazards. If the hazards are causally related, then the concept of multihazard is used, where the primary natural hazard and the secondary natural hazard can be identified. This series may continue, additional hazards may appear and human impacts are not yet included in the series (e.g. extra rainfall - flash floods - soil degradation - landslides). The triggering effect is not necessarily a natural hazard. The effects of interconnected hazards may be amplified, and methods are known to measure and mitigate this, but these require the precise definition of the connection of the systems. The methods for this are usually divided into three large groups: hazard matrices, hazard cascades (where one hazard triggers and amplifies the next) and cumulative (compound effect) networks of hazards. In the case of Hungary, the hazard matrix presents eight interconnected hazards. It indicates the triggered secondary hazards in color, and their mostly quantitative, statistically based changes in the frequency of occurrence.

Macroeconomic challenges of climate change and the contribution of the circular economy to community resilience to natural disasters

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Climate changes are inevitable today, and they will significantly affect the economies of all countries at the global level. Natural disasters and climate change increasingly condition migration and threaten to permanently threaten the well-being of both current and future generations. The global aspiration towards sustainability, which means meeting the needs of current generations without endangering future generations to meet their needs, is increasingly difficult to achieve with global climate changes and potential negative effects. The consequences of climate change are visible both at the macroeconomic and microeconomic levels, which is reflected in the impact of catastrophic events on the slowdown of economic activity and the impossibility of achieving long-term economic sustainability. The increasingly obvious climate changes are influenced by the industrial revolution, but also by everyday human activities, whereby the consequences of the human factor are increasingly unfavorable for life on planet Earth.

The paper presents the results of research conducted by the authors on a sample of 65 respondents from Serbia on the perception of natural disasters and climate change. The results of the survey show that the respondents are familiar with the concept of climate change and its consequences, and that more than half of the respondents assess the economic consequences of natural disasters in your country as very serious. When it comes to the circular economy, more than ¾ of the respondents are familiar with the concept of the circular economy and more than half of the respondents believe that the implementation of the circular economy can contribute to increasing the community's resistance to natural disasters. The study highlights the importance of circular economy education and the contribution of the implementation of circular economy principles to the economy's resilience to climate change.

Natural disaster beyond media barricades? Online news coverage on the 2022 drought in Hungary

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A severe drought impacted Europe in 2022, leading to water shortages and significant agricultural crop losses in several countries, including Hungary. Previous research indicated that media outlets' political or ideological orientation can shape the portrayal of climate change and related environmental issues. To examine this phenomenon in Hungary, we performed a quantitative content analysis on 200 articles discussing the Hungarian drought, evenly representing three pro-government and three independent online news portals, to identify and classify frames, tones, information sources, themes, and images to uncover the key differences between the two samples. Our findings reveal that Hungarian media, similarly to many other countries, is polarized on environmental issues, with right-wing populism influencing this polarization.

Prospects of social action - Possible legal framework in avoiding climate change crisis

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The presentation aims to designate the threats of climate change to society, and outline frameworks within which the predictable disturbances can be addressed on social and political level. Human-activities interfere in the ecosystem which have direct (immediate) effects on the environment, i.e., they either damage the environment or at least disrupt the ecosystem insomuch as we humans depend on it. Indirectly, the modern, large scale human interruption of the ecosystem indirectly causes social effects as well. The paper focuses on the shifts and changes in interhuman relations. How can we tackle the looming danger of climate change to our society? I approach the crisis-prevention in two steps which both refer to two levels we have to address: climate change mitigation and social-crisis prevention. For the first step, I explore what the political conditions, ramifications, and possibilities are. Democratic formations are indispensable, but only with underlying principles as conditions, e.g., survival precedes economic growth. Secondably, does any legal framework exist to manage the question and if so, what can it offer? The current climate change differs from the cyclic changes, furthermore, the system which facilitated the events developed along a new society. Global warming must be interpreted and addressed within international setting. Human rights are often explained through three generations, where the third group consists the international or solidarity rights. The human right for a healthy environment connects countries on multiple level because it is not only their moral duty to help others, it is also their interest to prevent climate induced crises.

DIRECTED Project: Enhancing Disaster Resilience in Europe

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The DIRECTED project aims to reduce the vulnerability of European societies to extreme weather events and foster disaster resilience. To achieve this, the project focuses on improving interoperability in data, models, communication, and governance among stakeholders in disaster risk management and climate adaptation. By bridging sectoral and disciplinary gaps, DIRECTED seeks to create a more integrated and efficient approach to multi-hazard risk governance.

The project establishes four Real-World Labs in Europe: Rhein-Erft District (Germany), the Capital Region of Denmark, Emilia-Romagna (Italy), and the Danube Region. In these living labs, local stakeholders and project partners collaboratively assess and refine existing disaster risk management workflows and governance structures. The outcome is the RISK-TANDEM framework, a transdisciplinary governance approach that enhances risk assessment, management, and communication for climate-related hazards.

A key innovation of the project is the development of an integrated Data Fabric, which connects existing datasets and models into a unified system. This structure strengthens synergies between disaster data and climate services, providing decision-makers and practitioners with actionable insights for proactive risk reduction.

Moreover, DIRECTED enhances communication between technical experts, policymakers, and various sectors, fostering multi-level governance and cross-scale synergies. The project promotes multi-hazard thinking, capacity-building, and the establishment of long-term partnerships that endure beyond its completion.

By addressing fragmentation in risk governance and improving knowledge-sharing mechanisms, DIRECTED contributes to a more resilient, adaptive, and well-connected European disaster management system.

Investigation of the relationship between solar activity, natural hazards and human mobility: Evidence from the Balkans

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Solar activity, as the main feature of the Sun, determines the changes in the solar-terrestrial environment and affects technologies, nature, humans and their activities on earth. The aim of this paper is to investigate the complex relationship between solar activity, natural hazards and human mobility in the Balkan Peninsula in the period 2008-2023. The primarily hypothesis of this study is that all processes in the solar-terrestrial environment are interconnected and that the change of one element in this system influences the changes of another element. In this regard, special emphasis is placed on the study of the characteristics of environmental migration as a phenomenon triggered by natural hazards, and possibly related to solar activity. The methodological framework includes data on Solar cycle 24 and Solar cycle 25 (current cycle) and environmental migration, as well as the application of statistical methods based on correlation procedures. The research results indicate intertwined connections among the mentioned categories, and revealed a statistically significant correlation between the number of sunspots (as indicator of solar activity) and internal displacements caused by weather-related hazards in the Balkans during the observed period. The paper offers insights into a new transdisciplinary field in which human mobility patterns have not yet been incorporated into the understanding of the Sun-Earth system, and provides guidelines for future research on this issue.

AI-Driven Geoinformatics Solutions for Precision Agriculture in a Climate-Stressed Region

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Climate change has intensified weather extremes, posing major challenges to agriculture in climate-stressed regions. To meet increasing demands for food production while complying with stricter environmental regulations, farmers must adopt more sustainable and efficient practices. Precision agriculture, supported by AI-driven geoinformatics, offers promising solutions. It enables optimized use of resource, such as water, fertilizers, and pesticides by leveraging high-resolution spatial data and machine learning to inform decision-making.

We have developed a methodology to estimate plant counts over large areas using a combination of drone and satellite imagery. Multispectral drone data with centimeter spatial resolution is used to train a convolutional neural network for segmentation of individual plants on several sample areas of a few hectares in size. The resulting plant counts then are correlated with OSAVI or LCI vegetation indices derived from same-day Sentinel-2 satellite imagery, enabling extrapolation of plant density across areas of several 100s of hectares.

The methodology was tested in two study sites on the Great Hungarian Plain, a region highly vulnerable to climate change. The first area is a biomass crop field of Virginia mallow and the second is an irrigated corn field. The resulting plant counts help farmers to avoid over- or underapplication of agricultural inputs, saving costs and reducing environmental impact. Early plant density is also an important variable in estimating potential yield, which allows farmers to plan sales, storage, and logistics more effectively.

Hydrologic and hydraulic analysis of the 2005 flood on the Bârzava River and its impact on hydrotechnical infrastructure

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This paper explores the effects of flooding caused by the damage and/or failure of hydraulic structures. The volumes and flow rates resulting from such incidents are considerably higher than those associated with natural floods, which can have catastrophic environmental impacts. Understanding the factors and parameters that lead to flooding is essential for effectively controlling and mitigating this phenomenon. The first section of the paper analyzes the rainfall-runoff relationship in the Bârzava hydrographic basin using the HEC-HMS software. Calibration is performed using observed and measured flow rates from 2005, provided by ABA Banat. Model validation is deemed satisfactory based on correlation values, RMSE, and Nash criteria. Following this, flood-prone areas are identified based on flow rates with different exceedance probabilities. Additionally, the integration of HEC-RAS and GIS analysis is employed to create a flood map for the selected basin, considering floods with various return periods. The flood risk assessment aims to examine the consequences of flooding and identify potential weaknesses in existing flood control measures, with the goal of enhancing future strategies for mitigating flash floods and reducing their harmful effects.