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BOOK OF ABSTRACTS

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Proceedings of the 40th Romanian National Symposium on Geomorphology

Exposure of Energy and Extractive Infrastructure to Concentrated Runoff in the Berbești-Alunu Area

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The study titled "Exposure of Energy and Extractive Infrastructure to Concentrated Runoff in the Berbești-Alunu Area" analyzes the vulnerability of this *infrastructure* with respect to the potential for concentrated runoff, generated by the interaction between geomorphological and climatic conditions. The relevance of the topic stems from the fact that this infrastructure is of national interest, while global warming intensifies torrentiality, increasing the risks to which it is exposed. The aim of the research is to identify how geomorphological factors *(TWI*, SPI, *slope*, profile and plan curvature, relief energy) and climatic factors (CHIRPS precipitation, ERA5-Land potential evapotranspiration, RX1 and RX5 indices) generate runoff potential, and to what extent the infrastructure is affected, taking into account its location as well. The methodology was based on processing a digital elevation model to derive geomorphological parameters, with relief energy calculated as the maximum-minimum difference using Spatial Tables. All rasters were reclassified into three classes, in order to correspond to the climatic classes, and subsequently integrated into a Fishnet grid, which allowed for a simplified overview of risk distribution. Infrastructure vectors (power poles and power lines) were extracted from QGIS - QuickMapServices, while point features (tailings dumps, *mines*, transformer station) were generated from coordinates taken from *Google Earth*. Comparison of the CHIRPS and ERA5-Land climatic datasets reveals a 75% overlap, with differences attributed to the different spatial resolution of the two sources. The results indicate that geomorphological risk exceeds climatic risk, with the dominant class being low runoff risk, only 8% of the area showing high risk, and the infrastructure intersecting concentrated runoff zones at only six points. Spatially, most infrastructure objectives are located in low-risk cells, suggesting that, overall, direct exposure to concentrated runoff is limited. Some of these are found in moderate-risk cells, and the main concentrated runoff path, derived from the binary *SPI* raster, passes in close proximity to several infrastructure points in the central part of the area. This localized overlap shows that, although the overall risk across the entire area is low, infrastructure placement is not entirely independent of the geomorphological configuration of the slopes, and runoff convergence zones may represent critical points, where even a moderate intensity of concentrated runoff could affect the stability or functioning of nearby infrastructure elements. Risk should therefore not be interpreted uniformly across the entire area, but rather differentiated spatially, with increased attention given to the identified intersection points, which could constitute priorities for future monitoring or infrastructure protection measures.

KEYWORDS : slope, SPI, Runoff, mines, infrastructure

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Coastal erosion in marine protected areas: a global assessment of shoreline retreat rates and their economic consequences

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Shorelines within marine protected areas (MPAs) are highly dynamic geomorphological systems driven by continuous physical processes. This study shows a global assessment of shoreline dynamics inside MPAs, combining satellite-derived rates of change with habitat-specific ecosystem-service values at 100-m transect resolution. Of the 6,855 MPAs listed in the WDPA, 5,205 (75.9%) intersect the global shoreline and 2,298 consist predominantly of sandy or muddy substrates (>75%); of these, 1,969 (29% of all MPAs) show measurable dynamics, comprising 858,541 transects. Accretional regimes prevail numerically (1,142 MPAs, 58%), while 827 (42%) are erosion-dominated, retreating at a median rate of 0.71 m yr^{-1}. Severe erosion clusters along the Gulf of Mexico and Central America, in Southeast Asia, around the Mozambique Channel and across the Mediterranean. Converting shoreline retreat into lost ecosystem-service value shows that the economic signal does not follow eroded area: neritic habitats and seagrass meadows generate a cost disproportionate to the surface they lose, whereas intertidal flats lose comparable areas but contribute far less. Normalized per kilometre of shoreline, loss intensity shows no gradient with national development (medians comparable across HDI quintiles): the geomorphological process operates independently of economic context, and what differs is the capacity to respond.

KEYWORDS: coastal erosion; marine protected areas; satellite-derived shorelines; ecosystem services; shoreline change rates

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Environmental and landscape transformations induced by lignite mining: Case study of Oltenia Region (Romania)

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The transition of landscapes shaped by intensive resource extraction represents a major challenge at the intersection of geomorphology, environmental sciences, society and technology. Mining activities contribute to soil degradation, slope instability, landslides, subsidence and the fragmentation of natural and agricultural landscapes. At the same time, the decline and closure of some mining operations have created new landscapes in transition, where ecological reconstruction, land reclamation and the reintroduction of degraded areas into productive or multifunctional uses become essential. This study investigates the environmental and landscape transformations associated with lignite mining in Oltenia, SW Romania. The research focuses on five major mining basins - Mehedinți, Motru, Jilț, Rovinari, and Berbești - and examines the spatial and temporal evolution of mining areas and land-use changes between 1990 and 2018. The analysis, based primarily on Corine Land Cover data, was complemented by the assessment of mining expansion, vegetation loss, waste dumps, soil degradation and geomorphological instability. Mining activities in Oltenia Region have resulted in significant environmental and geomorphological impacts, including severe soil degradation, slope instability, landslides, subsidence and the fragmentation of natural and agricultural landscapes. The results show that the total exploited area across the five Oltenia mining basins increased from 75.77 km^2 in 1990 to 110.34 km^2 in 2018, with the most significant expansion recorded in the Rovinari and Jilț basins. The expansion of open-pit mining led to the conversion and degradation of extensive forest and agricultural areas, while large surfaces were occupied by waste dumps and mining infrastructure. For example, the expansion of the Husnicioara quarry affected broad-leaved forests, including the Dumbrava and Negoiești forest areas, while the Jilț South quarry expanded over agricultural land and areas of natural vegetation. In the Rovinari mining basin, the expansion of the Tismana, Rovinari, Roșia, and Pește ana quarries affected forests, agricultural land, pastures, and natural vegetation. These changes were accompanied by the removal and degradation of the fertile topsoil layer and by geomorphological instability, including landslides affecting waste dumps and subsidence in the Motru mining basin. The results of the research indicate a significant overall increase in exploited surfaces, from 75.77 km^2 in 1990 to 110.34 km^2 in 2018, with the most pronounced expansion occurring in the Rovinari and Jilț mining basins. The development of open-pit mining resulted in the conversion of forest, agricultural and natural vegetation areas into quarries, waste-deposition sites, and mining infrastructure. The study also identifies important environmental and geomorphological impacts, including soil degradation, slope instability, landslides, subsidence and the incomplete rehabilitation of former mining areas. These transformations have substantially altered the visual and functional character of the regional landscape. The findings highlight the need for integrated post-mining management based on land reclamation, ecological reconstruction, geomorphological stabilization, vegetation restoration, and the sustainable reuse of degraded land. The study emphasizes that coordinated action among mining companies, public authorities, local communities, and environmental specialists is essential for achieving a resilient transition toward multifunctional and environmentally sustainable post-mining landscapes.

KEYWORDS: lignite mining, soil degradation, land-use change, landscape transformation, post-mining rehabilitation

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Weathering intensity and rate in the Bihor Massif: geochemical variability and geo-climatic controls

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Weathering intensity represents the quantitative expression of bedrock transformation under the combined influence of lithological, climatic, and temporal controls. This study assesses the variability of weathering intensity in the Bihor Massif through the geochemical analysis of more than 50 samples collected from bedrock, saprolite, and surficial deposits. The assessment integrates the standard-mineral method with four relative geochemical indices: the Chemical Index of Weathering (CIW), Chemical Index of Alteration (CIA), Reiche–Vogel index, Vogt ratio, and Ruxton ratio. The results reveal pronounced heterogeneity in the degree of geochemical transformation. CIW values range from 3.40 to 99.63, while CIA values range from 3.39 to 98.61, documenting a transition from weakly weathered materials to profiles in which the leaching of mobile constituents is highly advanced. This variability is further supported by the Reiche–Vogel index, with values ranging from 0.29 to 94.90, and by the Vogt ratio, which ranges from 0.02 to 186.13, indicating major geochemical contrasts among the analysed samples. The Ruxton ratio likewise exhibits considerable variability, ranging from 0.67 to 37.06, with lower values associated with more intense weathering. Analysis using the standard-mineral method highlights the differential mobility of the major geochemical constituents, with some profiles recording SiO_2 losses of up to 85%, whereas CaO and K_2O display strongly contrasting behaviour among individual profiles. Geochemical variability is interpreted in relation to both the lithological diversity of the substrate and the humid mountain climate, characterised by mean annual precipitation of approximately 1,200 mm, relative humidity of 84–86%, more than 100–150 days per year with snow cover, and an annual frost-free period limited to approximately 80–120 days. The seasonal alternation between cryogenic processes and chemical weathering, superimposed upon the contrasting mineralogical susceptibility of the substrate, generates a weathering system characterised by pronounced spatial variability. Weathering rate is considered separately from weathering intensity as a time-dependent parameter exhibiting nonlinear evolution. Its progressive decline is associated with regolith development and the protective effect exerted by the regolith mantle on the underlying weathering front. The results suggest that lithology controls the magnitude of the geochemical response, whereas the thermal and precipitation regime governs the environmental conditions and seasonality under which weathering proceeds. The interaction between these two sets of controls accounts for the major contrasts in weathering intensity identified across the Bihor Massif.

KEYWORDS: weathering intensity; weathering rate; CIW; CIA; geochemical indices; regolith; lithology; mountain climate; Bihor Massif.

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Holocene evolution of the Voidokilia barrier - Gialova lagoon system (SW Peloponnese, Greece): geomorphological development and evidence of extreme marine inundation

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The Voidokilia barrier – Gialova lagoon coastal system, located on the southwestern coast of the Peloponnese in Greece, forms one of the best preserved omega-shaped barrier-lagoon systems in the Mediterranean, renowned for its exceptional geomorphology and outstanding landscape value. Despite decades of geoarchaeological and palaeoenvironmental research, important questions remain regarding the mechanisms controlling the evolution of the barrier, the role of aeolian and marine processes in shaping its present morphology, but especially the frequency, origin and sedimentary expression of extreme marine inundation events on the sedimentary record, for which contrasting interpretations ranging from multiple Holocene tsunamis to alternative high-energy coastal processes have been proposed. This study aims to reconstruct the Holocene evolution of the Voidokilia barrier while assessing evidence for past tsunami inundations preserved within the Gialova lagoonal sequence. The investigation integrates geomorphological mapping, sediment coring, grain-size analysis, loss-on-ignition, X-ray fluorescence (XRF) geochemistry, magnetic susceptibility, micropalaeontological analyses, radiocarbon and optically stimulated luminescence (OSL) dating, together with ERA5 reanalysis wind data and Copernicus wave reanalysis to evaluate regional aeolian sediment transport and storm-wave forcing. Our results indicate that the present-day asymmetry of the Voidokilia barrier is primarily controlled by dominant regional aeolian transport, which favors the development of an extensive transgressive dune field on the lagoon-facing side of the barrier. Storm-wave analysis further demonstrates that although annual wave conditions are dominated by northwesterly waves, the most energetic winter events are generated by southwesterly Mediterranean cyclones, producing morphodynamic conditions capable of substantial coastal reworking. Sedimentological, geochemical and micropalaeontological evidence from core VDK2 identifies two high-energy depositional units interpreted as probable tsunami deposits. Based on the chronological framework established through radiocarbon and OSL dating, these units may correspond respectively to a Late Bronze Age event previously recognised elsewhere in western Greece and to the well-documented AD 1303 Crete tsunami. The available evidence suggests that extreme marine inundations contributed to episodic reorganisation of the barrier-lagoon system. However, several characteristics of the suspected deposits are inconsistent with established tsunami-deposit indicators, raising the possibility that some of the identified marine incursions may instead reflect other types of high-energy coastal events. The proposed evolutionary model describes four principal stages in the development of the Voidokilia–Gialova system, from post-glacial marine transgression and delta progradation to barrier formation,

dune-field expansion and the modern coastal configuration. The study illustrates the importance of integrating geomorphological, sedimentological, palaeoecological and climatological datasets in reconstructing the evolution of Mediterranean coastal barriers and contributes new evidence regarding the interaction between long-term coastal evolution and episodic extreme marine events.

KEYWORDS: barrier-lagoon coastal system, large-scale coastal behavior, tsunami deposits, palaeogeography

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Gully development on saline substratum: A Case Study within Jijia Hills, Moldavian Plateau, Romania

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The Moldavian Plateau is the most important hilly area of Romania by agricultural importance, being the most typical plateau unit in the entire country. Given that more than 70% of the its area is used as agricultural land, land degradation caused by erosional processes represents a widespread environmental issue that leads to significant ecological, economic and social consequences. The determining factors for this phenomenon are mainly represented by unsustainable agricultural practices, which overlap with natural characteristics conducive to erosion. Out of all of these, in the case of the Jijia Hills (the north-eastern subunit of the Moldavian Plateau), soil salinization stands out as the decisive, controlling factor, intensifying the erosion processes. Under these circumstances, once the upper humic soil is eroded, exposing the underlaying layers with high salt content, ideal conditions for installing piping, channels collapse and finally gully formation are created. Using remote sensing and field surveys, the main objectives of this study are to identify both a) the areas affected by salinization, leaving the soils vulnerable to external erosion factors, and b) the badlands and associated gullies formed under these circumstances. For this study, a two-step methodology was created for the extraction of salty areas from the Jijia Hills by identifying the year, month and day when salty soils can be easily extracted from Copernicus Sentinel-2 satellite imagery. Furthermore, a second methodology was used for the semi-automatic extraction of gullies from LiDAR derived digital terrain models. After applying the two complementary methodologies, a polygon overlay was conducted to identify the gullies developed on soil/deposits affected by salinization. Results show that 40223 areas (polygons) representing salty soil/deposits were identified. They cumulate a total area of 3825 hectares, most of them on arable lands and pastures. Moreover, over 14363 gullies were identified, resulting a mean density of 2.3 gullies/km^2. In addition, they add up to 3124 hectares, with a mean area of 2215,8 m^2 and a mean depth of 1.41 meters. For validation and soil sampling purposes, 13 gullies were selected from all over the study area. One of these was selected for a more detailed investigation conducted over several years using UAV surveys, including a DJI Matrice 300 RTK drone equipped with a LiDAR sensor. The main conclusion reveals that the advanced salinization of soil/subsoil in the Jijia Hills is the main preparatory factor of gully erosion in the area. Therefore, the gully development is directly related to dissolution of salts, which led to the occurrence of pipping and finally, to the collapse of small underground channels. Although the gullies developed on salty-clayey soils/deposits within Jijia Hills (the northern sector of Moldavian Plateau) are significantly less spectacular than the gullies formed on sandy or loess-like soils/deposits in Barlad and Covurlui Plateau (the central-southern sector of the Moldavian Plateau), the study of this particular process remains of significant importance due to its effects, especially on

agricultural land.

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KEYWORDS: gully erosion, saline soil/deposits, piping, Jijia Hills

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Morphometric and spatial distribution analysis of dolines in the Ciumerna Massif (Trascău Mountains, NW Romania): Implications for the evolution of Carpathian uvalas in the context of Quaternary climate variability

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Early classical geomorphological studies identified the Ciumerna Massif (southern Trascău Mountains, Apuseni Mountains, NW Romania) as the area with the highest doline density in the region and suggested the presence of multiple climatically controlled generations of dolines, together with an exceptional abundance of small, incipient karst depressions. This study advances these pioneering observations by combining field investigations and GIS-based morphometric analyses to quantitatively and qualitatively evaluate doline origin and evolution. Fault and fracture orientations were measured on the elevated plateau (~1200 m a.s.l.) in four selected limestone outcrops, as they are essential for understanding uvala development. A LiDAR-derived DEM was processed in ArcGIS Pro. In addition to established tools (e.g., *Point Density*, *Point Clusters*, *Flow Accumulation*, *Flow Direction*), the methodological workflow includes a newly released analytical tool (*Locate Depressions*; November 2025) to evaluate its applicability and limitations for the automatic detection of dolines. Four uvalas and a number of 248 dolines were analyzed. A diagnostic feature of uvalas development is their structural control by local faults, whereas dolines are preferentially aligned with subordinate joints and fractures. Within uvalas and other karst depressions, dolines located closer to, but still above, the water table are smaller, have a rounder planform, and predominantly exhibit conical and hemispherical shapes in vertical section. In contrast, dolines located on the surrounding slopes are larger, flatter, and mostly irregular in shape. These dolines were probably epeirogenically uplifted and are considerably older, reflecting their formation during past glacial periods, when higher CO_2 concentrations in infiltrating waters likely enhanced limestone dissolution. Morphometric indices (e.g., circularity index, depth, and volume) are interpreted here as proxies for Quaternary climatic variability, which influenced the morphological development of different generations of dolines. The study highlights the potential of GIS-based morphometric analysis to improve the assessment of the relationships among doline distribution, tectonically induced secondary porosity, and precipitation input in karst areas.

KEYWORDS: karst, doline, morphometric analysis, Quaternary, Carpathians

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Thawing Ground and Shifting Livelihood: Consequences of Permafrost Altitude Recession (PAR) on the Mountain Communities of Lahaul and Spiti, Western Himalaya

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The high-altitude cold-desert landscape of Lahaul and Spiti in Himachal Pradesh represents one of the most environmentally sensitive regions of the Indian Himalaya, where human livelihoods are closely dependent on snow, glacier and permafrost-derived water resources. Covering approximately 13,830 km^2 and extending largely above 2,500 m a.s.l., the region encompasses a complex assemblage of glacial, glacio-fluvial, paraglacial and periglacial processes. Agriculture and domestic water supplies are traditionally sustained through gravity-fed irrigation systems known as *kuhls*, making communities particularly vulnerable to changes in cryospheric processes and meltwater availability.

While glacier recession in the region has received considerable scientific attention, the spatial dynamics and socio-environmental implications of permafrost degradation remain comparatively under-investigated. Permafrost processes are particularly active around 4,000 m a.s.l., although local variations in slope gradient, aspect and terrain characteristics influence this threshold. Recent observations of active-layer failures, thermokarst development and ground instability in areas such as Lindur suggest that permafrost altitude recession is occurring in landscapes previously considered relatively stable. These changes have implications for slope stability, infrastructure, drainage systems, freshwater accessibility and high-altitude agricultural practices.

The present study investigates the socio-environmental consequences of permafrost thaw at selected locations, including Lindur, Chicham and Dhankar, with particular emphasis on the interactions among climatic variability, cryospheric change, geomorphic instability and human activity. The study examines the influence of erratic precipitation and persistent positive seasonal temperature anomalies on permafrost degradation and associated geomorphic responses, while assessing their implications for agricultural productivity, water security, settlement stability and human mobility. Evidence from palaeoclimatic investigations in the Miyar Valley, indicating a late-Holocene glacial and periglacial advance during the Little Ice Age (980–1840 CE), further demonstrates the long-term sensitivity of high-altitude landscapes and human activities to cryospheric fluctuations.

The study argues that contemporary permafrost degradation should be understood not solely as a component of Himalayan environmental change but as an emerging socio-environmental challenge. The interaction of

permafrost thaw, glacier recession, changing precipitation regimes and geomorphic instability has the potential to transform water availability, agricultural systems, infrastructure and settlement patterns. Understanding these interconnected processes is therefore essential for developing locally appropriate strategies for water security, infrastructure resilience, climate adaptation and sustainable livelihoods in the high-altitude communities of Lahaul and Spiti.

KEYWORDS: Permafrost Thaw, Cryosphere Degradation, Lahaul and Spiti, Climate Change Impacts, Highland Communities

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Stable isotope hydrology of karst groundwaters in Romania

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We present the first investigation of the stable isotope composition of groundwaters in Romania, East-Central Europe, with a focus on the karst areas. Our aim is twofold: (1) to provide a countrywide map with the distribution of stable oxygen and hydrogen isotope ratios in groundwater, and (2) to assess the recharge patterns of karst water. We collected more than 600 water samples from springs and wells across Romania for stable isotope analyses and monitored in detail the stable isotope composition of waters as they pass through five cave systems. Our data show a spatial distribution of the stable isotope composition of groundwater with low values in the mountainous areas and high values in the surrounding lowlands and the central Transylvanian Depression. However, waters in the karst areas induce departures from this distribution, resulting from the fast (hours to day) transfer of waters from high (ponor) to low (spring) altitudes. Water emerging from the karst springs has generally lower δ values than before sinking through the ponors, thus indicating a substantial contribution of winter recharge through diffuse infiltration and seepage. This contribution results in overall dilution of the water entering through ponors, likely resulting in changes in the chemical composition of the water and diluting potential pollutants. Our data call for careful separation between karst and non-karst spring/well water, as indiscriminate common treatment might lead to erroneous interpretations.

KEYWORDS: stable isotopes, karst, groundwater, caves, Romania

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Habitat Degradation Driven by Offroad Tourism in the Briței *Crocus heuffelianus* Field

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Unregulated off-road driving poses a growing threat to soil and plant communities. The Briței floral field – a primary transit corridor traversing the main ridge of the Bihor Mountains – experiences severe seasonal visitor pressure coinciding with the spring blooming period of *Crocus heuffelianus*. Soil compaction and structural degradation caused by wheel tracks crush subterranean corms, restrict water infiltration, and physically prevent emerging sprouts and buds in early spring. This study quantifies the extent to which motorized tourism degrades the *Crocus heuffelianus* habitat and population. To assess these anthropogenic pressures, high-resolution aerial datasets were collected using Unmanned Aerial Vehicles (UAVs) across three representative sample plots in May 2021. Photogrammetric processing was utilized to generate high-resolution Digital Surface Models (DSMs) and orthomosaics, enabling precise mapping of the spatial distribution of *C. heuffelianus*, assessment of habitat fragmentation, and measurement of direct mechanical damage caused by wheel-track erosion. While *C. heuffelianus* remains abundant across the site – occupying a mean 20.1% of the area – anthropogenic disturbance has caused noticeable spatial disruption. Severe disturbance reached 5.41% of the area in high-traffic zones, breaking up or compacting the soil across an average of 4% of the area. A key driver of habitat destruction is the practice of driving vehicles directly through flower beds to capture 'spectacular' social media content. Together with general ORV traffic, this behavior represents a major contributor to a roughly 3% population loss, destroying over 900,000 *C. heuffelianus* individuals across the study area. Still, data suggest that habitat fragmentation is not the only source of species loss in this context, rather the high values of the spatial overlap between vehicular trajectories and floral clusters determines the survival rate. Plot 2 proves that tourism may coexist with sensitive geophytes if the traffic is geographically restricted to the periphery of floral „hotspots". To protect soil and vegetation in general and subterranean corms of *C. heuffelianus* during both flowering and dormant phases, we recommend enforcing a single transit channel by installing camouflaged landscape barriers. The implementation of these measures would be significantly facilitated by a border extension of both the Apuseni Nature Park and the ROSCI0002 Apuseni Natura 2000 site to ensure that the entirety *C. heuffelianus* population receives formal protection.

KEYWORDS: wheel track erosion, off-road tourism, habitat fragmentation, *Crocus heuffelianus* damage and loss

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Topographic Channeling and Urban Climate in Bistrița: A Geomorphological Perspective on Heat and Air Quality

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Urban climate and air quality are shaped by a complex interaction between land cover, urban structure, meteorological conditions, and local relief. In cities located within depressions or valley systems, geomorphology may influence airflow, atmospheric stagnation, pollutant dispersion, and the spatial distribution of surface temperatures. This study explores these relationships in Bistrița, Romania, where the urban area is situated within a distinct depression bordered by higher terrain. The study adopts a geomorphological perspective to investigate how relief configuration may contribute to local variations in urban thermal conditions and air quality. Digital elevation data, satellite-derived land surface temperature, land-cover information, and available meteorological and air-quality observations are considered together in order to examine possible links between topographic position, airflow characteristics, urban heat, and pollutant concentrations. Particular attention is given to the potential role of valley orientation, topographic exposure and sheltering, as well as the influence of vegetation and built-up surfaces. Rather than assuming a direct geomorphological control, the analysis aims to identify spatial and temporal patterns that may indicate interactions between relief, ventilation, surface heating, and air pollution. The study provides an exploratory framework for assessing the relevance of geomorphology in urban climate studies and for better understanding the environmental variability of Bistrița.

KEYWORDS: urban climate, air quality, geomorphological setting, Bistrița

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Terrain Morphology and Snow Redistribution across the Galeșu Rock Glacier, Retezat Mountains: Insights from UAV-SfM and Geomorphometric Analysis

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Snow accumulation and persistence over rock glaciers are strongly conditioned by surface morphology, yet the geomorphological role of small-scale terrain variability in controlling snow redistribution remains insufficiently documented in the Southern Carpathians. In marginal periglacial environments, snow does not act only as a seasonal cover, but also as an important interface between atmospheric conditions, surface morphology, meltwater transfer, and the ground thermal regime. Understanding where snow accumulates, how long it persists, and how these patterns relate to rock glacier microtopography is therefore essential for interpreting the functioning of such landforms under present climatic conditions. This study investigates the relationship between terrain morphology and snow-depth variability on the Galeșu Rock Glacier, located in the Retezat Mountains, Southern Carpathians. The analysis is based on a multi-temporal UAV-SfM photogrammetric dataset acquired between 2023 and 2025, consisting of seven snow-covered surveys and one snow-free reference survey from August 2025. Snow-depth models were produced by subtracting the snow-free digital elevation model from each snow-covered surface model, allowing the spatial distribution of snow depth to be mapped at very high resolution. These datasets were then examined in relation to selected geomorphometric variables, with particular attention to profile curvature and relative topographic position, which were used to differentiate concave, convex, depressional, and locally elevated sectors of the rock glacier surface. The results show that snow depth is highly heterogeneous across the landform and that this variability is repeatedly organized by the same microtopographic structures. Furrows, concave sectors, and local depressions acted as preferential accumulation zones, while ridges, convex forms, and exposed topographic highs were associated with thinner and more discontinuous snow cover. Although interannual differences were substantial, the general spatial pattern remained consistent. The 2024 surveys recorded considerably greater snow depths than those from 2025, with mean values of 1.82 m in February and 1.62 m in March 2024, compared to 0.72 m and 0.83 m in February and March 2025. The April 2023 survey represented the most compact snow-cover state, with a mean snow depth of 2.27 m. Class-based comparisons further highlighted the importance of terrain morphometry, with median snow-depth contrasts between strongly concave and strongly convex curvature classes reaching 2.30 m in 2024 and 1.20 m in 2025. These findings indicate that the surface morphology of the Galeșu Rock Glacier imposes a persistent control on snow redistribution and late-

season snow persistence. By linking UAV-derived snow-depth models with geomorphometric analysis, the study provides a detailed geomorphological perspective on snow storage over a marginal periglacial landform. The results also support future investigations into snow–ground thermal coupling, meltwater routing, and the preservation of ground ice in rock glacier environments of the Southern Carpathians.

KEYWORDS: snow accumulation, periglacial environments, SfM Photogrammetry, microtopography, DEM of Difference

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Land Suitability for Future Urban Expansion Relative to Landslide Exposure. A Country-Wide Preventive Modelling for Romania

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Identifying land suitable for future urban development in landslide-prone areas is essential for informed and resilient urban planning. In this context, the present study aims to assess land suitability for future urban expansion in relation to landslide exposure in Romania - one of Europe's landslide hotspot countries and a territory that has undergone rapid urban transformation in recent decades. The modelling framework integrates projected land-use/cover patterns and landslide susceptibility maps for 2075 to estimate the potential exposure of future new built-up areas and to classify land suitability for urban expansion according to landslide likelihood. The results indicate that nearly 75% of the predicted new built-up areas are expected to develop within very low and low landslide susceptibility classes, suggesting generally favorable conditions for urban expansion. However, the remaining proportion is projected to occur in areas with moderate (13%) and high to very high (12%) landslide susceptibility, highlighting emerging exposure hotspots and potential constraints for sustainable urban development. These findings provide a practical decision-support tool for planners and policymakers by offering preventive guidance for development strategies and supporting long-term landslide risk management in rapidly urbanizing regions.

KEYWORDS: future urban growth; future landslide susceptibility; land suitability zonation; risk-preventive planning; Romania.

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The Setbacks Delieneation on the Southern Romanian Coast, After Recent Sand Nourishments Extensions

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In recent decades, the southern Romanian littoral of the Black Sea has been the focus of extensive coastal protection interventions, aiming to reduce erosion and to extend touristic facilities. These interventions include the construction of hard structures such as breakwaters, groins, and seawalls, as well as soft engineering measures like beach nourishment. While effective in stabilizing shorelines, such modifications have led to significant changes in marine habitats and regional coastal dynamics, as well in socio – economic / functional zones delineation. This study presents the methodologies applied for the delineation of the coastal setback limits within southern Romanian littoral, based mainly on geomorphological criteria, with a specific focus on hydro-morphological modifications as defined under Descriptors 7 (D7) and 6 (D6) of the Marine Strategy Framework Directive (MSFD). The evaluation of the above-mentioned Descriptors, encompassing certain permanent changes induced by the new geomorphologic / hydrographic conditions, includes a multi-method approach including remote sensing, in situ geomorphological assessments, sediment analysis, and hydrodynamic vs coastal response modelling. The southern re-arranged shore sector on the Romanian littoral, required two schemes of delineation to prevent irreparable loss of the uniqueness of the natural landscape of the beach as well cliff shore sectors in the emerges and the submerged part of the coastal zone. Results show a clear sub-sectorial conceivable implementation of the delineation criteria encompassing analysis-based results of substrate types and habitats/species composition, in relation with specific impact on ecological functioning in certain areas, especially where sediment deposition has increased in both emerged and submerged parts, after the new arrangements. Equally, the extension of new setbacks lines for coastal functional zones, associated with public and private domains within coastal zones, are now crucial as a countermeasure of harmonization after the new shore arrangements. At the same time, the results emphasize the needs of implementation for specific Integrated Coastal Zone Management (ICZM) measures, that aligns shoreline stabilization with the ecological objectives of the MSFD, encompassing an adaptive design of renaturation measures, an enforced ecosystem-based management, to ensure the coastal sustainability and the harmonization between excessively anthropogenous developments with impact on natural coastal geomorphology, and coastal ecology.

KEYWORDS: Black Sea, Southern Romanian Littoral, coastal zone, coastal delineation, setback limits

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International Association of Geomorphologists (IAG): 2026-2030 priorities

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The International Association of Geomorphologists (IAG) represents the most important international professional association in the field of Geomorphology. With an activity extended across four decades, IAG was founded at the Second International Conference on Geomorphology in Frankfurt/Main (Germany) in 1989; as per September 2026, the year when a New Executive Committee will start its 4 years mandate, the IAG gathers 74 countries grouped in National Scientific Members (64 individual countries and 4 regional associations, with a total of 10 countries). In agreement with its Constitution, the objectives of the IAG are: to develop Geomorphology through international cooperation, to promote the dissemination of geomorphological knowledge between the scientific community and the general public, to provide geomorphological advice to international institutions, to encourage the membership of countries around the world, incorporating the different national delegations of each country, to promote geomorphological research and the establishment of working groups on specific geomorphological topics, to support the training of geomorphologists at an early career stage from all around the world, and especially those from economically disadvantaged countries. It is the purpose of this presentation to show the IAG priorities for the 2026-2030 mandate: IAG Training Programme for Young Geomorphologists (Young Geomorphologists Council - IAG-YGC; IAG Mentorship Network - IAG-MentNet; IAG Training Hub - IAG-TrainHub; IAG Regional Summer Training Schools - IAG-TrainSchool); NSMs Cooperation (IAG Teammates Spirit - IAG-TeamSpirit; IAG Regional Research Networks - IAG-ResNet; IAG Geomorphology Data Portal - IAG-GeomorphoData; IAG Feedback Platform - IAG-FeedPlat); IAG Communication, Cooperation and Outreach (IAG Geomorphology for Society - IAG-GeomorphoSoc; IAG Global Communication Campaign - IAG-GlobComm; IAG Institutional Links - IAG-InstLink). Every activity will be set up and developed ensuring inclusiveness, gender, race and cultural background, in the spirit of the IAG Bylaws. By fostering scientific exchange among NSMs, supporting YGs, and strengthening internal regional, continental and external institutional partnerships, the IAG will continue to promote geomorphology as a central science for understanding the Earth's surface systems and their sustainability. This will be achieved through cooperation, collective effort and communication transparency, making thus certain that IAG will ensure that geomorphology remains at the forefront of addressing the environmental and societal challenges of the 21st century.

KEYWORDS: IAG, new mandate, priorities, NSMs, YGs

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Four decades of vegetation dynamics in the Danube Delta from a cross-sensor harmonized Landsat archive (1984–2026)

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The Danube Delta, Europe's largest and best-preserved wetland, has undergone continuous hydrological and anthropogenic pressure over the past four decades, yet its long-term vegetation dynamics remain under-documented at fine spatial and temporal resolution. This study reconstructs a near-complete Landsat Collection 2 Level-2 surface-reflectance time series (1984–2026, Landsat 4, 5, 7, 8, and 9) over the Delta, resampled onto a single fixed 30 m grid to allow direct pixel-wise comparison across the whole record. A recurrent obstacle to multi-decadal Landsat time series is that successive sensor generations, the Thematic Mapper/Enhanced Thematic Mapper Plus (TM/ETM+) family and the Operational Land Imager (OLI/OLI-2), carry different spectral response functions for nominally identical bands, introducing a systematic, sensor-driven discontinuity in derived indices exactly at the 2013 TM/ETM+-to-OLI changeover, independent of any real change on the ground. To remove this artifact, published cross-sensor ordinary least-squares coefficients (Roy et al., 2016) were applied to convert every TM/ETM+ scene's blue, green, red, near-infrared, and shortwave-infrared reflectance to OLI-equivalent values, leaving OLI/OLI-2 scenes as the untouched reference. Cloud, cloud-shadow, cirrus, and snow pixels were masked scene-by-scene from the quality-assurance band before analysis. Per-pixel ordinary least squares trends were then computed across the harmonized time series for a set of complementary spectral indices, NDVI, GNDVI, and MSAVI for vegetation vigor; and MNDWI/ANDWI for surface-water extent, allowing vegetation change to be interpreted jointly with the Delta's shifting water regime rather than in isolation. Harmonization visibly removes the spurious step change centered on the 2013 sensor transition from the pixel-wise index time series, letting the recovered trend track genuine multi-decadal vegetation dynamics. The resulting harmonized archive and per-pixel trend maps provide a methodologically sound baseline for future studies of vegetation–hydrology interactions in the Danube Delta, and the harmonization approach itself is transferable to any other site where a multi-sensor Landsat record spans the TM/ETM+-to OLI transition.

KEYWORDS: Danube Delta; Landsat time series; spectral harmonization; NDVI trend; wetland vegetation

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Restoring Sediment Balance and Its Flow: DANSER - Hydro-geomorphological Framework for Sustainable Danube River–Floodplain-Black Sea Interface Connectivity

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Sediment transport represents one of the primary hydro-geomorphological processes controlling channel evolution, floodplain dynamics, river–groundwater interactions, and ecosystem resilience. Across the Danube River Basin, sediment continuity has been progressively disrupted by dams, channelization, dredging, bank stabilization, land-use changes, and climate-induced hydrological alterations. These cumulative pressures have modified sediment budgets, accelerated channel incision and coastal erosion, reduced floodplain connectivity, and affected biodiversity and ecosystem services. This contribution presents the geomorphological framework developed within the Horizon Europe DANSER (DANube SEdiment Restoration) project for understanding and restoring sediment balance across the Danube Basin. The proposed methodology integrates historical geomorphological reconstruction, hydrographic surveys, sediment characterization, remote sensing, GIS-based spatio-temporal analyses, hydrodynamic modelling, and biodiversity assessment into a multi-scale decision-support framework. Particular emphasis is placed on quantifying sediment pathways, identifying erosion and deposition hotspots, evaluating river–floodplain connectivity, and reconstructing long-term channel evolution as a basis for sustainable sediment management. The framework combines field observations with digital technologies, including bathymetric surveys, Acoustic Doppler Current Profiler (ADCP) measurements, satellite observations, machine-learning-assisted analyses, and interoperable digital platforms capable of supporting continuous monitoring and predictive modelling. These integrated datasets enable the assessment of sediment transport processes under changing hydrological conditions while providing scientific support for restoration planning and adaptive river management. Beyond the physical processes, the study highlights the fundamental role of sediment continuity in maintaining geomorphological diversity, ecological integrity, groundwater exchange, and climate resilience. The proposed approach supports nature-based solutions, floodplain reconnection, sustainable dredged sediment management, and ecosystem restoration while contributing to the objectives of the EU Mission Restore our Ocean and Waters, the Water Framework Directive, and the Biodiversity Strategy 2030. The DANSER framework demonstrates that restoring sediment balance is fundamentally a geomorphological challenge requiring interdisciplinary integration between earth sciences, hydrology, ecology, and digital technologies. Its transferable methodology provides a robust scientific basis for sustainable sediment governance in large transboundary river systems and offers new perspectives for geomorphological research under accelerating environmental change. Multi-sensor hydro-geomorphological monitoring is an efficient and necessary approach for investigating sediment

dynamics in river-sea transition areas. The integration of high-resolution bathymetry, ADCP profiles, water quality observations, sedimentological analyses, remote sensing and GIS analysis allows a comprehensive assessment of sediment transport processes, morphological evolution and associated ecological implications. The methodology proposed in the DANSER project contributes to sustainable sediment governance, supporting numerical modelling, ecosystem restoration and climate change adaptation strategies. The modular architecture of the monitoring framework facilitates its replication in other sectors of the Danube basin and in other European transitional waters, contributing to the objectives of the EU Mission "Restoring our oceans and waters".

KEYWORDS: sediment dynamics, hydro-geomorphological monitoring, Danube–Black Sea interface, morphodynamics, multi-sensor integration

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Holocene fluvial threshold dynamics: examples of flood-related landscape transitions in Romania

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River systems rarely evolve gradually throughout the Holocene. Instead, they alternate between relatively stable periods and intervals of rapid geomorphic adjustment, reflecting the crossing of internal fluvial thresholds under changing climatic conditions. Understanding these transition phases is essential for reconstructing long-term river evolution and for placing recent flood activity into a broader environmental context. This contribution presents several examples from Romania that illustrate the relationship between Holocene hydroclimatic variability, flood-rich periods, and phases of accelerated channel reorganization. The study integrates geomorphological investigations, floodplain stratigraphy, sedimentological evidence, radiocarbon and optically stimulated luminescence (OSL) dating, together with historical cartographic sources and regional paleohydrological reconstructions. The analysed river systems reveal repeated alternations between stable channel configurations and episodes characterized by incision, avulsion, enhanced lateral mobility, sediment remobilization, and extensive floodplain reworking. These geomorphic responses appear to cluster during periods of increased climatic variability, suggesting that flood-rich intervals may represent critical phases when fluvial systems are more likely to exceed internal geomorphic thresholds. Special attention is given to the Late Holocene and the Little Ice Age, when documentary evidence and sedimentary archives indicate intensified flood activity across Romania. In both the Someș and Siret river basins, these intervals coincide with major channel adjustments, while differences between western and eastern catchments reflect the influence of the Carpathian Mountains on atmospheric circulation and regional hydroclimatic responses.
The Romanian case studies support a conceptual interpretation in which floods are viewed not only as individual hydrological events but also as geomorphic agents capable of driving long-term landscape transformation. Integrating sedimentary archives, historical evidence, and geomorphic threshold theory offers new perspectives on Holocene river evolution and contributes to a better understanding of river sensitivity under ongoing climate change.

KEYWORDS: Holocene, fluvial thresholds, flood-rich phases, river evolution, Romania

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Reconstructing the Evolution of the Iron Gates Gorge within the Lower Danube System: A Geomorphologist's Personal Perspective

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The geomorphology of the Iron Gates has been interpreted for more than a century through a variety of conceptual models, including marine corridors, regional erosion surfaces, antecedent drainage, river capture, and fluvial terrace development (e.g. Cvijić, 1908; Vâlsan, 1918; Posea et al., 1963, 2002; Marović et al., 1997; Leever et al., 2010). Each of these approaches successfully explains part of the observed landscape, yet none fully explains for its regional morphometric organization or the relationships among these seemingly independent geomorphic features. This contribution explores whether these apparently contrasting interpretations can be reconciled by analysing the inherited geomorphic architecture of the Carpatho–Balkan Bend Zone. The reconstruction integrates a critical review of classical geomorphological concepts, and three independent morphometric datasets: cross-valley mapping of slope breaks and terrace remnants, longitudinal profiles of tributary knickpoints, and DEM-based grid morphometry. The analysis reveals a remarkably coherent morphometric framework. The same altitude domains recur systematically across all three datasets, defining a hierarchical landscape organization that extends beyond individual valleys or geomorphic elements. In particular, the persistent 400–450 m morphometric corridor is interpreted as an inherited landscape feature that predates the integrated Danube and is interpreted as the valley floors of a former bidirectional drainage system developed along a tectonically controlled corridor. Differential uplift in the central Almăj Mountains subsequently established a regional drainage divide that was later breached by the westward-to-eastward integration of the Danube. The highest preserved terrace sequence (T10–T8) records this stage of drainage integration, whereas the deeply incised Iron Gates Gorge developed later, during the Latest Pliocene - Quaternary, as regional uplift accelerated river incision. Rather than introducing a new geomorphological model, this study shows that integrating independent morphometric observations provides a coherent framework for reinterpreting the evolution of the Lower Danube through the Iron Gates.

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KEYWORDS: Lower Danube, Iron Gates, landscape evolution, morphotectonic architecture, drainage integration

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Sensitivity of Electrical Resistivity Tomography to Automated Data Processing: A Case Study on the Internal Structure of the Detunata Talus Deposit

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Patchy permafrost lenses within low-altitude overcooled talus deposits are high electrical resistivity bodies (often >7-10 kΩ) highlighted through Electrical Resistivity Tomography (ERT). Their presence and distribution on tomograms indicate negative thermal anomalies induced by the chimney effect, allowing the preservation of subterranean ice. We present results from a multi-year ERT dataset (2020–2025) collected across seven profiles in the Detunata talus slope. To evaluate data processing impacts, the field data were analyzed in six variants, combining two inversion methods with three automatic filtering thresholds (removing 5%, 10%, and 15% of noisy data points). We compared the robust inversion (ABS)—which minimizes absolute deviations and mitigates extreme outliers—with the standard inversion (RMS)—which minimizes squared errors and remains sensitive to outliers. The variants were evaluated based on both formal model error and fidelity in rendering subsurface structures. ABS consistently generated lower formal errors (1.7–4.2%) compared to RMS (4.8–12.0%). However, comparing these models with direct borehole data revealed a counterintuitive finding: a lower mathematical error does not guarantee a faithful subsurface representation. RMS accurately reproduces the actual, thinner permafrost layer. In contrast, ABS significantly overestimates this thickness, extending the frozen layer almost to the surface. This occurs because ABS, by aggressively smoothing the data, attenuates real resistivity variations, erroneously treating them as noise. Similarly, automated filtering highlighted the risk of progressive useful signal loss. Conservative filtering (5%) preserves local resistivity anomalies representing actual subsurface structures. At an intermediate 10% threshold, these real features begin to blur and lose their structural definition. With more aggressive filtering (15%), these details disappear entirely, and the mathematical error decreases. Again, a better error metric masks an information deficit: real geological signal was removed along with the noise. While all variants successfully captured the basic stratigraphic architecture—a superficial horizon (0–3 m), a resistive ice core, a transition zone (8–12.4 m), and low-resistivity bedrock—RMS seem to have better estimated the true permafrost thickness. The software's mathematical error should not be viewed as an absolute indicator of interpretative accuracy. Although ABS yields lower errors, it distorts the true permafrost architecture. RMS, despite higher formal errors, better captures the ground-truthed ice core geometry. Modeling parameters must not be optimized solely to minimize statistical error, but rather should be anchored in direct field validations.

KEYWORDS: electrical resistivity tomography (ERT), talus slope, permafrost, inversion methods, Detunata.

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Snow avalanche and debris flow hazards in Calimani Mountains (Eastern Carpathians, Romania)

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Snow avalanches (SAs) and debris flows (DFs) are among the most significant geomorphic hazards affecting mountain environments, where they pose substantial risks to ecosystems, infrastructure, and recreational activities. The Calimani Mountains (Eastern Carpathians, Romania) are characterized by steep volcanic slopes, abundant precipitation, and a vegetation cover, creating favourable conditions for the occurrence of both SAs and DFs. Despite their significance, comprehensive assessments integrating hazard inventories, event frequency, and infrastructure exposure remain limited in this region. This study presents an assessment of SA and DF hazards by combining geomorphological mapping, dendrogeomorphological analysis, and spatial infrastructure exposure assessment. Inventory maps of SA paths and DF channels were developed through detailed field surveys and the interpretation of topographic data and remote sensing imagery. The resulting inventories provide a spatial database of these geomorphic hazards in the Calimani Mountains, enabling the identification of their distribution, spatial patterns, and geomorphic controls. To reconstruct the temporal occurrence of SA and DF events, dendrogeomorphic methods were applied using tree-ring analyses of disturbed coniferous trees growing within SA paths and along DF tracks. Tree-growth disturbances were used to identify past events and establish annual and seasonal chronologies of SA and DF activity, providing valuable insights into the recurrence of both processes. The exposure of the infrastructure to these geomorphic hazards was assessed by quantifying the lengths of roads and hiking trails intersecting SA paths and DF tracks. The results indicate that several roads and recreational trails are directly exposed to one or both hazards, potentially affecting accessibility, tourist safety, and maintenance requirements. The study improves the regional hazard assessment by providing new information on the spatial distribution, recurrence, and potential impacts of SAs and DFs on mountain infrastructure. The resulting datasets provide a valuable basis for hazard management, infrastructure planning, and future risk assessments in the area.

KEYWORDS: snow avalanches, debris flows, hazard assessment

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Permafrost degradation at Detunata cold scree after 2020

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Low-altitude mountain permafrost located in overcooled screes is highly sensitive to contemporary climate change. Detunata Goală from Metaliferi Mountains hosts such a permafrost body at an altitude of about 1050 m asl, preserved within a basaltic scree deposit due to a complex subterranean air circulation induced by chimney effect. The chimney effect is a thermodynamic phenomenon that describes the natural movement of air into and out of enclosed spaces such as a porous scree slope driven entirely by thermal buoyancy and inducing large negative thermal anomalies and permafrost presence at altitudes well below regional limits of discontinuous permafrost. Between 2020 and 2025 we performed several ERT investigations both on longitudinal and transverse profiles in order to detect changes in internal structure at Detunata Goală site. A 15-meter monitoring borehole was also drilled into the cold zone of the talus, penetrating the scree down to the underlying sandstone bedrock. The borehole was equipped with temperature loggers to monitor permafrost temperature, active layer depth variation in relation to climatic conditions. This allowed us to compare indirect measurements (resistivity profiles) with direct measurements (temperatures at depth). On several occasions, the logger chain was extracted and the physical presence of ice in the ground could be visually assessed. Thermal monitoring from 2021 to 2023 confirmed the existence of a continuously frozen permafrost layer at a depth of 7 meters. However, a dramatic thermal shift occurred starting in October 2023, resulting in the complete and irreversible thawing of this deep permafrost at the borehole location. Consequently, subsequent freezing has been strictly seasonal, penetrating only down to a maximum depth of 6 meters. Interestingly, ERT surveys seem to fail in capturing these subsurface phase changes which indicates that in such coarse scree environments, the ERT method might be primarily sensitive to high porosity rather than low interstitial ice content. Despite the localized thermal collapse observed within the borehole, ERT profiles suggest that fragmented permafrost likely still persists in the surrounding areas of the site.

KEYWORDS: low altitude permafrost, ERT, chimney effect, borehole, thermal survey

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Forest structural responses to snow avalanche frequency: integrating tree-ring evidence and UAV photogrammetry

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This study investigates the relationship between snow avalanche frequency and forest structural patterns by combining dendrogeomorphological reconstruction, field observations, and high-resolution UAV-based Structure-from-Motion (SfM) photogrammetry. The approach was applied to two avalanche paths in the Piatra Craiului Mountains, Southern Carpathians, Romania (Southern Carpathians, Romania). Tree ring analyses allowed reconstruction of spatially explicit minimum avalanche chronologies for the 1980–2025 period. UAV-SfM photogrammetry supports high-resolution mapping of vegetation structure and surface states. Vegetation was classified using a machine-learning-based object-oriented approach (Random Forest) integrating spectral, geometric, structural, and textural parameters. The multi-parameter feature set yielded very high classification accuracy (Cohen's Kappa ≈ 0.95). Across avalanche return-period gradients, both UAV-derived and field-based metrics showed a systematic associations between tree height and avalanche frequency, whereas tree age and stem diameter exhibited more variable, path-dependent responses. The proposed framework provides a transferable basis for linking avalanche disturbance regimes with vegetation structure and surface stability in mountain landscapes lacking long-term observational records.

KEYWORDS: Snow-avalanche disturbance, Dendrogeomorphic reconstruction, Avalanche return period, UAV-SfM photogrammetry, Vegetation structure

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Quantifying 3D Volumetric Mass Loss of Soft-Rock Shorelines: Insights from 2 Mai, Black Sea Coast

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Soft-rock cliffs are among the most dynamic coastal landforms, where erosion results from the continuous, complex combined action of marine and subaerial processes. Understanding their seasonal behavior and spatial variability is essential for improving coastal hazard assessment, risk mitigation, and long-term environmental monitoring strategies. This study investigates the recent morphological evolution of the vulnerable loess cliffs located in the *2 Mai sector* along the Romanian Black Sea coast. To capture these rapid surface changes, I use high-resolution monitoring approach combining terrestrial laser scanning (*TLS*) and Unmanned Aerial Vehicle (*UAV*) photogrammetry. The field campaigns and data acquisition took place over a continuous monitoring timeframe between February 2024 and May 2025. Successive high-resolution 3D point clouds and Digital Elevation Models (*DEMs*) were processed, aligned, and compared using cloud-to-cloud and DEM differentiation techniques to precisely quantify seasonal topographic shifts and volumetric mass loss. The overall results reveal marked temporal and spatial variations in erosion rates, primarily controlled by seasonal shifts in hydrodynamic and atmospheric conditions. During the energetic cold season (October–April), increased storm activity, elevated sea levels, and higher wave energy intensified *marine undercutting* at the cliff base. This marine action accounted for approximately 75% of the total annual cliff retreat. Conversely, during the calmer warm season (May–September), the natural accumulation and formation of a protective beach berm significantly reduced direct wave attack. However, prolonged warm and dry atmospheric conditions combined with episodic heavy rainfall events triggered intense *subaerial processes*. These led to widespread desiccation cracking and small-scale rotational slumping, which were particularly pronounced along the *southeast*- and *east-facing* cliff sectors. Over the total monitored surface area of 754 m^2, a net volume loss of approximately 870 m^3 was quantified between February 2024 and February 2025. The integration of *TLS* and *UAV* photogrammetric datasets enabled the detection of subtle geomorphic modifications with high spatial accuracy. Ultimately, this multi-temporal three-dimensional framework demonstrates the critical value of combined monitoring for isolating the dominant drivers of *soft-rock cliff evolution*, directly supporting future coastal management initiatives on the Black Sea coast.

KEYWORDS: loess erosion; coastal morphodynamics; 3D volumetric mass loss; seasonal dynamics; Black Sea

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Multidecadal variability of wind and wave direction in the north-western Black Sea (1940-2024): implications on longshore sediment transport in the Danube Delta

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This study analyses the multidecadal variability of the wind regime over the north-western Black Sea, seeking to identify changes in wind direction between 1940 and 2024. It uses ERA5 reanalysis wind data, from which hourly values of wind speed and direction were derived. The methodology rests on dividing the record into distinct periods, so as to bring out the transition from the historical to the present wind regime and to avoid smoothing the trends through simple multiannual averages. The evaluation of the upper percentiles allows the hypothesis to be tested that a change in the dominant direction is reflected not only in moderate winds but also in the extreme events responsible for the major processes of coastal erosion. The wind was analysed in sixteen directional sectors, so as to identify precisely which directions gain or lose frequency. The Danube Delta coast is one of the most dynamic sedimentary systems of the Black Sea, a semi-enclosed and virtually non-tidal basin where waves are generated almost entirely by the local wind and by fetch. On such a coast the angle at which waves reach the shoreline governs the magnitude and the alongshore distribution of longshore sediment transport at least as strongly as wave height does, so the analysis ultimately rests on the wave field. Preliminary results indicate a rotation of the wind regime, with an increase in the south-western sectors, led by SSW, and a decrease in the north-eastern sectors, led by NNE, while the mean wind speed remains essentially unchanged. Using CMEMS (derived product from the ERA5 wind field) wave data, this atmospheric shift is shown to reach the sea surface, the wave direction reproducing the same sectoral shift and pointing to a possible change in the angle at which waves approach the shore. To quantify this effect, the CERC formula is applied at a representative point offshore of the Sfântu Gheorghe mouth, using wave height, direction and period, with the wave directions validated against the wind field, to estimate the potential longshore sediment transport and the way in which the shift modifies it. Monitoring these changes of the wind direction thus remains critical for understanding the future evolution of the deltaic shoreline.

KEYWORDS: wind direction, ERA5, Black Sea, longshore sediment transport, coastal erosion

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From Channels to Coast: A Geomorphological Case for Evidence-Based Sediment Management in the Danube Delta

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The Danube Delta is shaped, and increasingly reshaped, by sediment fluxes that operate at every scale, from individual channels to the open coast. Yet the geomorphological reasoning that should underpin interventions in this sediment system – channel and branch dredging for navigation, desilting of delta lakes, and coastal sediment disposal – remains largely absent from current management practice. This contribution argues that some of Romania's most geomorphologically consequential sediment interventions are still authorized without a sediment budget, without predictive modelling of their morphological consequences, and without systematic monitoring of the response, at any point in the delta system. A representative case is the Sulina-Sfântu Gheorghe coastal sector, where jetty-confined outflow traps much of the historical longshore drift (~500,000 m^3/yr). There, between 0.5 and 2.0 million m^3 of clean, Danube-derived sand are periodically dredged from the mouth bar and disposed of offshore, below the depth of closure. This practice has major implications for one of the fastest-eroding coasts on the Black Sea, where local retreat exceeds 20 m/yr. The same governance gap extends far beyond the shoreline. Navigation dredging on secondary Danube branches, channel maintenance within the delta plain, and periodic desilting of delta lakes generate comparable sediment volumes, yet their fate is rarely assessed in relation to the geomorphological needs of receiving environments, such as subsiding reedbeds, infilling lakes, or eroding channel banks that could benefit from this material. Across these settings, interventions are typically approved project by project, without considering their cumulative or delta-wide effects on the sediment budget. We propose that this fragmented approach be replaced with an integrated, scientifically grounded framework applicable across the whole delta system: (i) quantified sediment budgets for littoral cells, branches, channels and lake basins; (ii) source characterization and quality screening prior to any disposal or reuse decision; (iii) predictive morphodynamic modelling to anticipate the consequences of removing or redistributing sediment; (iv) systematic pre- and post-intervention monitoring; and (v) cumulative-effects assessment conducted at the scale of the delta system rather than the individual project. A potential beneficial-reuse initiative on the Sulina–Sfântu Gheorghe coast illustrates the underlying principle: redirecting dredged sand into the littoral system, instead of disposing of it, can restore coastal sediment supply at a fraction of the cost of later restoration. The same reasoning applies to sediment removed from channels, branches and lakes across the delta plain, where it could support marsh accretion, counter subsidence, or replenish silted basins instead of being discarded. Establishing this scientific basis as standard practice, rather than as a pilot exception, is essential if the Danube Delta's geomorphological integrity is to be maintained under mounting pressure from sea-level rise, subsidence, and continued navigational and tourist demands on its sediment system.

KEYWORDS: sediment budget; dredging and beneficial reuse; coastal erosion; cumulative effects assessment

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Electrical resistivity tomography (ERT) investigations in fluvial deposits and hydrogeological structures in the Lipova area

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In many areas of Romania the sustainable water management is particularly important, and where drilled wells often remain the only reliable source of fresh water. Locating aquifers in such regions is challenging due to the complex geological conditions, and one such case is the city of Lipova. Electrical Resistivity Tomography (ERT) represents a widely employed geophysical techniques in hydrogeological investigations due to its ability to provide non-invasive, high resolution imaging of subsurface electrical properties. ERT method is particularly valuable for characterizing aquifers, delineating groundwater contamination, mapping lithological variations, and monitoring subsurface hydrological processes. In the case of the city of Lipova, the water source is obtained through 5 shallow boreholes located in the low terrace on the left bank of the Mureş River, in the eastern extremity of the city. The insufficient flows require the identification of new groundwater sources, which we intend to achieve through ERT investigations. The current catchment area and another one located upstream were taken into account, with longitudinal upstream-downstream profiles and 3 transversal profiles being carried out, in the upstream case taking into account the existence of a dejection cone in the median area. The objectives of the survey were: 1. to explore the groundwater aquifer and its electrical characteristics; 2. to gain insights into the resistivity structure and distribution beneath the survey area; 3, to determine the depth and thickness of the aquifer and saturated zone, all with the aim of facilitating future well-drilling endeavors for groundwater extraction.

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Multiple phases of rock glaciers dynamics and stabilization in the Southern Carpathians during Late glacial to Early Holocene derived from absolute and relative dating

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The abundance of relict rock glaciers in the highest massifs of the Southern Carpathians is a strong indicator of intense debris production and landscape transformation following or simultaneously with deglaciation, under periglacial conditions. Stabilization of rock glaciers is assumed to have occurred in response to warming phases, when the creep movement has ceased as a consequence of the ice volume significant reduction or complete disappearance. Morphological evidence, as well as preliminary absolute ages and the existing geochronological data documenting the deglaciation in the area indicate multiple development phases or reactivations, especially in the case of complex rock glaciers. High-altitude rock glaciers stabilization is regarded with special attention, as it could provide complementary data in assessing persistence of small glaciers during the Younger Dryas and Early Holocene within the highest cirques of the two massifs. We here bring new information on the dynamics and stabilization phases for rock glaciers from Retezat and Făgăraș Mountains, the highest ranges in the Southern Carpathians, supported by 36 absolute ages derived from TCN dating, which were complemented by relative dating profiles (Schmidt Hammer rebound values). The results indicate a first stabilization phase around between 15.9-14.8 ka in the Retezat mountains, when complex rock glacier such as Valea Rea and Galeșu reached their maximum extension. During the Bolling-Allerod (starting from 14.1 ka until 12.9 ka), the rock glaciers reaching 2100 m a.s.l. stabilized their fronts and complex rock glaciers ended a second extension phase. Most of the rock glaciers situated above this altitude were stabilized during the Younger Dryas (12.8-11.7 ka), except for their higher most sectors that were also active during the Early Holocene (estimated stabilization around 9.8 ka) and most probably experienced reactivations during the cold episodes of the Holocene, some of these sectors still preserving ice in the present. The results are discussed in paleoclimatic context and show a striking correlation with the chronology and evolution of the High Tatra Mountains rock glaciers, which confirms a similar evolution of the periglacial environment in the two mountain ranges and provides a valid geochronological frame for permafrost evolution at a regional scale.

KEYWORDS: rockglaciers, geochronology, deglaciation, Younger Dryas, Southern Carpathians

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Rethinking Holocene landscape evolution at Olympia (Greece): challenging the palaeolake hypothesis in favour of an open fluvial system

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The lower Alpheios valley hosts one of the most iconic geoarchaeological landscapes of the Mediterranean, where long-term interactions between fluvial, tectonic and sedimentary processes governed the evolution of the Olympia plain and directly influenced the development of the sanctuary of Ancient Olympia. Reconstructing the Holocene evolution of this landscape is therefore essential not only for understanding regional geomorphological dynamics, but also for refining archaeological interpretations concerning river evolution, landscape accessibility and site preservation. Recent studies have proposed that much of the lower Alpheios valley was occupied by a long-lived palaeolake throughout the Holocene, fundamentally revising the traditional interpretation of the area as an active fluvial system. This study critically reassesses the palaeolake hypothesis through an integrated geomorphological framework combining published chronostratigraphic, sedimentological and palaeoecological datasets with basin-scale geomorphological analysis, sediment-budget calculations, palaeohydrological reconstruction and regional source-to-sink comparisons. Available evidence consistently favours an open fluvial system throughout the Holocene, as the stratigraphic record lacks the laterally continuous fine-grained deposits expected within a persistent lake basin and instead consists predominantly of mixed grain-size assemblages and repeated moderate- to high-energy depositional facies indicative of dynamic fluvial environments. Sediment-budget analysis also reveals a pronounced volumetric mismatch between the theoretical storage capacity of the proposed palaeolake and the preserved volume of Holocene sediments within the lower Alpheios floodplain and delta. Comparison with seven additional river systems in the Peloponnese furthermore demonstrates that sediment transfer within the Alpheios catchment falls well within the regional geomorphological envelope expected for an unimpounded fluvial system, whereas the palaeolake model would require anomalously inefficient sediment export. Geomorphological and lithological observations indicate that long-term natural damming within the Flokas sector is highly improbable, while chronostratigraphic marker horizons instead support localized late-Holocene tectonic block uplift as a more likely explanation for previously reported elevation offsets. Comparative grain-size and microfaunal evidence likewise suggests that deposits formerly interpreted as lacustrine are fully compatible with periodically inundated floodplain environments. These findings support a revised model in which the Olympia plain functioned as an open, continuously active fluvial landscape throughout the Holocene, with the

Alpheios River flowing close to the southern margin of the sanctuary rather than along the shore of a persistent lake during Antiquity. This reinterpretation provides a more robust environmental framework for understanding the archaeological evolution, accessibility and long-term preservation of one of the most significant cultural landscapes of the ancient Mediterranean.

KEYWORDS: fluvial and coastal geomorphology, source-to-sink sediment budgets, Holocene landscape evolution, geoarchaeology