

# BOOK OF ABSTRACTS

The background features a stylized globe with concentric circles and a wireframe landscape at the bottom. The colors transition from blue and green at the top to orange and yellow in the middle, and purple and blue at the bottom.

## GEOSCIENCE FRONTIERS

**Editors:**

**FLORINA CHITEA, DRAGOȘ TĂTARU, IRINA STANCIU,  
ANDREEA ANDRA-TOPÂRCEANU, RALUCA DINESCU,  
MIHAELA ROCA**

Presa Universitară Clujeană

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## FOREWORD

The 10<sup>th</sup> edition of the International Symposium of the Romanian Society of Applied Geophysics (SGAR) - GEOSCIENCE 2025 is distinguished not only by marking a decade of GEOSCIENCE but also by coinciding with a significant anniversary: one hundred years of Romanian geophysics. This centennial milestone reflects an impressive scientific legacy and a continuing responsibility toward advancing research and education in the field of geophysics.

In an era defined by complex global challenges - including climate change, energy transition, and the quest for sustainable interaction between society and the environment - geophysical research plays an essential role. By enhancing understanding of the Earth's structure and processes, informing the responsible management of natural resources, monitoring hazards, and contributing to risk reduction, geophysics provides a solid scientific foundation for sustainable development. Education and training in geophysics remain central to the formation of future generations of specialists. SGAR remains committed to support young researchers, to facilitate access to knowledge and technology, and to foster an open, collaborative, and engaged scientific community.

Throughout its development, the GEOSCIENCE Symposium has benefited from SGAR's leadership and the collaboration of esteemed educational and research institutions, including the National Institute for Earth Physics, Faculty of Geology and Geophysics of the University of Bucharest, the Institute of Geodynamics of the Romanian Academy, and the National Institute for Research and Development of Marine Geology and Geoecology - GeoEcoMar, whose sustained commitment have been essential to the successful organization of this event.

GEOSCIENCE 2025 featured presentations and discussions on global challenges - including geophysics for international security, climate action, natural hazards resilience, geothermal resources, geophysical data processing, quality education, and capacity building - directly supporting the UN Sustainable Development Goals. The exchange of ideas, research findings, and perspectives throughout its sessions and workshops helps sustain the scientific relevance and dynamism that define this series of events.

The GEOSCIENCE 2025 Symposium thus stands as both a celebration and a reaffirmation - of ten years of continuity and applied geophysical research, and of a century of Romanian geophysics, all built upon science, perseverance, and the enduring pursuit of knowledge.

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*Măgurele, Romania, 30-31 October 2025*



## INFRASOUND SIGNALS GENERATED BY PRODUCTION BLASTS IN A NEARBY QUARRY

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The mobile Infrasound Array ISCO of the Austrian National Data Center at GeoSphere Austria is a part of the Central and Eastern European Infrasound Network (CEEIN). It was installed early 2021 at the Trafelberg, with the premises of the Conrad Observatory in Lower Austria. In 2022 and 2023 a multitude of signals caused by production blasts of a quarry in a distance of 16 km to the array were detected at the station ISCO. Approximately 50 signals were selected, analyzed and compared not only with the data of the seismic station CONA at the Conrad Observatory but also with the recordings of the Macro Seismic Sensor Network, a local low-cost sensor network. Blasting parameters were provided by the operator. Values of peak-to-peak amplitudes range between 0.16 and 0.38 Pascal, the half widths of the envelopes vary from 1 to 3 seconds and the frequency range covers 0.25 to 6.35 Hertz.

In addition, video recordings for the blast process and photogrammetric surveys of the blasted rock mass are available for selected events. The videos of the blasting process show an initial expansion of the blasted rock mass, followed by the deposition in front of the blasting area. We interpret the primary increase of volume and the subsequent compaction during the deposition as the source mechanism of the infrasound signal. Numerical modelling results in volume changes during the overall blasting process.

The dominant wavelength of the observed infrasound-signal is significantly larger than the volume of the blasted rock mass. Therefore, we consider the whole process as a 1D process by substituting the volume with the radius of an equivalent sphere. We tested several models which base on the drag equation and a pulsating sphere. The Green Function is derived by deconvolving the signal and the source function. A feasible Green function was provided by the source function created by acceleration (pulsating sphere) which corresponds to the reverberation of sound in a closed room. Those effects were observed as well in open spaces like amphitheatres.



## SPACE-TIME CLUSTERING IN THE VRANCEA SEISMIC ZONE FROM NEAREST-NEIGHBOUR ANALYSIS

Laura Petrescu<sup>1,2</sup> and Bogdan Enescu<sup>3</sup>

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The Vrancea Seismic Zone (VSZ) in the South-East Carpathians, Romania, is an atypical intermediate-depth earthquake nest, often interpreted as a relic slab sinking into the mantle. However, the physical origin of both the slab and the earthquakes it generates remains debated. Seismic clustering patterns can be influenced by deformation regime, fluid content, and thermal state, and can therefore provide valuable constraints on the active seismogenic processes in Vrancea.

Here, we investigate VSZ seismicity ( $M_w \geq 2.5$ , 1977-2023) from the ROMPLUS local catalogue using the nearest-neighbour distance (NND) method. The NND metric integrates differences in hypocentre location, origin time, and magnitude, together with the b-value and fractal dimension of the entire nest, to quantify the correlation between earthquake pairs and distinguish clustered from background events. Clusters are further differentiated into mainshock-aftershock sequences and swarms based on their topological leaf depth and Bath Law.

Our results indicate that only ~8% of earthquakes form space-time clusters, with 12 conventional mainshock sequences with very few foreshocks and 17 swarms identified. Statistical properties of these clusters differ markedly: mainshock sequences exhibit a relatively low b-value (~0.92) and aftershock decay consistent with typical stress relaxation ( $p \approx 0.99$ ), whereas swarms display higher b-values (~1.73) and faster stress release ( $p \approx 1.42$ ), consistent with fluid-driven processes. Swarms are concentrated in the crust, while mainshock-dominated clusters prevail at subcrustal depths and can occasionally trigger shallower aftershocks.

This depth-dependent partitioning points to distinct seismogenic regimes: fluid- and heat-controlled activity in the crust, and abrupt stress release associated with the sinking Vrancea slab at mantle depths. The upward migration of aftershocks from deep mainshocks supports the idea of stress transfer from the descending slab into the overlying crust, with implications for seismic hazard and for understanding crust-mantle coupling beneath the Carpathians.



## ENHANCING SEISMIC EVENT DISCRIMINATION IN THE CARPATHIAN OROGEN USING MACHINE LEARNING ALGORITHMS

Felix Borleanu<sup>1</sup>, Laura Petrescu<sup>1</sup>, Anca Otilia Placinta<sup>1</sup>, Iren Adelina Moldovan<sup>1</sup>, Raluca  
Dinescu<sup>1</sup>, Bogdan Enescu<sup>1,2,3</sup>

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The Carpathian Orogen exhibits a significant seismic activity, including both crustal and intermediate-depth earthquakes mainly driven by the complex tectonic setting, shaped by the collision of several microplates. In recent years, however, anthropogenic seismic events have also been observed, originating from activities such as mining, oil and gas extraction, and infrastructure development. These man-made events often resemble natural earthquakes, making their discrimination challenging. Distinguishing between natural and anthropogenic seismicity is essential for reliable seismic monitoring and hazard assessment."

Using the extended seismic catalogue of crustal events recorded between 2014 and 2025 we apply both unsupervised and supervised machine learning algorithms. We first employ the DBSCAN clustering technique to group events and to identify those occurring during working days, which were labelled as potential anthropogenic sources. These candidate events are subsequently incorporated into a supervised classification scheme using a Random Forest classifier with 200 trees, trained on various features extracted from the catalogue and seismic recordings.

Our results show that DBSCAN effectively isolates likely anthropogenic events, while the Random Forest model achieves high classification accuracy in distinguishing them from tectonic events. Feature importance analysis further highlights the attributes most relevant for discrimination. This methodology demonstrates the value of integrating unsupervised clustering with supervised learning to enhance seismic event classification and improve monitoring of both tectonic and anthropogenic activity in the Carpathian Orogen.

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## REAL-TIME ANALYSIS AND FORECASTING OF CRUSTAL AFTERSHOCK SEQUENCES IN ROMANIA

Cristian Ghita<sup>1</sup>, Bogdan Enescu<sup>1,2</sup>, Like An<sup>2</sup>, Iren-Adelina Moldovan<sup>1</sup>, Constantin Ionescu<sup>1</sup>,  
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Romania is best known for the persistent intermediate-depth seismicity of the Vrancea region, which generates most of the country's seismic hazard. However, important crustal seismicity, although less frequent, also contributes to seismic risk, particularly at the local scale, where damage can be significant. Large crustal earthquakes are rare, but moderate-magnitude events can still be followed by aftershock sequences with implications for safety, infrastructure, and emergency management. This study represents the first systematic attempt to statistically characterize and forecast two recent Romanian crustal aftershock sequences, both triggered by mainshocks of moment magnitude  $M_w 5.4$  – the 2014 Vrancea-Mărășești event and the 2023 Gorj-Oltenia event (Ghita et al., 2025). We adopt a robust, state-of-the-art method previously developed and validated for Japan, enabling quasi-real-time estimation of the Gutenberg-Richter and Omori-Utsu parameters and continuous updates of the probability for larger aftershocks as new seismicity data become available. Several short learning windows (few hours up to one day) followed by operational forecasting intervals are tested. For both sequences, the Gutenberg-Richter b-value lies between 0.8 - 0.9, slightly below the global average of 1.0, suggesting a relatively higher proportion of larger aftershocks. The aftershock decay rate is characterized by a Omori-Utsu law p-value of approximately 1.0, a typical value for crustal settings worldwide. The c-value, indicating the onset time of the power-law decay of aftershocks, ranges from several minutes to a few hours. Although the mainshocks share the same magnitude, the Gorj-Oltenia sequence displays a higher probability for larger aftershocks, possibly reflecting differences in local stress state, fault geometry, or crustal properties. Notably, the Gorj sequence began with a  $M_w 4.8$  shock on 13 February 2023, initially perceived as the mainshock, but followed less than a day later by the actual  $M_w 5.4$  mainshock. Similar situations have been observed in other regions, such as for the 2025 Kamchatka and Santorini earthquakes, underscoring the need to develop reliable real-time forecasting methods at short times after larger earthquakes.

Achieving real-time aftershock forecasting for the Romanian crustal seismicity would open the way to important benefits, including more informed and timely decision-making, clearer risk communication, and stronger emergency response, ultimately enhancing the seismic resilience of affected communities.

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## MANTLE TRANSITION ZONE IMAGING USING P-TO-S RECEIVER FUNCTIONS IN THE ALPINE-CARPATHIAN-DINARIDES REGION

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The mantle transition zone (MTZ), between ~410 km and ~660 km depth, marks major mineral phase changes whose depths are sensitive to temperature, composition, and water content. Variations in these boundaries can reveal the imprint of past tectonic events, the fate of subducted slabs, and heterogeneities in the mantle.

We image the MTZ beneath Central and Eastern Europe using 3D Common Conversion Point migration of P-to-S receiver functions - seismic signals converted at mantle boundaries and extracted from teleseismic earthquake records. This approach allows detailed mapping of the ~410 km, ~520 km, and ~660 km discontinuities.

Our results show MTZ thickening in the Western Alps and central Pannonian Basin and boundary deflections beneath the Carpathians and the Dinarides. These patterns are consistent with the presence of cold stagnant remnants of subducted slabs within the transition zone that tend to shift the depth at which mineral phase changes occur, inflating the MTZ. Additionally, we find disturbances of the 410 km discontinuity beneath the Pannonian Basin which point to mantle upwellings originating in the MTZ or thermal anomalies at this depth. We also detect a mid-MTZ discontinuity at 520 km depth, which is not a global feature, but appears in many regional studies and is often interpreted as a marker of recycled oceanic lithospheric material in the MTZ. These findings provide direct evidence of how past subductions have shaped the present-day mantle beneath the Alpine-Carpathian-Pannonian-Dinarides region.



## EVALUATION OF THE LATEST GLOBAL TSUNAMI: JULY 29<sup>TH</sup>, 2025, KAMCHATKA

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A high magnitude earthquake (Mw 8.8) occurred on 29<sup>th</sup> of July at 23:24 UTC in Kamchatka region, with the following coordinates and depth: latitude 52.53 N, longitude 160. 16 E, depth 20 km. It is considered the 8<sup>th</sup> out of 10 worldwide strongest earthquakes, and the biggest in the last 14 years (since 9.2 Mw earthquake from Japan, 11<sup>th</sup> of March 2011), being followed by a wide spread tsunami, with maximum measured waves of 1.74 m recorded at Kahului Maui sea level station. Other measurements higher than 1 m wave heights are: 1.5 m at Hilo Hawaii, 1.3 m at Kujinko, 1.21 m at Haleiwa Hi and 1.17 m at Hanalei Hi, according to multiple sources: Pacific Tsunami Warning Centre (PTWC), National Weather Service (NWS) and Japan Meteorological Agency (JMA). In the framework of ARISTOTLE (All Risk Integrated System Towards the Holistic Early-Warning) project, tsunami simulations were accomplished using HySEA (Hyperbolic Systems and Efficient Algorithms) modelling software, the results displaying maximum 4 m wave heights. Moreover, using TAT (Tsunami Analysis Tool) software, further simulations resulted in even higher estimates, of maximum 7.3 m waves in 3 different locations from Russia (Staryy Ostrogo, OStrovnaya and Ostrovnoye).

After analysing and comparing the results of the simulations to the measurements, our conclusion is that there is an overestimation of simulation results vs. measurements with both software, double with HySEA, or even 4 times higher with TAT. This discrepancy might be due to the differences in computation methodology, bathymetry and workflow used for each software. Furthermore, the high differences between the measured wave values and those resulted from the simulations could also derive from the initial input earthquake parameters, slip, fault length and width, which are mainly based on the magnitude, not particularly using a computed Moment Tensor solution. Further analysis is necessary, in order to improve the simulations and obtain computations similar to the measurements.

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## ROMANIAN SECULAR VARIATION NETWORK. GEOMAGNETIC MEASUREMENTS

2024-2025

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The magnetic field of the Earth is monitored both at ground, by means of magnetic observatories and repeat stations, and from space, by means of satellites, leading to complex studies and modelling of the geomagnetic field. The secular variation (SV), defined as the time change underwent by the main geomagnetic field produced through a dynamo process in the outer core, is of great importance to geodynamo modelling. The SV studies generally deal with satellite data (presently SWARM constellation), observatory annual means and/or with repeat station data that are reduced to the middle of the measurement year. Generally, a country of Romania's size has only one observatory. The Romanian one, namely Surlari geomagnetic observatory (IAGA code, SUA), was established in 1942.

The information from geomagnetic observatories is supplemented at regional level by repeated measurements in a station network called secular variation network. As regards monitoring the space-time evolution of the geomagnetic field over the Romanian territory (begun as long back as 1964), in the last decade, a systematic survey of the geomagnetic field at the National Secular Variation Network, consisting of 26 repeat stations, has been carried out.

The present study reports the results of geomagnetic measurements carried out in the last two years (2024-2025) at the 26 repeat stations of the Romanian secular variation network. The absolute values of declination,  $D$ , and inclination,  $I$ , have been taken by means of a DI-Flux theodolite (Bartington Mag 01H), of total intensity,  $F$ , by a proton magnetometer (Geometrics G-856). The horizontal component,  $H$ , was also controlled by two QHMs, in order to continue the measurement series started in 1964. The values obtained for the geomagnetic elements have been reduced to the middle of the year (geomagnetic epoch year.5) in which measurements were taken using Surlari geomagnetic observatory data. Maps with geographical distribution on the Romanian territory are presented.



## PETROLOGICAL CONSIDERATIONS ON THE NEW PETROGRAPHIC AND GEOCHEMICAL DATA OF UPPER CRETACEOUS BANATITIC MAGMATISM IN ROMANIA

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Apuseni-Banat-Timok-Srednogorie (ABTS) Belt is a complex calc-alkaline magmatic system that formed during the Late Cretaceous period, spanning for 1,500 kilometers with a width of 30 to 70 km. This belt runs across southeastern Europe, with a north-south orientation in Romania and Serbia and an east-west orientation in Bulgaria, reaching the Black Sea. A large volume of these rocks crops out in Romania

This research aims to capitalize a number of 54 Upper Cretaceous volcanic and subvolcanic/plutonic rock samples collected during several years by our colleague Mihai Tatu in order to reveal the petrological updates. The study is focused on rock composition, geochemistry and geological significance. This article is expected to contribute with new information to the knowledge of these well-known up to now Upper Cretaceous magmatic rocks. The data will be included in a regional database seeking to expand scientific knowledge and influence future regional geological research.



## **DELTA-HUB: a new EU-funded project on river delta science, education and modelling**

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River deltas – crucial ecosystems that sustain hundreds of millions of people – are experiencing an unprecedented crisis driven by climate change and human activity. Sediment depletion, land subsidence, rising sea levels, and unsustainable management practices are eroding their resilience, threatening biodiversity, livelihoods, and essential ecosystem services.

To confront these challenges, the University of Bucharest has launched DELTA-HUB (River Delta Science, Education, and Modelling Hub), a Horizon Europe ERA Chairs initiative that establishes a world-class center for research, education, and policy innovation within the Danube Delta.

Built on an integrated model of research, education, and engagement, DELTA-HUB aims to develop the next generation of delta experts through a comprehensive training framework for students and postdoctoral researchers. The program offers advanced skills in field methods, remote sensing, and process-based modelling, ensuring long-term scientific and management capacity.

Equally, DELTA-HUB seeks to bridge science and policy by translating research into actionable strategies for sustainable delta management. Central to this effort are stakeholder partnerships, policy-oriented workshops, and co-creation processes that connect evidence-based science with governance. A key outcome will be the Web Platform for Sustainable Delta Management – an open-access portal providing data, modelling results, and scenario analyses for decision-makers and local communities.

Aligned with the European Green Deal and supporting initiatives such as the proposed UN Convention on Conserving River Deltas (UNCCRD), DELTA-HUB represents a replicable model of science-informed governance. While grounded in the Danube Delta, its approach is designed to foster global collaboration across the world's major delta systems.



## SGAR – GEOPHYSICS EDUCATION PROGRAMS & OUTREACH CAMPAIGNS

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As a scientific and professional association dedicated to promoting geophysical knowledge and its applications in Earth studies, the Romanian Society of Applied Geophysics (SGAR) actively develops programs that strengthen academic training, support young scientists, promote professional development, and enhance societal understanding of geosciences.

A major pillar of SGAR's mission is its sustained involvement in educational initiatives that directly benefit students of the Faculty of Geology and Geophysics of the University of Bucharest. Through field camps, hands-on training, mentoring programs, and logistical support, SGAR contributes to maintaining student engagement - an ongoing challenge linked to the diverse educational backgrounds of incoming cohorts.

SGAR has significantly expanded the scope of advanced field training through its partnership with the Bucharest Student Chapter of SEG. The 2024 and 2025 editions of the SEG Field Camp represent flagship examples of this evolution. The 2025 Field Camp in Rătești introduced participants to geophysical investigations in a landslide-prone area, under the theme RO-GEO4SDG: "Unlocking the Past - Securing the Future." Students engaged in seismic surveys, GPR, electrical resistivity tomography, drone photogrammetry and cutting-edge satellite radar interferometry (PSInSAR) techniques to analyse ground deformation, infrastructure vulnerability, and land instability. The outcomes - including datasets, case studies and student-led reports - will feed into future teaching, theses and research initiatives, thereby sustaining the camp's educational impact well beyond its field period. Likewise, the 2024 RO-GEO4HUMANITY initiative expanded training into humanitarian and security-focused applications, offering hands-on experience with UXO geophysical detection, and the interpretation of seismic and infrasound signatures of weapons testing - filling a notable gap in traditional geoscience curricula. These activities place Romanian geophysics education at the forefront of modern applied geoscience, bridging traditional fieldwork with emerging societal challenges.

Complementing its field programs, SGAR organizes workshops, scientific meetings, and public campaigns that elevate the visibility of geophysics. Events such as the Geoscience International Symposium, discussion panels, and book publications foster knowledge exchange and strengthen the community of early-career researchers. Through these integrated educational and outreach efforts, SGAR effectively cultivates a new generation of geoscientists while enhancing public awareness of the discipline's societal relevance.



## **BUILDING BRIDGES BETWEEN STEM EDUCATION AND GEOSCIENCE CAREERS: THE ROLE OF THE EGU GEOSCIENCE FIELD OFFICER IN ROMANIA**

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Geoscience education plays a crucial role in raising awareness of Earth processes, natural hazards, and sustainable development. Since 2023, the European Geosciences Union (EGU) has appointed national Geoscience Field Officers (GEFOs) to promote geoscience outreach, teacher training, and engagement with local communities. In Romania, the GEFO programme has become a catalyst for connecting research institutions, schools, and geoparks, while providing teachers with innovative tools to integrate geoscience into STEM education.

This contribution presents recent initiatives undertaken by the Romanian GEFO, focusing on three main directions: (i) dissemination of EGU activities such as the Geosciences Information for Teachers (GIFT) workshops, (ii) the organization of hands-on summer schools for teachers and students in Bucharest-Măgurele and in UNESCO Global Geoparks such as Buzău Land, and (iii) the integration of Earth Learning Ideas into classroom and field-based activities. These actions address both the professional development of teachers and the early engagement of high school students with geoscience-related career paths.

The workshops and field activities combine interactive demonstrations, low-cost experiments, and place-based learning in natural laboratories. Teachers are encouraged to adapt these resources to their curricula, thus linking geoscience with physics, chemistry, biology, and geography. The emphasis on inquiry-based learning and student participation has proven to increase curiosity, understanding of Earth processes, and awareness of natural hazards.

A key objective of the programme is to foster collaboration among researchers, educators, and policymakers. By sharing best practices and creating networks between universities, research institutes, and schools, GEFO activities in Romania contribute to strengthening the visibility and societal relevance of geosciences. The outcomes highlight the need for continued investment in teacher training, interdisciplinary STEM approaches, and the development of open educational resources.

This presentation will serve as both a synthesis of ongoing activities and a call to action. Researchers, teachers, and educational stakeholders are invited to join efforts in promoting geosciences as a vital component of STEM education and in inspiring the next generation of geoscientists.



## MORPHOMETRIC ANALYSIS OF IALOMIȚA CAVE USING TERRESTRIAL LASER SCANNING AND DRONE-BASED SLAM LIDAR

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Traditional cave mapping methods are time-consuming and often constrained by accessibility, especially in vertical shafts, elevated chambers, or hazardous passages that require technical speleological climbing. LiDAR-based technologies overcome many of these limitations, enabling rapid and precise 3D documentation of underground spaces. This study presents a morphometric survey of Ialomita Cave, located in the Bucegi Mountains, Romania, at 1623 m altitude, with a mapped length of 1128 m and a vertical range of 62 m. The cave, developed in limestone and historically used as both a monastic refuge and a touristic site, was surveyed using two complementary systems: a Leica RTC360 terrestrial laser scanner (TLS) and a Flyability Elios 3 drone equipped with an Ouster SLAM LiDAR sensor.

The TLS survey involved 66 scanning stations, each acquiring dense point clouds at millimetric precision (up to 2 million points per second) with full 360° coverage. The drone-based SLAM LiDAR extended mapping capabilities into galleries and chambers that are difficult or impossible to access with static instruments. Combined, the two datasets yielded approximately 70 billion points, processed into high-resolution 3D models, digital terrain representations, cross-sectional profiles, and 2D cave maps. Integration with GPS control points allowed the spatial orientation of the dataset within the local geodetic reference system.

The resulting 3D model provides a detailed representation of the cave's morphometry, supporting volumetric and geomorphological analyses as well as investigations of geological structures, paleoclimate archives, and vulnerability to environmental change. Beyond scientific applications, the dataset offers valuable resources for cultural heritage documentation and for the promotion of speleological tourism, through both virtual exploration and improved visitor management.

This work demonstrates the potential of combining TLS and drone-based SLAM LiDAR for high-resolution morphometric cave analysis, offering a powerful methodology for research, conservation, and hazard assessment in fragile subterranean environments.

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## PEATLAND SUITABILITY MAPPING USING REMOTE SENSING AND GIS TECHNIQUES FOR INFRASTRUCTURE PLANNING: BRAȘOV-BACĂU HIGHWAY, ROMANIA

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Peatlands are sensitive ecosystems of high ecological and hydrological importance and represent a significant challenge in the planning of infrastructure projects due to their unstable physical and chemical properties. This study aims to produce a peatland suitability map along the proposed Brașov-Bacău motorway in Romania, using remote sensing techniques and geographic information systems (GIS) to support decision-making in infrastructure planning and geotechnical risk assessment. The methodology incorporated several spatial parameters affecting peatland formation, including elevation, slope, topographic wetness index (TWI), Normalized Difference Vegetation Index (NDVI), Normalized Difference Water Index (NDWI), Normalized Difference Moisture Index (NDMI), Land Surface Temperature (LST), Depression type, soil type, land use and hydrological regime. Topographic data extracted from a digital elevation model (DEM) were classified into elevation and slope categories to identify low-lying areas with poor drainage. TWI was also used to identify flood-prone areas, a key factor in the development of peatland environments. Soil data were collected from accurate national surveys and classified to identify peat-supporting soil types, such as histosols and hydrated soils (gleisols), which received the highest suitability scores. All layers were converted to raster formats, recalibrated to five suitability scores and combined using multi-criteria analysis (MCA) to generate the Peatland Suitability Index (PSI). The model was validated using field data from 88 geotechnical drilling sites, where the presence of peat layers was confirmed by laboratory analysis of organic matter (humus) content. The ROC curve results showed high model accuracy, with an ASC of approximately 0.953, demonstrating the effectiveness of the model in predicting suitable peatland sites. This study provides a practical and applicable framework for assessing peatland suitability using GIS and remote sensing tools, contributing to supporting sustainable infrastructure planning and avoiding areas of high geotechnical risk. The proposed methodology can be adopted in other regions with similar conditions, especially in the context of large-scale projects such as highways or national transport networks.



## SEISMO-ACOUSTIC OBSERVATION OF THE EXPLOSIVE SOURCES AT NEAR-REGIONAL DISTANCE (RUSSIA-UKRAINE CONFLICT)

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A combined analysis of seismic and acoustic signal observations for tracking explosive sources generated by the bombardment and shelling during the Russia-Ukraine conflict is presented. Events reported in the bulletins provided by IDC/CTBTO are used to identify and associate detections of the Romanian arrays: seismic (BURAR) and infrasonic (BURARI and IPLOR). Seismo-acoustic signature (signal shape and amplitude, frequency content), as well as the propagation path of infrasonic signals, were analysed. Spectrograms of infrasonic and seismic waveforms were computed as an important tool for the examination of frequency content and energy released by the explosive sources.

The directions from IPLOR and BURARI infrasound data were estimated. Locations obtained by cross-bearing the derived back azimuths are affected by deviating effects of zonal cross winds along the propagation path through the atmosphere. Acoustic phase identification on both seismic and infrasound instruments was performed using array analysis and atmospheric ray tracing. By using infraGA 2D ray tracer through NRL-G2S atmospheric model, stratospheric and thermosphere infrasonic phases were identified to be observed at BURARI and IPLOR stations.

A specific array tool has been applied for seismo-acoustic data processing in order to detect the signals and to investigate the nature of the signals: CEA/DASE PMCC detector embedded in DTK-PMCC and DTK-GPMCC (CTBTO/NDC-in-a-box). DTK-DIVA tool (CTBTO NDC-in-a-box) was used to visualize and analyse the detections.



## STRENGTHENING NUCLEAR HAZARD MONITORING THROUGH ATMOSPHERIC RADIOXENON ISOTOPES MEASUREMENTS IN ROMANIA

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Atmospheric radionuclides are widely recognized as sensitive tracers for monitoring nuclear activities, supporting both treaty verification and environmental monitoring. We present results from SAUNA Qube, an automated system for the collection and analysis of atmospheric radionuclides, designed to enable rapid source assessment and early hazard warning. The system processes ambient air through multistage adsorption to isolate xenon. The collected xenon volume is quantified, and activities of  $^{131m}\text{Xe}$ ,  $^{133}\text{Xe}$ ,  $^{133m}\text{Xe}$ , and  $^{135}\text{Xe}$  are measured by  $\beta$ - $\gamma$  coincidence spectroscopy. Based on their different half-lives  $^{135}\text{Xe}$  (9.1 h),  $^{133m}\text{Xe}$  (2.2 d),  $^{133}\text{Xe}$  (5.2 d), and  $^{131m}\text{Xe}$  (11.9 d), these isotopes provide complementary information. For example, short lived nuclides indicate proximity to recent emissions, while longer lived species extend the detection range and constrain atmospheric transport. Two radionuclide stations are now operational in Romania, since winter 2024 in Campulung Moldovenesc (Qube 1) and spring 2025 in Eforie Nord (Qube 2). Twice daily sampling with backtrajectory modeling (i.e., FLEXPART and HYSPLIT) revealed distinct detection patterns in Xe. To date, Qube 1 has reported detection frequencies of 11.1% ( $^{131m}\text{Xe}$ ), 96.0% ( $^{133}\text{Xe}$ ), 15.1% ( $^{133m}\text{Xe}$ ), and 5.6% ( $^{135}\text{Xe}$ ), while Qube 2 has shown higher rates for  $^{131m}\text{Xe}$  (33.9%),  $^{133m}\text{Xe}$  (9.8%) and  $^{135}\text{Xe}$  (7.3%), but a lower frequency for  $^{133}\text{Xe}$  (75.0%). These differences reflect regional emission influences, specific meteorological conditions for each site, and transport pathways. At both stations,  $^{133}\text{Xe}$  dominated detections, consistent with its half-life and common release during standard operations of nuclear facilities. Background levels of  $^{133}\text{Xe}$  in the global atmosphere typically range between 0.01 and 5 mBq/m<sup>3</sup>, with episodic peaks of several mBq/m<sup>3</sup> near nuclear power plants and medical isotope facilities. These values largely reflect anthropogenic sources. The results obtained in Romania fall within the expected anthropogenic background, with detection patterns closely matching routine civil emissions. Importantly, the concentrations measured with the SAUNA Qube system are extremely low and present no risk to public health or the environment.

These deployments demonstrate the existing capabilities to provide reliable, regular data for both scientific and regulatory applications. By integrating sensitive isotope detection with atmospheric transport modeling, the system enhances regional capacity for nuclear hazard assessment and strengthens Europe's role in global monitoring networks.

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## RADON AS NATURAL TRACER FOR OTHER CONTAMINANTS

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Radon (<sup>222</sup>Rn), a naturally occurring radioactive noble gas generated in the uranium-238 decay series, is increasingly used as a natural tracer in environmental studies. While it is primarily known as the leading source of natural radiation exposure to humans, its unique physical and chemical characteristics – such as inertness, short half-life, and ease of detection—make it a valuable tool for investigating the presence, movement, and interaction of other contaminants. Radon’s mobility in soil, groundwater, and the atmosphere enables researchers to identify transport pathways, diffusion processes, and transfer mechanisms that are often shared with chemical pollutants, including heavy metals, organic compounds, and other radionuclides. By monitoring radon concentrations, it is possible to infer the dynamics of contaminant migration and to assess environmental risks associated with both natural and anthropogenic sources. This approach has proven especially useful in groundwater studies, soil-gas investigations, and indoor air assessments, where radon acts as a sensitive indicator of subsurface processes.

The applications of radon as a natural tracer therefore represent an effective, non-invasive, and cost-efficient method to complement traditional monitoring techniques, contributing to a deeper understanding of contaminant behavior and to the development of improved strategies for environmental protection and risk management.



## ASSESSMENT OF THE POTENTIAL FOR GEOTHERMAL RESOURCE UTILIZATION IN THE BEIUȘ BASIN

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The Beiuș Basin (northwestern Romania) is a post-tectonic intramontane depression within the Apuseni Mountains, underlain by a heterogeneous basement composed of Paleozoic and Mesozoic formations. Hydrogeological and geophysical investigations, supported by deep geothermal drilling, indicate that the Triassic dolomites represent the main geothermal „reservoir” (actually a hydro-geothermal system), which is crosscut by major fault networks that ensure recharge from the surrounding massifs. Data from deep geothermal wells (e.g., F-3001H, F-3003H, F-3005H) indicate the presence of low-to-medium enthalpy geothermal waters, with measured temperatures ranging from 72 °C to 81 °C at depths between 2,100 and 2,700 m. Complementary datasets – including geophysical surveys conducted between 1961 – 1982 and interpreted by Dinu et al. (1991), deep-well geological information collected by TRANSGEX SA, regional geological studies (Orășeanu, 2015), and recent hydrogeochemical analyses (Balassa et al., 2023) – now allow a more robust characterization of the basin. Together, they help refine our understanding of depths, temperatures, and subsurface water dynamics in the region.

The northwestern Galbena Fault System remains the principal recharge pathway of the hydro-geothermal system, channeling waters from Bihor and Pădurea Craiului Mts. However, the southwestern Codru-Moma Mts. and their associated fault systems must also be considered as recharge sources, as this sector represents the known accumulation area of the hydro-geothermal system currently exploited in Beiuș Municipality. The subsurface architecture of the Mesozoic formations, strongly influenced by Neogene magmatism, creates both permissive and restrictive conditions for groundwater circulation. Geophysical data further suggest the presence of intrusive magmatic bodies within the basin, which may retain residual heat but are unlikely to sustain water-bearing systems. All these data sets provide a coherent framework for assessing the spatial distribution of geothermal resources in the Beiuș Basin. These results expand the knowledge regarding the basin’s significant potential for geothermal energy utilization, supporting both local development and broader regional energy transition strategies.



## **petrophysics vo.1.3 – A PYTHON LIBRARY WITH USEFUL FUNCTIONS FOR WELL LOG INTERPRETATION**

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The interpretation of geophysical well logs is a fundamental process in reservoir characterization in oil and gas industry, providing essential data like subsurface lithology, fluid saturation, porosity and permeability. This article introduces *petrophysics vo.1.3*, an open-source Python library developed to provide a robust suite of functions for the analysis and interpretation of geophysical well log data.

Python is an essential programming language and an indispensable tool in the geoscience community. Its wide range of specialized external libraries makes it a primary choice for geoscientists, enabling them to easily share and collaborate on their research. This is why *petrophysics vo.1.3* was developed using Python.

The entire package contains a large collection of classical petrophysical equations, written as Python functions and grouped in the following categories: clay volume calculation, temperature estimation, lithology, permeability (e.g. Tixier, Timur, Coates formulas), porosity (e.g. from sonic, density, neutronic methods), resistivity, basic rock physics equations, salinity, water saturation calculation (e.g. Archie, Simandoux, Indonesian formulas), etc. The package intends to be a useful tool for students, researchers, professionals and to make petrophysical analysis and interpretation more facile and accessible.

The *petrophysics vo.1.3* library has existed for nine years, having been built and posted on collaborative repositories like GitHub in 2016. A new review and update of the package is planned for the near future to make the library even more comprehensive and useful for petrophysicists.



## SEASONAL VARIATIONS OF HV RATIOS OF SEISMIC NOISE ACROSS ROMANIA: INSIGHTS INTO SOIL MOISTURE AND HYDROLOGICAL LOADING

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The Horizontal-to-Vertical (HV) spectral ratio of seismic noise is a well-established technique for probing near-surface site conditions and identifying subsurface structural contrasts. Its efficiency and robustness have led to widespread application in both seismic hazard assessment and environmental studies. In this work, we investigate the seasonal variability of HVSRs across Romania, with a focus on amplitude changes and frequency shifts of prominent spectral peaks throughout the year. We explore how environmental factors, including precipitation, snowmelt, and soil moisture variations, modify near-surface mechanical properties, thereby influencing the spectral characteristics of ambient seismic noise. Broadband seismic data from multiple stations are analysed together with meteorological and hydrological records, some of which sourced from ERA5 reanalysis products, to assess correlations between HVSR variability and seasonal environmental loading. To complement this observational analysis, we apply a probabilistic inversion of HVSR curves to explore shallow velocity structures and their associated uncertainties. The inversion uses a Markov-chain Monte Carlo (MCMC) approach under the diffuse field assumption, allowing the investigation of a wide range of velocity-depth models without being constrained by local minima. The resulting profiles provide estimates of uncertainties and are used to examine potential relative changes in shallow shear-wave velocities related to seasonal forcing. Rather than emphasizing detailed stratigraphy, the inversion is employed to investigate how the shallow subsurface may respond to environmental variability over the course of the year. Model evaluation relies on misfit functions, while parameter uncertainties are assessed through posterior probability distributions and covariance analysis. By jointly examining seasonal HVSR variability and probabilistic structural inversions, this study provides new insights into how environmental forcing interacts with subsurface properties. The results have direct implications for improving site response estimates, refining seismic hazard assessments, and exploring the use of ambient seismic noise as a tool for hydrological and environmental monitoring in regions subject to strong seasonal climatic fluctuations.

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## HOW TO RECOGNISE, BALANCE AND REPAIR MINING DAMAGE ON SOCIETIES AND THE ENVIRONMENT IN THE EU - EUMINDA 2025-2029

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The aim of the project is to improve public policy instruments, through exchange of experience and transfer of knowledge between stakeholders at European level, for economic growth in mining areas. EUMINDA aims to improve regional development policies related to local mining damages (MDL), addressing three key thematic pillars: (1) Legal aspects – clarifying responsibilities and the legal status of affected areas; (2) Socio-economic concerns – supporting affected communities and finding solutions for sustainable development; (3) Sustainability challenges – protecting the environment and promoting responsible practices.

The project structure allows for both regional and inter-regional learning, facilitating the exchange of good practices and specific improvements to policy instruments. EUMINDA's communication strategy plays a key role in supporting these efforts, ensuring stakeholder engagement, raising public awareness and wide dissemination of the knowledge gained across the European Union.

In the case of Romania, EUMINDA aims to improve the Annual Programme for the conservation, closure, environmental remediation and post closure monitoring of mining sites (PCCEP).

Actions:

- Analysis of current conditions in Hunedoara County, regarding active and inactive mining operations: underground coal, ferrous and gold-silver ore mining operations.
- Analysis of the impact of mining on affected areas, current needs and identification of their gaps at local and county levels to facilitate environmental remediation and greening programs.
- Implementation of best practice measures from partner countries regarding greening and reconstruction works of former mining areas.
- Replication of the results obtained within the project on a national scale.

The project EUMINDA is implemented in the framework of the Interreg Europe programme and co-financed by the European Union.



## **THERMAL STRESS TRENDS AND HUMAN VULNERABILITY IN EUROPE (1940–2023). IMPLICATIONS FOR CLIMATE RESILIENCE AND SUSTAINABLE DEVELOPMENT**

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Thermal stress over Europe during 1940–2023 was assessed with the Universal Thermal Climate Index, using ERA5-HEAT reanalysis at hourly resolution. Drivers of thermal stress were isolated with a one-at-a-time substitution experiment for air temperature, relative humidity, wind speed, and mean radiant temperature. City-scale behavior was examined for 118 urban areas. Heat Vulnerability Index values were computed at NUTS-2 using EUROSTAT indicators for exposure, sensitivity, and adaptive capacity. Results indicate a continental shift toward milder conditions, accompanied by expanding warm-season stress in southern regions. Hours with no to moderate stress increased by about 0.6 percent per decade, while cold stress declined by about 0.67 percent per decade. Heat stress rose from a low baseline by about 0.06 percent per decade. Winter months showed the fastest change. January cold stress dropped by about 1.93 percent per decade, with corresponding gains in no to moderate stress. Summer trends concentrated in late spring and midsummer. July heat stress rose by about 0.27 percent per decade. Air temperature and mean radiant temperature dominated long-term UTCI increases across northern and central Europe, with typical warming of 0.2 to 0.6 degrees Celsius per decade. Declining wind speed added to thermal stress in parts of central and eastern Europe. Relative humidity showed mixed signals across the continent. Interaction terms suggested partial compensation among drivers in some regions. Spatial patterns remained distinct. Cold stress persisted over northern and high-elevation areas, yet with widespread decreases of 4 to 12 hours per year. Heat stress concentrated around the Mediterranean, with increases of 4 to 6 hours per year. City analysis showed strong positive heat-stress trends for Mediterranean and southeastern cities, and widespread declines in cold stress for northern cities. Coastal locations tended to show fewer heat-stress hours than inland peers at similar latitudes. Vulnerability analysis highlighted higher risk across southern and eastern Europe, where frequent heat stress coincided with larger elderly shares, higher poverty risk, and lower GDP per capita. Findings support targeted urban cooling, ventilation corridors, and public-health interventions, with priority for regions combining high exposure and limited adaptive capacity.

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## SEVERE STORMS IN ROMANIA: HAZARD, IMPACT, ADAPTATION

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Severe storms risk in Romania was assessed with a multi-source framework aligned with Sustainable Development Goals and critical infrastructure protection. Long term patterns, based on different datasets, show declines in hours with favorable environments for severe storms across many regions, linked to stronger convective inhibition and lower humidity in the 0 to 4 km layer. When storms are triggered, higher intensity is observed. The 2024 database of severe weather events lists more than 1100 reports, and lightning maxima in 2024 cluster over the mountain and Subcarpathian areas. Projected change was evaluated at warming levels of plus 1.5, 2.0, and 3.0 degrees under SSP585. Frequency of hail above 5 cm increases over central and northern Romania, reaching about plus 30 percent at plus 3 degrees. Hail above 2 cm tends to rise in north and center, with decreases in the southeast near minus 12 percent. Vulnerability to severe storms peaks in Vâlcea, Argeş, Olt, Teleorman, Prahova, Buzău, Suceava, and Neamţ. Lower values appear in Bucharest, Ilfov, Constanţa, and parts of the west and northeast. Risk to energy, transport, and communications networks is emphasized by 2024 impacts. Actionable measures are presented. Urban programs should include tree risk inventories, anchoring of exposed building elements, expansion of permeable surfaces, and modern drainage. Critical networks should be protected against wind and debris. Agriculture should adopt hail nets, shelter belts, and farmer focused alerts. Public education and impact-based warnings should be scaled nationally before the warm season. The approach supports United Nation Sustainable Development Goals, in particular Good Health and Well-being, Sustainable Cities and Communities, and Climate Action, and contributes to international security by protecting critical infrastructure and supply chains.

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## **THE EVOLUTION OF THE HYDROCLIMATE IN THE LOWER DANUBE BASIN UNDER THE IMPACT OF ENDOGENOUS AND EXOGENOUS FACTORS**

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In this study, a review of our recent investigations regarding the evolution of the hydroclimate in the lower Danube basin, under the impact of the external factor – the solar variability, as well as climatic factors, is presented.

The variable of interest was the Danube discharge at Orsova (Q), the station representing an integrator of precipitation from the upper and middle basins. Among the atmospheric variables that can influence the variability of Q, large-scale atmospheric circulation indices (Greenland-Balkan Oscillation index (GBOI), North Atlantic Oscillation index (NAOI)), temperature and precipitation, and Palmer-type drought indices were considered. The solar variability was described by various indices: sunspot number (SSN), solar radio flux (F<sub>10.7</sub>), aa geomagnetic index. In general, the tests were performed for variables defined at monthly and seasonal levels.

To test the connection between atmospheric and extra-atmospheric factors that influence the hydroclimate variability in the Danube basin, both relatively simple statistical methods (Pearson correlations, the decomposition into empirical orthogonal functions (EOFs) and multiple EOFs (MEOFs), multiple linear regressions (MLR)) and more complex statistical methods were applied. Among the methods that highlight the type of linear/non-linear relationship, the nonlinear correlation coefficients (NLR) based on mutual information were used. To eliminate redundant predictors, a measure of multivariate information, namely the redundancy-synergy index (RSI) was applied. The quantification of the information transfer, which outlines causality, from a predictor variable to the predictand variable was achieved by calculating the transfer entropy (TE). To highlight the time-frequency distribution of the relationship between the studied variables, we applied wavelet analysis. An experiment was also conducted by applying the extreme learning machine (ELM), finding the most efficient influence of certain atmospheric circulation indices for estimating Q. Also, the methods used to eliminate noise from the data, as well as the use of linear/non-linear relationships between geophysical/exospheric and hydroclimatic parameters, allowed us to make robust long-term predictions.

A novelty of the present paper is the result of chaotic/nonchaotic quantification through Lyapunov exponent, return map Poincaré, informational entropy. This approach will allow us, in the future, to specify with defined errors the risk of hazardous hydrological phenomena, of practical utility and major economic and social interest.



## NATURAL HAZARD ASSESSMENT IN THE SIUTGHIOL LAKE AREA FROM THE WESTERN BLACK SEA COAST

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Siutghiol Lake, located along the western Black Sea coast, lies within the Black Sea Basin—a back-arc basin formed during the Early Cretaceous–Early Paleogene by the subduction of the Neotethys Ocean beneath the Balkanides-Pontides volcanic arc. The surrounding region is framed by active Alpine orogenic systems, including the Caucasus-Crimea, Balkanides-Pontides, and North Dobrogea–Strandja-Sakarya zones, which contribute to a complex tectonic and geological setting. Structurally, the area is segmented into two major extensional sub-basins (Western and Eastern), separated by the Mid-Black Sea Ridge (Andrusov Ridge).

The seismic hazard at Siutghiol Lake results from local crustal sources ( $M_{max}7.2$ ), broader Black Sea seismic sources ( $M_{max}7.2$ ), and the intermediate-depth Vrancea zone ( $M_{max}7.9$ ). Probabilistic seismic hazard analysis (PSHA), integrates the activity rates of all relevant sources to estimate probabilities of macroseismic intensity, peak ground acceleration, and peak ground velocity. In this study, macroseismic intensity is emphasized, as it directly correlates with potential damage to critical infrastructure. Extreme but low-probability earthquakes with  $I_{MSK} > VIII$  could significantly impact dams, roads, bridges, industrial facilities, residential areas, and lake systems.

Large marine earthquakes may also generate tsunamis. Historically, 22 tsunami events have been documented in the Black Sea region. Using parameters from Moldovan I.A. (2013) and a numerical procedure, the expected and most probable magnitudes and their recurrence intervals for the Shabla tsunamigenic source were used for assessing the most severe tsunami scenario, considered highly unlikely due to the limited length of the Shabla faults.

Other geophysical phenomena, such as natural gas emissions from the sedimentary basin, may also pose environmental risks. These hazards raise scientific questions about their influence on freshwater and coastal ecosystems: Can earthquakes, tsunamis, or gas emissions affect eutrophication processes beyond climatic and anthropogenic factors? How likely are such impacts? The Siutghiol Lake case study provides initial insights, highlighting the need to integrate geophysical hazards into ecosystem and climate resilience assessments.



## ABSOLUTE GRAVIMETRY IN BUCHAREST: MICRO-G LACOSTE A-10 VS PHYPHOX

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The accurate determination of the Earth's gravitational field is essential for geophysical studies, geodesy, and applied Earth sciences. This work presents a comparative analysis of absolute gravity measurements performed in the metropolitan area of Bucharest, Romania, using a Micro-g LaCoste A-10 absolute gravimeter and complementary observations obtained with a mobile application (Phyphox) on a smartphone platform. The main objective was to assess the accuracy and applicability of portable and low-cost sensing methods in comparison with established absolute gravimetry techniques, and to evaluate the potential of such tools for educational and preliminary survey purposes.

Field campaigns were conducted at selected points across Bucharest, covering both urbanized and less developed areas. The measurement protocol included instrument setup, calibration procedures, and corrections for tidal effects, latitude, and instrumental drift. Residual gravity anomalies were calculated relative to the normal gravity field, using the WGS84 reference ellipsoid. The anomalies were then compared against values derived from the World Gravity Map 2012 (WGM2012) global model, providing an external benchmark for interpretation.

The results confirm that the A-10 absolute gravimeter provides precise and reliable values of gravity, which serve as a baseline for anomaly determination. Interpolated using the inverse distance weighting (IDW) method, the calculated residual gravity anomaly variations are in agreement with the reference values reported by the International Bureau of Gravimetry (France). In contrast, the Phyphox application, although limited in precision, successfully reproduced the general spatial trend of the anomalies. The differences between the smartphone-based and absolute gravimeter measurements remain within an order of magnitude that is acceptable for didactic applications, but not for professional geophysical surveys.

The main conclusion is that absolute gravimetry remains indispensable for high-accuracy investigations, while smartphone-based solutions can complement professional data by offering accessibility for outreach, rapid reconnaissance, or educational activities. This study demonstrates that integrating conventional gravimetric techniques with innovative digital tools provides a broader perspective for both applied research and science communication.

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## INTEGRATION OF STATISTICAL PREDICTION AND STANDARD METHODS FOR ACCURATE SOIL PLASTICITY ASSESSMENT

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Accurate determination of soil plasticity parameters is fundamental to geotechnical engineering, influencing the assessment of bearing capacity, settlement behavior, and slope stability. In Europe, standardized procedures - such as those specified in Eurocode 7 - provide a normative framework to ensure reliability and comparability of results across projects and regions. In Romania, these procedures are complemented by the national standard NP 122/2010, which adapts Eurocode principles to local soil conditions. While these methods are well established, they typically require extensive laboratory testing and may not fully exploit the predictive potential of soil property correlations. Additionally, the characteristic value of these parameters often differs significantly between engineers, especially when the available data is highly variable within the same layer.

This study aims to address this gap by conducting a comparative analysis between characteristic values of the plasticity index and consistency index obtained using a mathematical-statistical approach and those determined by the conventional Eurocode 7 and NP 122/2010 methodologies. The investigation focuses on the Doftana region, using representative samples of clayey marls and marls.

The case study is focused on Doftana region, using a representative number of marly clay and marl samples collected from geotechnical boreholes at varying depths between 2.80m to 34.80 m.

The statistical approach involved developing predictive relationships for the target parameters as functions of liquid limit, depth, and clay content. For this purpose, multivariate statistical regression was applied to obtain strong equations with a determination accuracy greater than 95% and normal distribution of residual values. The characteristic values derived from these models were directly compared to those calculated via standard procedures, with the aim of evaluating not only accuracy but also the potential for reducing testing time, optimizing resource allocation, and enhancing predictive capability in European geotechnical practice.



## ROMANIAN-UNESCO HERITAGE SITES EXPOSED TO GEOMORPHOLOGICAL HAZARDS AND SURVEY APPROACHES

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This study focuses on assessing the exposure of Romanian UNESCO cultural heritage sites, specifically Sighisoara Citadel, Prejmer Fortress, and Horezu Monastery to geomorphological threats related to slope instability, including rockfall, landslides, and human-induced pressures such as construction, hydrotechnical works, and urban encroachment. A comprehensive spatial analysis was conducted using a Geographic Information System (GIS) framework integrated with multicriteria analysis (MCA) to evaluate site-specific susceptibility and vulnerability.

The methodology involved the identification and ranking of various hazard types, a detailed inventory of site attributes (such as structural material, age, foundation depth, and conservation status), and the weighting of contributing hazard factors. A key part of the hazard assessment involved the use of Vertical Electrical Soundings (VES). VES measurements helped to detect subsurface moisture levels, lithological variations, and potential zones of instability. These measurements provide insights into ground conditions that are not visible on the surface but significantly influence structural vulnerability.

Results reveal varying degrees of exposure and risk across different heritage sites. Some locations resulted in being under imminent threat due to a combination of high hazard intensity and structural vulnerability, while others, despite being exposed to hazards, benefit from favourable site conditions or have previously implemented mitigation measures. The findings support the development of targeted risk mitigation strategies, serving as a valuable tool for site managers, urban planners, and conservation authorities. By identifying the most at-risk heritage locations, this approach enhances the potential for implementing preventive measures and promotes the sustainable preservation of cultural assets amid increasing environmental and anthropogenic pressures. Furthermore, preserving UNESCO's cultural heritage sites while enhancing their tourism attraction role and growing the cultural and educational value of the whole region, aligns with Sustainable Cities and Communities goals (SDG 11).



## MONITORING EXTREME EVENTS IN THE BLACK SEA AREA

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NIEP has developed a system for monitoring extreme events (storms, tornadoes, lightning, tsunamis) at the Black Sea in its center in Eforie with measurement points along the entire Romanian coastline. For this purpose, along with traditional seismic equipment (seismometer and accelerometer), lightning detectors and atmospheric electrostatic field measurement, ceilometer, weather stations, water level radars, coastal and offshore beacons (cooperation with GEOECOMAR), air ionization, ozone and infrasound measurement equipment are used. These parameters generate warnings when pre-established limits are exceeded, which are analyzed in real time. Depending on the most likely scenario, warning messages are sent locally and to specialized organizations for emergency situations (IGSU mainly). Data analysis shows an interaction between phenomena in the Black Sea and the Mediterranean Sea. For this purpose, we use monitoring stations from the UNESCO/IOC network located in the Mediterranean Sea. During 2014, several extreme events were monitored. An example is the extratropical cyclone Boris (August 30 and 31, 2024), which brought storms and heavy rains to the coast. The extreme atmospheric instability it produced prompted the National Meteorological Agency to issue yellow and orange warnings in certain areas of Constanța and Tulcea. Cyclone Boris and the devastating floods that hit Central European countries were largely caused by climate change, according to the latest specialist study. Climate change affects the Black Sea region locally due to differences in water and air temperature, but can also occur outside the area due to storms originating from the Atlantic or the North Sea. During a storm, there can be over 58,000 electrical strikes. The existing monitoring system can be expanded with new stations to measure water level and temperature, on which the ocean currents depend. One direction of development concerns the more efficient use of data. For example, the Boltek EFM100 devices are used individually, but by installing new devices at a distance of less than 30 km between them, they can be used to locate thunderstorms with better resolution than the Boltek LD250 lightning detector. In addition, the software applications need to take into account new scenarios created by the effects of extreme events.

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## INSIGHTS INTO RUPTURE DYNAMICS AND STRESS TRANSFER OF THE FEBRUARY 2023 TÂRGU JIU MW 5.4 EARTHQUAKE FROM SELF-SIMILAR DYNAMIC RUPTURE MODELING

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The February 2023 seismic sequence in the Târgu Jiu region of Romania provides a unique opportunity to investigate rupture dynamics and stress interactions within a complex intraplate extensional setting. The mainshock of February 14th, with moment magnitude  $M_w = 5.4$  and focal depth of  $\sim 15$  km, occurred along ENE–WSW trending normal faults at the contact between the Getic Depression and the Southern Carpathians. To better understand the rupture process and its implications for seismic hazard in the Oltenia region, we applied a simplified self-similar dynamic rupture model, recently implemented in the open-source Python toolbox Pyrocko. This methodology decouples fracture front propagation from slip evolution, allowing for computationally efficient yet physically consistent simulations of rupture kinematics and stress release. We combined high-resolution relocated hypocenters, moment tensor solutions, and waveform inversion results with dynamic rupture simulations to constrain source geometry and stress conditions. The self-similar approach requires only a limited set of input parameters, such as rupture velocity, stress drop, and fracture energy, but is capable of reproducing key features of rupture evolution. For the  $M_w = 5.4$  event, the simulations indicate a unilateral rupture propagating toward the WSW, with average rupture velocity close to 75% of the local shear wave speed. The inferred stress drop ( $\sim 43$  MPa) and rise times ( $\sim 1.5$ – $2.0$  s) are consistent with empirical scaling laws for moderate-magnitude intraplate earthquakes. Our modeling reproduces the observed directivity effects in regional waveform envelopes, particularly amplitude enhancement in the SW quadrant, and suggests heterogeneous slip with two main asperities aligned with mapped fault segments. Stress interaction analysis further indicates that the rupture likely increased Coulomb stress on adjacent ENE–WSW faults, consistent with the high rate of aftershocks following the mainshock.

Despite its conceptual simplicity, the self-similar rupture framework provides robust insights into source physics, slip distribution, and stress transfer processes. The Pyrocko implementation enables efficient testing of multiple rupture scenarios and offers a flexible tool for integrating observational constraints with dynamic modeling. Applied to the February 2023 Târgu Jiu mainshock, this approach highlights the potential of simplified dynamic rupture models to improve understanding of intraplate fault systems and to contribute to refined seismic hazard assessment in tectonically complex regions of Romania.

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## ACTIVE FAULTS FOR 5.6 (M<sub>w</sub>) MEHADIA EARTHQUAKE, 4.1 (M<sub>w</sub>) WEST TEREHOVA EARTHQUAKE, 4.1 (M<sub>w</sub>) MOLDOVA NOUA EARTHQUAKE AND 4.3 HATEG EARTHQUAKE

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The current tectonic structure of the southern part of the Southern Carpathians, nearby Danube, is the combined result of a main northward translation movement and a secondary right-lateral rotation of the tectonic units from their Mesozoic position to their current position during the Paleogene-Neogene period. The main fault system in the region is the South Carpathian Fault System, which characterizes the basement and orogenic structures and delineates the major geotectonic units. The faults within this system are either thrust faults (Sichevița-Retezat) or trans-crustal vertical faults (Oravița-Moldova Nouă). The faults of the South Carpathian System are predominantly oriented NE-SW (Cerna Jiu Fault), with the exception of the Bistrița Fault and the West Teregoval Fault, which are oriented E-W. To the west the South Carpathian Fault System interacts with another significant fault system, the Pannonian Fault System. This system controls the neotectonic activity in the region, exhibiting predominant NNE-SSW directions (Hateg-Sarmisegetusa Fault).

1. **Hateg-Sarmizegetuza Regia Fault** is an active, crustal-scale, normal fault with a strike-slip component. It trends NE-SW and belongs to the Hateg-Strei Fault System (a sub hercynian-age tectonic rupture overprinted on a monoclinical structure, where rock units sequence from oldest to youngest ENE to WSW).
2. **Moldova Nouă-Reșița Fault** is an active, crustal-scale, normal, vertical fault, oriented NNE-SSW. This fault belongs to the Moldova Nouă-Oravița-Bocșa Montană (Dognecea) Seismic. It represents the Romanian extension of the Ozren-Tron Fractures.
3. **Cerna Fault** is an active, curved, crustal, vertical, NE-SW oriented fault, deemed a right-lateral normal fault, of Late Oligocene age. The Cerna Fault is also considered a graben (the Cerna Graben).
4. **West Teregoval Fault**. The fault plane solutions and the nodal planes oriented NE-SW in Caransebes-Teregoval area having a right-lateral movements. These are mainly thrusts which delineate WNW verging nappes inside Median and Marginal Dacides. The relatively high stress drop values are compatible with a stress regime specific for intra-continental tectonics.



## GEOGRAPHICAL FACTORS SHAPING LANDSLIDE HAZARDS ON HISTORICAL HERITAGE AREAS

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Historical heritage areas are particularly vulnerable to geomorphological hazards as they were often established on elevated landforms and steep slopes to secure strategic advantages, such as enhanced visibility and natural defense.

Among the various geomorphological processes, landslides are the most common hazards impacting inhabited areas. Their occurrence is driven by a combination of geological and geomorphological factors, as well as historical human changes in land cover, water resources, and landscapes. Many of the historical heritage sites are located in hilly regions, where the instability of slopes heightens their vulnerability to hazards, a risk further amplified by climate change. The landslide hazard analysis is based on various associations of predisposing, preparatory – such as geographical conditions, and triggering factors. This analysis also considers their interactions, intensity-level and their spatial-temporal distribution, which may exceed the threshold of the landscape's stability. Key factors are categorized in geomorphological, meteorological, hydrogeological, land use - land cover, and anthropogenic parameters. These factors depict both the static and dynamic conditions of a fragile heritage site. Each landslide event in heritage site areas is modelled based on the spatial-temporal variation of their frequency, magnitude, rhythm, duration and dynamics. The patterns generated by these associations define differently the heritage site areas at risk from landslide hazards. Historical heritage sites were constructed using different materials and historical techniques and they response to the instability of ground foundations can vary significantly. Some of them are affected by tourism, while others are inhabited. Therefore, assessing the geographical factors that contribute to landslide hazards in historical heritage areas requires consideration of the correlation with various expert-based weighting impacts.



## SOURCE PROPERTIES OF THE CRUSTAL EARTHQUAKES OCCURRED CLOSE TO ORSOVA CITY (SOUTHERN CARPATHIANS, ROMANIA)

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Seismic activity in the southwestern part of Romania concentrates along a transitional zone between two major geological units, Southern Carpathians and Moesian Platform. This area is characterized by complex structural features, including faults, fractures and crustal heterogeneities that occasionally generate moderate-magnitude earthquakes. Overall seismicity here is much lower compared with the strong earthquake activity at the Southeastern Carpathians arc bend (Vrancea intermediate-depth source). However, understanding the seismic behaviour of this area is essential not only for regional seismic hazard assessment but also for gaining insights into the geodynamic processes governing the interactions between the Carpathians and the Moesian Platform. The aim of this study is to apply empirical Green's function and spectral ratio techniques to determine the source parameters of the seismic sequence that occurred near Orșova city in the western Southern Carpathians between 25 June and 6 July 2020. The sequence was initiated around 16 km depth by a foreshock (ML 3.4), followed by a mainshock (ML 4.5) and 16 (identified and located) aftershocks with magnitudes ranging from ML 1.5 to 3.4. For the mainshock, we identified well-recorded, co-located aftershocks with similar focal mechanisms, which were used as empirical Green's functions. The observed difference of approximately 1.0 magnitude unit between the mainshock and the largest aftershock is consistent with typical aftershock behaviour in crustal regions. Despite the relatively small magnitudes of most of the events, high-quality waveforms were available for several pairs of co-located events across the recording stations of the national seismic network covering the epicentral area. Finally, the source scaling properties of these earthquakes were investigated in the context of the regional seismotectonic setting. Our results are discussed in relation with the seismotectonic framework of the Romanian Carpathians, aiming to enhance our understanding of seismogenic parameters relevant for seismic hazard assessment. The applied methodologies are particularly effective for analyzing seismic sequences, as they enable the determination of source parameters from pairs of closely spaced earthquakes recorded by the same stations. The resulting source parameters will be integrated into an expanded dataset, providing a foundation for establishing scaling relationships that can be applied to characterize seismicity across the wider Carpathian region.

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## NATURAL RADIOACTIVITY AND ELEMENTAL COMPOSITION OF MOUNT VESUVIUS ROCKS: A COMBINED GAMMA SPECTROSCOPY AND XRF STUDY

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The present work is dedicated to the systematic study of volcanic rocks collected from different areas of Mount Vesuvius, with the purpose of achieving both a radiological and geochemical characterization by means of high-resolution gamma-ray spectroscopy and X-ray fluorescence (XRF).

Gamma spectrometry will be carried out using a high-purity germanium (HPGe) detector, which ensures excellent energy resolution for the identification and quantification of gamma-emitting radionuclides. The focus will be placed on primordial radionuclides such as <sup>238</sup>U, <sup>232</sup>Th, and <sup>40</sup>K, as these are the main contributors to natural background radiation in geological materials. The analysis will include the determination of activity concentrations, dose rates, and their potential relevance for environmental radiation exposure and radiological safety assessments.

In parallel, XRF analysis will be performed to determine the major, minor, and trace element composition of the samples. The elemental data will serve as a geochemical fingerprint, providing valuable information regarding magma evolution, mineralogical composition, and possible post-eruptive alteration processes. The combined use of gamma spectroscopy and XRF will allow correlations to be explored between radionuclide activities and elemental abundances, which may reflect geochemical controls on the distribution of radioactivity in volcanic systems.

The integration of these complementary analytical techniques is expected to deliver a comprehensive characterization of the investigated materials. Such an approach is highly relevant for establishing a radiological baseline of the Vesuvius region, for assessing the environmental significance of naturally occurring radionuclides, and for contributing to volcanological research. Beyond their scientific value, these results may support broader applications, including radioprotection strategies, geological mapping, and the long-term monitoring of volcanic areas with both societal and environmental implications.



## THE GEONETSEE REAL-TIME GEOSCIENTIFIC NETWORK: A REGIONAL INFRASTRUCTURE FOR SEISMIC AND GEOHAZARD MONITORING IN SOUTHEASTERN EUROPE

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GeoNetSee is a real-time geoscientific monitoring network designed to enhance the detection and analysis of geohazard events across Southeastern Europe. Built as a cross-border infrastructure, the network integrates inertial, GNSS, and environmental sensors distributed across the Balkan-Carpathian region, enabling continuous, high-resolution data collection for both scientific and civil protection purposes. The core strength of the GeoNetSee network lies in its real-time data acquisition and transmission capabilities. High-bandwidth telemetry ensures the low-latency transmission of data from geosensors to processing centres, where automated systems perform event detection, data quality control, and rapid information dissemination. The Danube Collaborative Center acts as the leading platform, integrating this information to provide early warning functionality and coordinated support for cross-border risk management. Designed for interoperability, GeoNetSee adheres to open data standards, facilitating integration with European and global monitoring systems (e.g., EPOS, ORFEUS, EMSC). Data from the network are accessible to partner institutions and the broader scientific community, supporting both operational use and research into regional tectonics, seismicity, and related hazards. The network enables observation of co-seismic ground deformation, landslide activity, and environmental precursors to geohazards. The modular architecture allows for future expansion and integration of additional sensor types or data sources, reinforcing the long-term sustainability of the system. GeoNetSee also plays a key role in strengthening regional cooperation by harmonising technical standards, sharing expertise, and improving emergency response coordination. Its real-time functionality provides inputs to researchers, field experts, and policymakers, leveraging the GeoNetSee system's advanced GNSS, IoT, and sensor networks for real-time geospatial and environmental monitoring, thereby supporting evidence-based research, sustainable resource management, and data-driven policy decisions. The GeoNetSee system will be validated through three main pilots in Serbia, Montenegro, and Bosnia and Herzegovina, where 20 geosensors, supported by a CORS station, will be deployed at selected locations of interest. In addition, each of the other six partner countries will receive five geosensors to be installed at designated test sites. In Romania, the test area is Slănic Prahova, among the 5 locations being Baia Baciului, Baia Verde and Tudor Vladimirescu street. The results of the recordings will be available on the Danube Collaborative Center platform. Thus, the GeoNetSee network represents a scalable, resilient, and interoperable platform that bridges science, technology, and public safety. By delivering real-time, cross-border geoscientific data, it significantly strengthens Southeastern Europe's capacity to monitor, understand, and respond to environmental and natural hazards.



## SEISMIC VELOCITY ANOMALIES AND ACTIVE FAULTING IN THE TÂRGU JIU REGION, ROMANIA: EVIDENCE FROM LOCAL EARTHQUAKE TOMOGRAPHY

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In February 2023, the Târgu Jiu region of southwestern Romania experienced an atypical earthquake sequence, including two main shocks of Mw 4.8 and Mw 5.4 and over 4,000 aftershocks. This activity occurred in an area previously considered of low seismic hazard, highlighting the need for detailed investigation of its crustal structure and active fault systems. We present a high-resolution seismic tomography study using 105,976 P- and S-wave arrival times from 5,281 local earthquakes recorded between 2016 and 2023 by 133 seismic stations of the Romanian Seismic Network and collaborating arrays. The LOTOS algorithm was applied to invert the dataset into 3D velocity models, following optimization of a reference 1D model and rigorous resolution testing, including checkerboard and synthetic anomaly recovery experiments. Our results reveal a distinct NE–SW structural boundary separating high-velocity domains in the north and northeast—associated with dense, rigid magmatic or metamorphic rocks—from low-velocity zones in the central and southern sectors, correlated with active faults and sedimentary units of the Getic Depression. A pronounced low  $V_s$  anomaly, spatially coinciding with the 2023 epicentral cluster, is interpreted as highly fractured, fluid-saturated crust, consistent with  $V_p/V_s$  ratios of  $\geq 1.8$ –1.9. These anomalies likely influence rupture dynamics, aftershock persistence, and hypocenter migration. The southern sector exhibits low velocities and high fracturing consistent with weakly consolidated sedimentary rocks, while the northern sector shows compact lithologies typical of the South Carpathian orogen. The integrated velocity and seismicity patterns support the existence of an active NE–SW fault system, potentially the source of the 2023 sequence. The findings suggest that crustal fluids, in combination with fault geometry, may play a critical role in earthquake generation and propagation in the region. This study provides new constraints on the tectonic framework of the Târgu Jiu area and contributes to improved seismic hazard assessment in a geodynamically complex sector of the South Carpathian Foredeep. Future research integrating AI-driven data preprocessing with physics-based inversion could enhance resolution and model robustness for similar intraplate seismic zones.



## APPLICATION OF MANUAL BORING TECHNIQUES IN THE ANALYSIS OF THE LANDSLIDE THAT DAMAGED THE RĂTEȘTI MONASTERY

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In this paper, we present the results of a hand-drilling investigation carried out in the courtyard of the ruined and subsequently abandoned Rătești Monastery. This study was conducted as part of the fieldwork for students enrolled in the Engineering Geology program at the Faculty of Geology and Geophysics, representing a collaborative effort between second- and third-year students.

Rătești monastery is located on the left bank of Buzău river, at an elevation of 449m above sea level, and lies about 26 kilometres from the city of Buzău. From a morphological perspective, it is located at the base of the Subcarpathians Bend Zone, a region characterized by hilly topography, elongated ridges, and narrow valleys. From a geological standpoint, the monastery rests on the axis of a syncline, with a lithological composition primarily made up of clays and sandy clays belonging to the Upper Pliocene. The origin of these deposits is alluvial, indicating that they were formed by ancient river processes. In order to investigate the lithological composition underlying the abbey and assess its relationship to the landslide, we carried out three manual boreholes using a hand auger drilling method, which allowed us to obtain continuous disturbed samples of the shallow subsurface without the use of heavy machinery. These boreholes, designed specifically for geotechnical and lithological logging, were designated as F<sub>1</sub>, drilled to a depth of 8 meters; F<sub>2</sub>, drilled to a depth of 6 meters; and F<sub>3</sub>, drilled to a depth of 5 meters. During manual drilling, soil samples were collected at regular intervals and visually described on-site, with special attention given to changes in color, texture, and plasticity. The manual technique required gradual advancement in short sections, ensuring minimal disturbance to the surrounding ground and accurate observation of the strata. The boreholes were positioned at distances of approximately 10 to 15 meters from one another. Analysis of the hand-drilling logs from all three locations indicated that the subsurface materials were predominantly clay, with only minor lithological variations between sites. Notably, borehole F<sub>2</sub> intercepted groundwater at a depth of 6 meters. The information obtained through these shallow-depth boreholes will serve to calibrate geophysical data of the project RO-GEO4SDG and support its interpretation, providing a more reliable understanding of the subsurface conditions and the mechanisms behind the 2014 landslide.



## ERT DATA IN INFRASTRUCTURE PLANNING AND IMPLEMENTATION

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This paper examines the role of geophysical measurements in road infrastructure development, emphasising their value for subsurface characterization, geohazard assessment, and informed engineering design. Integrating geophysical methods into the planning, construction, and maintenance phases of roadway projects enhances safety, durability, and resilience to geotechnical and environmental challenges.

As a case study, the investigation phase for the Sibiu–Pitești highway, a major infrastructure project crossing the Southern Carpathians, is presented to illustrate the benefits of combining seismological and geoelectrical datasets. Seismological information derived from the ROMPLUS Earthquake Catalogue provided an updated understanding of regional seismicity patterns relevant to route alignment and hazard consideration. Complementarily, Electrical Resistivity Tomography (ERT) surveys were conducted to support geotechnical investigations by refining lithological interpretation, identifying zones with elevated moisture content, and detecting areas susceptible to slope instability.

Several ERT profiles were particularly valuable in an active landslide sector to delineate the slip surface and differentiate unstable volumes from stable strata based on resistivity contrasts. These results were calibrated with borehole and geotechnical data, improving confidence in the subsurface model and enabling a more accurate assessment of landslide geometry and associated risks.

This integrated approach demonstrates how geoelectrical and seismological methods can significantly improve risk evaluation and inform cost-effective engineering decisions in highway design by addressing geological and hydrogeological risks in complex environments.



## **GAMMA-RAY SPECTROMETRY AND XRF IN THE STUDY OF ARCHAEOLOGICAL BRICKS: IMPLICATIONS FOR ANCIENT BUILDING PRACTICES AND ENVIRONMENTAL SAFETY**

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This study presents a comparative physicochemical investigation of eight archaeological brick samples recovered from the Histria Museum collection, carried out using gamma-ray spectrometry and X-ray fluorescence (XRF). The primary objective was to characterize the elemental composition and natural radioactivity of the materials, in order to gain insights into the provenance, technological choices, and potential environmental implications of their use in ancient construction. Each brick was first carefully cleaned, then ground into a fine homogeneous powder to ensure representative sampling and minimize surface contamination effects prior to analysis. Another important objective was to determine the natural radioactivity levels associated with primordial radionuclides ( $^{226}\text{Ra}$ ,  $^{232}\text{Th}$ , and  $^{40}\text{K}$ ) and to evaluate the potential radiological impact of the materials used in historical construction practices. The activity concentrations of the radionuclides were quantified using high-resolution gamma ray spectrometry, with results compared against international reference values and radiological safety limits. The calculated radiological indices, including the absorbed dose rate, annual effective dose, radium equivalent activity, and hazard indices, provide an assessment of both environmental and human exposure associated with the use of these materials in antiquity. The findings contribute to the understanding of historical building practices at Histria, while also supplying valuable baseline data for environmental radioactivity studies in the region. Moreover, the study highlights the role of gamma spectrometry as a non-destructive and highly sensitive technique for cultural heritage research. Complementary XRF measurements provided a precise elemental fingerprint of major and trace elements, as well as for minor constituents. The integration of these two techniques facilitated a multidimensional assessment of the samples, highlighting compositional similarities and variations between the bricks.

By combining nuclear and spectroscopic methods, this work contributes to the archaeometric understanding of construction materials employed in Histria and underscores the value of non-destructive analytical approaches in cultural heritage research. The findings not only provide baseline data for comparative studies of ancient building materials but also support broader discussions on technological traditions and resource exploitation in the Black Sea region.



## CHARACTERISATION OF DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA NUCLEAR TESTS THROUGH SEISMIC WAVEFORM ANALYSIS

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Since 2006, the Democratic People's Republic of Korea (DPRK) has conducted six underground nuclear explosions at the Punggye-ri test site. The final detonation, reported to be a hydrogen bomb in September 2017, produced the highest yield - estimated by several studies to range between 100 and 250 kilotons - and was followed by increased seismic activity in the region.

At the Romanian National Data Centre (NDC), one of the seismic monitoring objectives is to distinguish natural tectonic events from anthropogenic sources, including nuclear explosions.

To improve event discrimination and treaty verification accuracy, we developed a robust algorithm that combines the  $M_s/m_b$  magnitude ratio (surface-wave magnitude to body-wave magnitude) with complementary methods such as infrasound detection, seismic waveform correlation, spectral analysis, and signal-to noise ratio (SNR) evaluation. This algorithm was applied to recordings from various seismic stations located up to 70 degrees from the test site, in order to assess its effectiveness in differentiating tectonic events from nuclear explosions. The proposed discriminants successfully separate the two types of events, although their performance is strongly influenced by epicentral distance and quality of the seismic recordings.



## SHALLOW SEISMIC REGIME IN THE VRANCEA ZONE: FOCAL MECHANISM INSIGHTS

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One of the most seismically active and complex areas in Europe is located in Romania, where both crustal and intermediate-depth earthquakes occur within the Vrancea zone.

This work aims to determine and analyse focal mechanisms for earthquakes with crustal depths (<60 km). Seismic activity is concentrated in the first 40 km, while the gap between 40 and 80 km may be related to the transition from crust to mantle associated with ongoing delamination processes.

Shallow earthquakes are linked to fault systems and fractures in the crust around the Carpathian Arc, activated by stresses generated by the convergence of sub-plates. In this study, focal mechanisms were determined using P-wave polarities for crustal events recorded between 2010 and 2025.

The obtained solutions indicate both normal and reverse faulting with strike-slip components. The stress field in the region is complex, reflecting a transitional regime from extension in the Moesian Platform to compression in the Vrancea subcrustal zone.



## TSUNAMI SIMULATIONS OF THE 7.2 MAGNITUDE EARTHQUAKE FROM 31<sup>ST</sup> OF MARCH 1901, SHABLA AREA, BLACK SEA

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A number of 22 historical tsunamis were evidenced and documented in the Black Sea, almost all countries surrounding the area facing tsunamis in the past. From this total, eleven were triggered in the 20th Century and one in the 21st, and if considering the location / area, four events were in Bulgaria, affecting also the Romanian shores. The most recent and significant tsunami related to an earthquake was observed on 31<sup>st</sup> of March 1901 in Shabla area, in the western part of the Black Sea. An earthquake of 7.2 (Mw) magnitude generated at 43.4 latitude and 28.6 longitude at a depth of 10 km below the sea level, triggered tsunami waves of 2.5 - 3 m height. It was a multi-hazard event with material losses, involving the earthquake itself, landslides, subsidence and local inundation, according to witness testimonies and observations (there were no measurement instruments at that time).

Using two modeling software, Tsunami Analysis Tool (TAT) and TRIDEC Cloud, we accomplished multiple tsunami modeling simulations, based on the earthquake's parameters. The results with TAT software show maximum waves of 0.2m in three locations from Bulgarian shore (Varna, Kamen Bryag and Bulgarevo), and 0.1m in two locations from Romania (Constanta and Techirghiol). The estimates of TRIDEC software display higher maximum values, of 0.4 m in Varna (Bulgaria) and only 0.07 m in Constanta (Romania).

Furthermore, we compared the results of the simulations (0.2 - 0.4 m) to the observations (2.5 - 3 m) and concluded that there is an undestimation in the simulations with both software, most probably due the precision of the earthquake's parameters (being a quite far past event) or even questionable validity of the maximum observed values (mostly from old testimonies of those times).

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We acknowledge the contribution of our colleague Diaconescu Mihail, now retired, to all the tsunami-related activity in the Black Sea area.



## CARTOGRAPHIC EVOLUTION OF IALOMITA CAVE

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Maps allow navigation of a space and documentation of the major features of the cave extension, but in a geoarchaeological, paleoclimatic, paleontological context, etc., maps allow researchers to locate artifacts and characteristics of the (geological) environment necessary for carrying out integral spatial studies. Creating cave maps is an essential part of their research, but the characteristics of the underground environment are most often extremely difficult, either very narrow, steep, filled with water, etc. Cartographic achievements with traditional technology consume an extremely long time and energy, so they switched to using scanning techniques. The case study is the Ialomita Cave located on Mount Batrâna in the Bucegi Mountains, dug into Jurassic limestone at about 1620 m, known and visited since the beginning of the 16th century. Later in the 18th century, the monks from Sinaia Monastery built a hermitage at the entrance to the cave. Among the best-known descriptions and cartographic materials of the underground environment, we cite the most relevant ones to illustrate the cartographic evolution of the Ialomita Cave. In 1897, synthetic descriptions appeared, in 1953 speleological researchers conducted research and compiled a detailed plan of the galleries. Later, in 1974, a map accompanied by a longitudinal profile of the cave was published (Șerban M. and Viehmann I.). Later, descriptions of the galleries were made with or without a cartographic sketch/map. With the discovery of new passages, such as Hades in 1979, other sketches/maps appeared (amateur speleologists of the Hades Speleological Club). In the first half of the 1980s, maps and plans of the cave were made, coordinated and executed by speleologists of the "Emil Racoviță" Speleological Institute in Bucharest, which show high accuracy. At the same time, many sketches and maps appear in tourist brochures or in works that study the Bucegi massif, or necessary for the tourist development of the cave. In the summer of 2025, we carried out a mapping campaign using LiDAR-based technologies, allowing for both 2D and 3D mapping of the underground environment. Sea systems such as a Leica RTC360 terrestrial scanner (TLS) and a Flyability Elios 3 drone were used, with which high-accuracy morphometric and volume data can be extracted.



## **DYNAMIC RUPTURE MODELING OF THE JUNE 2023 ARAD SEISMIC SEQUENCE (MW 4.7) USING A SELF – SIMILAR APPROACH IN PYROCKO**

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The June 2023 seismic sequence in the Arad region of western Romania provides important insights into the rupture dynamics of shallow intraplate strike-slip fault systems. The mainshock, which occurred on June 6th, 2023, had a moment magnitude  $M_w = 4.7$  and a focal depth of  $\sim 5.6$  km. Focal mechanism solutions indicate a strike-slip fault, consistent with the dominant NW–SE oriented fault system, intersected by a secondary NE–SW fault network that characterizes the seismotectonic setting of the Arad Basin. The sequence comprised a total of 64 earthquakes, highlighting the structural complexity and stress interaction within the region.

To investigate the rupture process, we applied a simplified self-similar dynamic rupture model implemented in the open-source Python toolbox Pyrocko. This methodology decouples rupture front propagation from slip evolution, allowing for computationally efficient yet physically consistent simulations of earthquake kinematics. The model requires only a reduced set of input parameters, such as rupture velocity, stress drop, and nucleation location, while being able to reproduce key features of rupture dynamics and stress release.

For the  $M_w 4.7$  mainshock, simulations suggest a predominantly unilateral rupture propagating toward to SE, with an average rupture velocity of  $\sim 0.75$  times the local shear-wave speed. The rise times are short,  $\sim 0.5$ – $0.8$  s, consistent with empirical scaling laws for shallow crustal earthquakes of moderate magnitude. Slip distribution is heterogeneous, with maximum slip localized in asperities along the NW–SE fault plane. These results are compatible with the observed waveform directivity effects recorded at local stations, where amplitude enhancement is most evident along the rupture propagation direction.

Furthermore, stress transfer calculations indicate that the mainshock likely promoted failure on adjacent fault segments, explaining the number of aftershocks and their spatial clustering. Despite its conceptual simplicity, the self-similar dynamic rupture framework provides robust constraints on source physics and stress interactions, and proves particularly useful for moderate intraplate strike-slip events. Applied to the Arad sequence, this approach improves understanding of seismotectonic processes in western Romania and contributes to a refined assessment of local seismic hazard.

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## COMPARATIVE MORPHOLOGICAL AND HYDROGEOLOGICAL ANALYSIS OF THE MARTEL AND LAZULUI CAVES IN THE MOTRU SEC-BAIA DE ARAMĂ KARST AREA (ROMANIA)

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The karst area of Motru Sec-Baia de Aramă, situated at the tectonic boundary between the Danubian Domain and the Getic Nappe, serves as a key site for analyzing the interplay among karst morphology, tectonic controls, and hydrogeological processes.

The Martel and Lazului caves, formed within the thick Barremian-Aptian limestones of the Danubian Domain, represent karst systems influenced by the seasonal hydrological regime of the Motru Sec River. This river is known to lose surface flow through diffuse infiltration and multiple swallets during dry periods, subsequently feeding large karst springs downstream at Brebina and Baia de Aramă. At a shallow scale, these systems are hydrologically independent; however, at a deeper structural level, the continuity of limestones beneath the Getic Nappe and the presence of major faults suggest the possibility of shared phreatic conduits.

Martel Cave, approximately 4,130 meters long, is situated on the left bank at about +1 meter above the Motru Sec River's thalweg. It follows a northwest-southeast oriented branchwork system, with the main passage developed roughly between -11 and -20 meters below the entrance elevation. The cave exhibits a mixed phreatic-epiphreatic regime with vadose remodeling, featuring both active and fossil passages, as well as deep sumps reaching -34 meters below the entrance elevation. Lazului Cave, approximately 3,200 meters in length, is located upstream on the right side of the Motru Sec River, at about +1.5 meters relative altitude. It comprises two main sectors: a shallow, climatically influenced labyrinth and a larger active passage drained by several perennial streams and internal springs. The cave's branchwork network, sediment variation, and limited speleothems reflect a dual genesis under both phreatic and vadose conditions.

The comparative analysis of the Martel and Lazului caves highlights contrasting recharge regimes, morphological evolution, and hydrogeological behaviors within the same structural framework.



## KARST SYSTEM EVOLUTION SUPPORTED BY CHI PLOT ANALYSIS IN THE SUBCATCHMENTS OF THE MOTRU RIVER

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Very little is known about the asymmetry of the cross-sectional shape of the Motru River and the graded karst evolution in terms of recent uplift patterns and of the stream network evolution. The rivers in the karst area evolve gradually through a dynamic interaction of the surface and subsurface processes, influenced by geology, hydrology, and tectonic movements. The preliminary insight into the above-mentioned issues has been acquired by performing a chi plot analysis of the sub-catchments of the Motru basin. The chi analysis/integral method plot is a graph showing the steepness of a river channel by plotting the elevation against a transformed horizontal coordinate called ‘chi’( $\chi$ ).

In other words, the length along the streambed is replaced by the variable chi, which integrates the length increment at each point, normalized by the area providing stream recharge at that point, raised to a sub-unitary power. For the latter exponent, designated as concavity index, the optimum value is the one that secures the best collinearity between the trunk stream and its tributaries.

The chi-transformed profiles have shown that both lines corresponding to the Motru River trunk stream and the collapsing tributaries were almost straight (the  $R^2$  value of the fitted linear regression exceeded by 0.9).

This model (pattern) shows the stream courses in a steady state (the incision rate is in equilibrium by the uplift rate), and no temporary processes distorted the chi-plot model. On the other hand, the tectonic tilting, watershed loss by stream beheading, or alternatively watershed gain by stream capture might cause systematic distortions of the images of the collinearity between the trunk stream and the tributaries. The question is as follows: is there any connection between the temporary distorted processes and the change in the karstification level and, ultimately, a new development of the endokarst/exokarst system?

This is a preliminary study about the importance of the uplift movement, the reshaping of the longitudinal profile of the river and the downward karstification. Besides the change in longitudinal profile of the river, the uplift may rejuvenate the karst system. For this reason, we have considered the analysis of chi plot graph may be a key finding in the karst evolution.



**THE “SABBA S. STEFANESCU” INSTITUTE OF GEODYNAMICS OF THE ROMANIAN ACADEMY – ACTIVE PARTICIPANT IN THE ROMANIAN COMPONENT OF DANUBIUS-RI PROJECT, DANUBIUS-RO**

Venera Dobrica<sup>1</sup> and DANUBIUS-RO team

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The International Center for Advanced Studies on River–Delta–Sea Systems DANUBIUS-RI is a pan-European distributed research infrastructure supporting interdisciplinary research on large river-sea systems. Among the river-sea systems, the Danube-Danube Delta-Black Sea system is of prime importance for Europe, and especially for Romania. Over 95% of the country's territory is in the drainage basin of the river, almost all the rivers flowing on the national territory are tributary to the Danube river, the last 1,075 km of the Danube river course is on the territory of Romania, and also its mouth zone into the Black Sea, including the delta, which marks the direct interaction between the river and the sea. The Romanian component of DANUBIUS-RI, DANUBIUS-RO comprising the Hub, located in Murighiol, and the Danube Delta supersite consisting of the seven field research stations, namely Murighiol, Chilia Veche, Maliuc, Sulina, Jurilovca, Sfantu Gheorghe and Grindu.

The contribution of the Institute of Geodynamics is mainly related to the Sulina research station from the Danube Delta Supersite, where the Sulina analogue modelling laboratory and the Letea magnetic station will be developed. The analogue modelling laboratory will allow for conducting advanced studies of hydrological, sedimentological and dynamic processes in the river-sea interaction area. The Letea magnetic station will be the first magnetic station that will continuously record the values of the Earth's magnetic field in the Danube Delta for studying and monitoring the variations of the geomagnetic field with implications on the state of the Danube Delta characteristic ecosystems and biodiversity.

The purpose of this note is to raise the importance of such a project and to draw attention of students, PhDs and young researchers to the existence of such a research infrastructure, which will shortly become operational and will make possible advanced research in the fields of Earth's physics and much more.



## GEOTOURISTIC ATTRACTIONS IN THE CHIOJDU COMMUNE AREA

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This study presents the main geotourism objectives in the commune of Chiojdu, located in the Buzău Subcarpathians, at the junction of the Siriu and Penteleu Mountains. The objectives of the study include: assessing the geotourism potential of the geosites in the commune of Chiojdu and contextual analysis and integration into the natural and cultural heritage. The methods used are: the bibliographic method, the method of quantitative evaluation of geosites, proposed by Brilha in 2015 (Brilha, 2015), and the method of field observations.

The commune of Chiojdu is located in the northwestern part of Buzău County, in the Curburii Subcarpathians, at the junction with the Siriu and Tătaru Mountains. Due to the formation of the relief of this commune over time, a variety of rocks can be found, including Neogene deposits, Helvetian deposits represented by sandstones, marls with shaly intercalations, but also Levantine and Quaternary deposits, represented by clays, sands, gravels, and conglomerates.

Under the action of external agents, various geomorphological structures have formed on these rocks, some of them in unique shapes, which may be of scientific and tourist interest. Right at the entrance to the commune, there are two rocks: the brown Lera rock, from which people have long used the sulphurous water that comes to the surface in the form of a spring, and Pietricica, a blue rock that has been reforested. The valley of the Bâsca Chiojdului River, which crosses the villages, is a wide valley on a clay bed with a lot of gravel, sand, and large pieces of rock broken off from the banks. However, the most interesting phenomenon in this river valley is the trovăni from Lera, but especially those from Chiojdu, irregular spherical formations made of sand and friable sandstone, cemented by calcareous waters, ranging in size from 5 to 200 cm, but some exceeding 2 m. They are formed by the rolling of marl cores to which local chemical precipitation cementation is added. Also, in the Bâscea Valley is the Şipot Waterfall, downstream of which, on the steep wall of the Siriu, is built the "Domeniul Gârbea" complex. On the Manta plateau there is a mesotrophic marsh, rare in the region, which is of particular geological importance. It has an accumulation of peat and is an ecosystem specific to wetlands, being declared a nature reserve, along with trovăni. Another geotouristic attraction in the Siriu Mountains is Lake Vulturilor, of periglacial origin, surrounded by hills from which the waters carry scree and which is home to black goats and eagles.

All these sites can be visited and studied by pupils and students, as there are accommodation options in various guesthouses in the commune, and the area is of historical and geological interest. This study aims to promote these geosites, attract tourists, and protect the area, as the commune of Chiojdu is an important starting point for geotourism in the region.



## INSIGHTS FROM RECENT ACTIVE AND PASSIVE SEISMIC INVESTIGATIONS IN THE SLANIC AREA

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This presentation highlights recent active and passive seismic investigations carried out within the GEOMONITOR project in the Slănic area, Romania. Two main seismic methods were employed: MASW (Multichannel Analysis of Surface Waves), an active seismic technique, and MAM (Microtremor Array Method), a passive seismic approach. Both methods utilized a dense network of wireless, three-component seismographs (ATOM 3C, Geometrics) to estimate shear-wave velocity ( $V_s$ ) profiles down to depths of approximately 30–50 meters. Data processing was performed using the SeisImager software suite from Geometrics. For the MASW method, the ATOM 3C arrays were complemented by a GEMINI2 acquisition system and an integrated 3D geophone (PASI) to accurately determine the seismic source timing. The expected outcomes include a better understanding of local site effects, identification of potentially unstable zones, and support for future hazard mitigation strategies and land-use planning.



## EVOLUTION OF COMPOUND EVENTS IN ROMANIA (1951-2024)

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With increasing global temperatures, extreme weather events are becoming more frequent and intense. One of the most severe types is compound events (CEs), which are weather and climate phenomena generated by the simultaneous interaction of multiple hazards, such as heatwaves and intense precipitation. These combinations aggravate the individual effects, causing greater social and economic impacts compared to isolated phenomena by amplifying damage and increasing the number of victims. These events are categorized into four types: preconditioned, multivariate, temporal, and spatial. In this study, we analyzed only multivariate events in Romania from 1951 to 2024. A tool used to analyze compound events is CETD (Compound Events Toolbox and Dataset), which can generate the frequency, duration, and severity of CEs. For this study, the following parameters were extracted from the Copernicus Climate Change Service (C3S) Climate Data Store (CDS): daily maximum temperature (tasmax), daily minimum temperature (tasmin), total precipitation (pr), mean surface wind speed (sfcWind), and mean wind speed at 500 hPa (preWind500). Individual hazard thresholds were defined as follows: hot (>95th percentile), dry (<5th percentile), stagnation (sfcWind < 3.2 m/s and preWind500 < 13 m/s), hot day (>90th percentile), and hot night (>90th percentile). We selected three event types focused on extreme temperature combined with other conditions: hot-dry, hot-stagnation, and hot day-hot night. Stagnation events are related to low wind speeds, which can lead to serious health issues, as reduced air circulation can amplify atmospheric pollution by causing it to accumulate near the Earth's surface. Our analysis reveals that certain regions of Romania are disproportionately affected by multivariate compound events, with a statistically significant upward trend in their frequency and intensity over recent decades. Recognizing these vulnerable regions is vital for guiding future planning, implementing effective risk mitigation, and developing comprehensive adaptation strategies in the context of climate change challenges.



## **GEOPHYSICS FOR SUSTAINABLE DEVELOPMENT GOALS – EXAMPLES FROM ROMANIA & TÜRKIYE**

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Geophysics constitutes a fundamental pillar of sustainable and hazard-resilient development, offering robust capabilities for evidence-based spatial planning, quantitative risk assessment, and the design of safer built environments. This paper evaluates the contributions of geophysical technologies to the advancement of key U.N. Sustainable Development Goals (SDGs), with particular focus on resilient infrastructure (SDG 9) and sustainable cities and communities (SDG 11), especially through the disaster-risk-reduction components. The integration of advanced geophysical methodologies into national hazard-mitigation frameworks represents a critical pathway for operationalising these goals.

Romania and Türkiye exhibit exposure to persistent natural seismicity and cascading geohazards, particularly earthquake-triggered landslides, which collectively impose substantial risks to critical infrastructure and urban systems. Both states have articulated commitments to progress toward the SDGs, necessitating improved hazard characterisation and risk governance. In Türkiye, among of the principal strategies proposed for reducing seismic vulnerability has been the formulation of fault-avoidance zoning plans. The efficacy of such schemes is contingent upon the high-resolution delineation of active fault traces, a task for which integrated geophysical surveying and dense seismological monitoring networks are essential. Romania has developed an operational early-warning system used by national authorities to mitigate the impacts of major Vrancea earthquakes. However, the recent rise in seismicity in the Târgu Jiu region, previously considered a moderate- to low-hazard area, exposes significant knowledge gaps regarding local fault activity and kinematics. Addressing these uncertainties demands continuous geophysical monitoring, detailed fault-zone characterisation, and updated seismic-hazard models, all essential for progress toward SDGs 9 and 11. Beyond tectonic hazards, geophysical data support engineering decision-making for the alignment and structural design of highways, tunnels, and other critical transport corridors intersecting landslide-prone terrains. When integrated with geotechnical testing, geological mapping, and remote-sensing observations, multi-method geophysical datasets enable local authorities and planners to develop urban environments that are both safer and more resilient to climate- and tectonically induced hazards



## CHARACTERISTICS OF FAULT ROCKS ALONG TUZGÖLÜ FAULT ZONE, CENTRAL TÜRKIYE

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In fault zones, the movement of blocks causes rocks to undergo processes of fracturing, crushing, and displacement, resulting in the formation of fault rocks. These rocks, which are characteristic products of faulting processes, develop in various types depending on the deformation style, intensity, and environmental conditions within the fault zone.

The Tuzgölü Fault Zone (TGFZ) is an active, NW-SE-trending intracontinental fault zone located in Central Anatolia. As one of the main structures influencing the neotectonic evolution of the region, the age of the TGFZ has been interpreted differently in the literature. While some researchers suggest that the fault has been active since the Cretaceous, others consider it to have formed after the Miocene. The study area discussed in this research is located on the eastern block of the TFZ. The area is composed predominantly of Paleogene and Neogene clastic and chemical sedimentary rocks, which are cut by dip-slip faults. Considering the ages of these lithologies, the faults are interpreted to have developed after the Paleocene.

Investigations conducted within the cataclastic zones of these faults reveal different types of fault rocks and mesoscopic structures. In this context, the cataclastic zones are distinguished as the fault core and the damage zone. The fault core consists mainly of gouge and cataclasite fault rocks, which display asymmetric development in the hanging wall and footwall blocks, depending on lithology and stress intensity. The thickness of fault rock development in the hanging wall is generally greater than in the footwall, ranging from a few millimeters to several tens of centimeters. The damage zone, on the other hand, varies in width from several tens of centimeters to several tens of meters. This part of the cataclastic zone mainly consists of breccia-type rocks, locally containing gouge. Within the damage zone, synthetic and, to a lesser extent, antithetic faults and fractures relative to the main fault are typical mesoscopic features, while small-scale folds occur locally.

Our structural analysis of the exposed faults in the study area yields the following results: (1) Cataclastic zones exhibit an asymmetric geometry. (2) Fault rocks are predominantly cohesive, locally semi-cohesive. (3) Deformation developed in the shallow crust under low-temperature conditions through a cataclastic deformation mechanism.



**WORKSHOP: From Monitoring to Mitigation: Interim Insights from  
the GEOMONITOR Project in Slănic Prahova**



## THE GEOMONITOR PROJECT IN SLĂNIC PRAHOVA – OBJECTIVES, METHODOLOGY, AND CURRENT IMPLEMENTATION STATUS

Dragos Tataru & GEOMONITOR Team

The GEOMONITOR project aims to develop an integrated monitoring framework for natural and anthropogenic hazards in the salt karst environment of Slănic, Prahova, Romania. The initiative combines seismic, geodetic, geoelectrical, geochemical, hydrogeological, and multi-sensor remote sensing techniques to track ground deformation, structural instability, and environmental changes. Since its launch in March 2025, the project has deployed temporary passive seismic arrays, GNSS stations, tiltmeters, and vibration sensors, and conducted UAV and terrestrial laser-scanning and InSAR analyses. Interim results suggest early stages of differential ground motion, localized deformation in critical buildings, and geomorphological changes linked to suffosion and salt karst processes. This presentation outlines the project's objectives, multidisciplinary methodology, stakeholder engagement, and the roadmap for delivering a real-time monitoring platform to support decision-making and risk mitigation for local authorities and communities.

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## REVISITING LEGACY DATA SETS: CASE STUDY OF SLĂNIC, ROMANIA

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Solving geological problems, especially those enhanced by anthropic activities, requires all the data available in the area that can contribute to the construction of the subsurface (geological) model and a history of the anthropic activities/exploitation. Scrapping the information's from the vintage data sets might be a challenging task due to: availability, quality, type, storage media, public or proprietary, etc; however, if successful it might represent an important starting point for the future research with modern techniques. This is the case of the Slanic town Romania, where in the last years a series of events culminated in 2024 with the formation of a large sinkhole in the city centre, affecting several inhabited constructions. This study is part of the GEOMONITOR Project that focuses on the monitoring of the Slanic area for natural and anthropic processes with societal impact. Defining a monitoring strategy requires the definition of the geological model, that includes the uncertainties giving by the data sets and interpreters. In the Slanic case most of the data sets were acquired for the salt body delimitation, the main resource in the area. The second source of data sets are the regional and geological mapping of the East Carpathians and Romanian territory in general. All of these data sets are on paper format media requiring a significant work for transforming them into digital data set that was subsequently integrated into GIS and modelling software. GIS integration was a challenging task given the local coordinate system that does not has a straight forward conversion into a regional one, inserting errors, that have to be acknowledged by the interpreting geologist. With all of the uncertainties scrapping the vintage data set was a necessary task which brought a significant update over the geological knowledge of the Slanic area, which was subsequently used for the new data acquisition design.

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## UAV LIDAR, AIRBORNE MAPPING, AND INSAR FOR MULTI-SCALE DEFORMATION MONITORING IN THE SLĂNIC SALT-KARST (ROMANIA)

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In the GEOMONITOR project, UAV- and aircraft-mounted remote sensing systems were deployed to monitor ground deformation in the Slănic salt-karst area, Romania. Two airborne campaigns (March and May 2025) and several UAV missions with a DJI Matrice 300 RTK, equipped with a YellowScan Surveyor Ultra LiDAR and a DJI P1 photogrammetric sensor, provided high-resolution point clouds (>700 million points), orthophotos (0.15 m GSD), and Digital Terrain Models (DTMs). Field control was ensured by a dense GNSS network with centimeter-level accuracy. The LiDAR datasets allowed the detection of subtle morphologic changes, including surface cracks, depressions, and subsidence related to salt dissolution and suffosion processes, with a sensitivity of 3–5 cm. Data processing included point cloud classification, DSM/DTM generation, and 3D modeling, enabling detailed geomorphological analysis and risk mapping. Complementary multi-temporal InSAR analysis of Sentinel-1 imagery provided millimetric-scale deformation time series, capturing both localized instabilities and broader subsidence trends. The integration of UAV LiDAR, airborne photogrammetry, and spaceborne InSAR results into a coherent framework strengthens the capacity to detect hazards, quantify ground instability, and support decision-making in vulnerable karst environments.

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## ACTIVE ANTROPO-SALINE KARST SYSTEMS IN SLĂNIC (PRAHOVA) AREA – ALTERNATIVE HYPOTHESES AND SUPPORTING DATA/INFORMATION

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The hydrogeological and geological framework of the Slănic salt karst area plays a critical role in the initiation and evolution of instability processes such as suffosion, subsidence, and sinkhole development.

The genesis of the collapse from april 2024 is the main goal of the actual research in the Slănic area and requires:

- clarification of triggering factors and
- developing a conceptual model, based on direct and indirect investigations.

By and large the focuss of the technical documents dealing with local hydrogeological aspects are related to the groundwater bodies that interfere with old and actual salt exploitation works in Slanic area occuring since 1875 only on the eastern side of Slanic River.

Consequently, the main goal of the research project is to improve and accomodate the existing and future data as a contribution to a similar/common hydrogeologic knowledge on both sides of the river either upward or downward the administrative-economic limits of the city of Slanic.

Within the GEOMONITOR project, detailed geological mapping, borehole logging, and hydrogeological monitoring have been undertaken to characterize lithological sequences, fault systems, and groundwater dynamics. Monitoring wells and piezometric measurements track seasonal and event-based variations in water levels, while water chemistry analyses help identify sources and flow paths. The results indicate that fluctuations in the saline–freshwater interface, driven by precipitation and anthropogenic water management, directly influence dissolution rates and the mechanical stability of overlying sediments.

Several alternative hypotheses dealing with dynamic, antro-po-saline karst systems within Slanic area are tested with pros and cons in order to assess the magnitude and, if possibly, the future development of the dissolution processes.

An integrated approach of all data may offer valuable insights for predicting hazard evolution and informing land-use planning in vulnerable zones.

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## CHARACTERIZATION OF LOCAL SITE EFFECTS TOWARDS SEISMIC MICROZONATION OF SLĂNIC USING PASSIVE AND ACTIVE SEISMIC METHODS

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Within the GEOMONITOR project, active and passive seismic methods are used to investigate subsurface structure and site effects in the salt karst (halokarst) environment of Slănic, Romania. A dense temporary network was deployed, comprising Nanometrics broadband sensors with continuous recording and short-period Atom 3C and SmartSolo sensors deployed during several field campaigns, to record ambient seismic noise over extended periods. The Horizontal-to-Vertical Spectral Ratio (HVSr) technique was used for mapping the fundamental resonance frequencies of near-surface geological units, while seismic noise array-based methods, such as Microtremor Array Measurements (MAM) and Multichannel Analysis of Surface Waves (MASW), were employed for deriving shear-wave velocity profiles. Results indicate pronounced spatial variability in shallow velocity structure. Fundamental resonance frequencies and  $V_{s30}$  values highlight areas of potential ground-motion amplification during seismic events. Correlations with geological and deformation data suggest that areas above active salt dissolution display both reduced stiffness and increased amplification potential. These findings provide essential input for local seismic microzonation maps and support improved seismic risk assessment and urban planning in vulnerable karst regions.

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## GEOELECTRICAL INVESTIGATION OF SUBSURFACE STABILITY IN THE SLĂNIC PRAHOVA AREA

Liliana-Irina Stoian<sup>1</sup>, Elena Tudor<sup>1</sup>, Antonio Ulmeanu<sup>1</sup>, Avram Ovidiu<sup>1</sup>, Ioan Scutelnicu<sup>1</sup>, Adrian Tătaru<sup>1</sup>, Iustina Popescu<sup>1</sup>

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Geoelectrical surveys represent a key methodological approach in the GEOMONITOR project, which aims to assess subsurface conditions and potential ground instability in the Slănic region, an area renowned for its complex geology and susceptibility to subsidence and collapse phenomena. Within the framework of the project, ten Electrical Resistivity Tomography (ERT) profiles were acquired, each extending up to approximately one kilometer in length. The surveys employed a combination of Dipole–Dipole, Wenner, and Schlumberger electrode configurations in order to ensure adequate depth penetration, high-resolution imaging, and sensitivity to both vertical and lateral resistivity contrasts. Profiles were strategically distributed across sectors previously identified as geotechnically sensitive, based on historical data and geomorphological observations. The resulting datasets reveal pronounced resistivity contrasts that reflect lithological heterogeneity, the presence of water-saturated horizons, and the potential presence of voids or mechanically weak layers. In several cases, anomalously low resistivity values are spatially correlated with surface deformation features such as fissures, depressions, or subsidence zones. This correspondence provides compelling evidence that zones of diminished resistivity can serve as indicators of unstable subsurface conditions, which may evolve into hazardous ground failures if left unmonitored. In addition, the ERT results enabled the delineation of subsurface stratigraphy, distinguishing between higher-resistivity competent formations and lower-resistivity clayey or water-bearing layers.

Beyond structural interpretation, the surveys provide insights into hydrogeological pathways that control groundwater circulation within the salt and overburden formations. Identifying these pathways is particularly relevant for understanding the initiation and propagation of instability processes, as water infiltration often serves as a trigger for weakening and dissolution phenomena. By integrating resistivity data with geological and geotechnical observations, the study establishes a robust framework for characterising subsurface conditions and defining areas at risk. Overall, the findings confirm the effectiveness of geoelectrical investigations as a non-invasive tool for monitoring ground stability in geologically sensitive environments. The integration of ERT results into the broader GEOMONITOR monitoring strategy provides a more reliable basis for early-warning systems, risk assessment, and the implementation of preventive or mitigative measures. Such outcomes are crucial for supporting sustainable land use and ensuring infrastructure safety in vulnerable regions, such as Slănic Prahova.

*Acknowledgements:* This work was carried out within the project, ctr. no. 28Sol(T28) / 2025, funded by the Ministry of Education and Research, through UEFISCDI (Romanian Executive Agency for Higher Education, Research, Development and Innovation Funding).



## TERRESTRIAL LASER SCANNING FOR MONITORING BUILDING STRUCTURES IN THE SLĂNIC URBAN AREA

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The GEOMONITOR project addresses the monitoring of natural and anthropogenic hazards affecting the salt karst (halokarst) environment of Slănic, Prahova. As part of this effort, high-resolution Terrestrial Laser Scanning (TLS) campaigns were conducted between March and July 2025 to establish a 3D reference model of critical buildings and their surrounding terrain in the urban area. Data were acquired using Leica RTC360, Leica BLK2FLY, and Leica Nova MS60 systems, enabling detailed geometric documentation of structural elements, roof areas, and façade features. The resulting point clouds, classified to separate buildings and ground surfaces, serve as a baseline for detecting displacements, deformations, and crack evolution in future surveys. This dataset will be integrated with long-term monitoring systems (GNSS, tiltmeters, InSAR, vibration sensors) to provide a comprehensive hazard assessment framework. The methodology highlights the potential of combining ground-based and aerial scanning for urban stability assessment in a complex salt karst environment.

*Acknowledgements:* This work was carried out within the project, ctr. no. 28Sol(T28) / 2025, funded by the Ministry of Education and Research, through UEFISCDI (Romanian Executive Agency for Higher Education, Research, Development and Innovation Funding).



## DIRECT WELLS INSPECTIONS USING CCTV CAMERA – A SIMPLE TOOL IN THE HANDS OF GEOLOGICAL ENGINEERS

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<sup>1</sup>Faculty of Geology and Geophysics, University of Bucharest, Romania; <sup>2</sup> Sabba S. Stefanescu Institute of Geodynamics, Romanian Academy

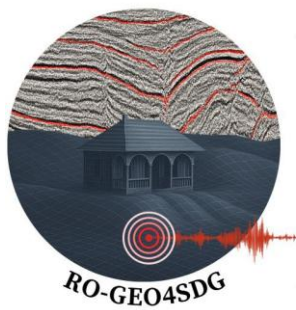
Direct observation in an existing well or borehole can be a useful tool for geological engineers, providing data that a specialist can integrate into a multidisciplinary study aimed at solving a specific problem. Direct well inspection is used in various situations, regardless of whether the wells are documented or not. However, certain construction details must be verified, such as installation depth, casing length, connections, screen positions and integrity, sediment accumulation, as well as a visual assessment of water quality. These are critical data for any hydrogeological, geotechnical, or even geological study.

This case study focuses on the town of Slănic, where a ground collapse event occurred in April 2024, severely impacting residential buildings, critical infrastructure, and public utility networks. This event highlighted the need for geotechnical and hydrogeological investigations in the affected area and its surroundings. For this purpose, monitoring wells were installed to assess the groundwater level following the recommendations of a technical assessment report, initiated at the request of the local authorities.

The direct video inspection method (CCTV) was used to evaluate nine existing wells, in order to support the groundwater monitoring program by providing insights into local hydrogeological conditions. This activity is part of the GEOMONITOR Project, which focuses on monitoring geohazards and anthropogenic influences in the Slănic area, with particular emphasis on their potential impact on society. Due to the absence of standardized technical documentation and the need to verify the integrity of the wells, the following parameters were recorded and analyzed during the inspection process: installation depth; physical condition and structural integrity of the casing and screens; depth and total length of the screen sections; degree of clogging of the screen slots; sediment accumulation at the bottom (sump); identification of any mechanical damage to the casing; and the measured groundwater level.

The investigation revealed that all monitoring wells are in good physical condition, with sediment accumulation observed at the bottom of each well. The positions of the screen sections that allow groundwater inflow were identified: seven monitoring wells contain a single screen zone located at the bottom, while two wells have dual screen intervals — one at the bottom and another near the upper section. In this context, video camera inspection of monitoring wells represents a direct, real-time, non-invasive, and time-efficient technique that is accessible and applicable for the next phase of monitoring.

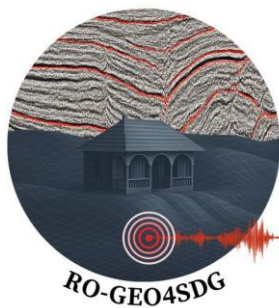
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**WORKSHOP: Geophysical Field Studies in High-Risk Areas:  
Unlocking the Past – Securing the Future  
(RO-GEO<sub>4</sub>SDG)**



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## RO-GEO4SDG: THE EDUCATIONAL PROGRAM AND MULTIDISCIPLINARY GEO-INVESTIGATION OF RĂTEȘTI ZONE

Florina Chitea<sup>1,2</sup>, Ana Suditu<sup>1</sup>, Gheorghe Turturea<sup>1</sup>, Irina Stanciu<sup>3</sup>, Andreea Andra-Topârceanu<sup>4</sup>,  
Alin Titus Șerban<sup>5</sup>

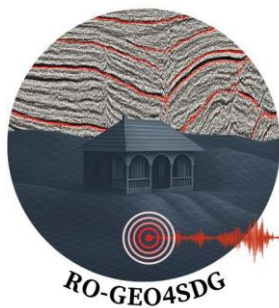
<sup>1</sup>Faculty of Geology and Geophysics, University of Bucharest, Romania; <sup>2</sup>Sabba Ștefănescu Institute of Geodynamics of the Romanian Academy; <sup>3</sup>National Institute for R&D on Marine Geology and Geoecology - GeoEcoMar, Romania; <sup>4</sup>Faculty of Geography, University of Bucharest, Romania; <sup>5</sup>Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, Romania

The RO-GEO4SDG initiative integrated applied geoscientific research with hands-on education to address the land movement in Rătești, Romania, while training the next generation of geophysicists and fostering collaboration among universities, research institutions, and private companies specializing in geophysics, geotechnics, and satellite data analysis. The project employed a comprehensive geophysical approach, including ground-based and drone-based geophysics. Among the used methods were electromagnetic investigations, electrical resistivity and seismic, complemented by PSInSAR datasets and geotechnical measurements.

Aligned with Sustainable Development Goal 4 (Quality Education), the project offered inclusive and practical learning experiences through pre-camp workshops, hands-on field training, collaborative data analysis, and post-camp reporting. Participants engage with advanced instrumentation, SAR-based monitoring, GIS-based hazard assessment, and environmental and safety protocols, fostering critical thinking, problem-solving skills, and an appreciation of geoscientists' contributions to human safety (SDG 11), well-being (SDG 3), and environmental stewardship (SDG 13 and 15).

By integrating scientific investigation with structured educational experiences, the RO-GEO4SDG project has established a robust foundation for future hazard assessment and intervention planning in the study area, while also serving as a model for combining high-quality geoscience education with community-focused services.

*Acknowledgements:* We gratefully acknowledge the award granted by SEG and the SEG Foundation, which made possible the implementation of the project “Geophysical Field Studies in High-Risk Areas: Unlocking the Past – Securing the Future” (RO-GEO4SDG), carried out by the Romanian Society of Applied Geophysics and the SEG Bucharest Student Chapter at the Faculty of Geology and Geophysics. The successful execution of the project was greatly supported by the technical contributions of the Institute of Geodynamics of the Romanian Academy, GeoEcoMar, Dirac, GeoLog, Terrasigna, Geokit Green Solution, Ar-Geo-Edu, and Vibrometric.



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## MATERIAL AND MAGNETIC CHARACTERIZATION OF BRICKS FROM RĂTEȘTI MONASTIC BUILDINGS: INSIGHTS FOR CONSERVATION OF A HISTORIC ENSEMBLE

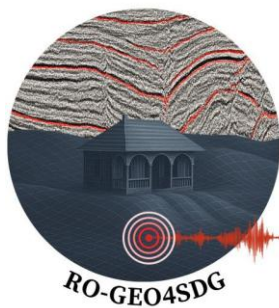
Irina Stanciu<sup>1</sup>, Bianca Stănică<sup>2</sup>, Florina Chitea<sup>3,4</sup>, Alin Titus Șerban<sup>5</sup>, Daniela Cristea-Stan<sup>5</sup>,  
Simion Corina Anca<sup>5</sup>, Florin Pitea<sup>1,3</sup>, Ana Suditu<sup>3</sup>, Timeea-Maria Manolache<sup>3</sup>

<sup>1</sup>National Institute for R&D on Marine Geology and Geoecology - GeoEcoMar, Romania; <sup>2</sup>Independent researcher, Romania; <sup>3</sup>Faculty of Geology and Geophysics, University of Bucharest, Romania; <sup>4</sup>Sabba Ștefănescu Institute of Geodynamics of the Romanian Academy; <sup>5</sup>Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, Romania

The Rătești Monastery, located in Buzău County, stands as a cultural and spiritual landmark of 17th–19th centuries in Romania. The church iconography was created by Nicolae Teodorescu and Gheorghe Tătărescu, launching Tătărescu's career as a major figure in 19th-century religious and neoclassical painting. A critical moment in the monastery's history was the landslide event of 2014, which caused severe structural damage and partial collapse of the church and other several buildings, and the successive degradation of the monastic ensemble.

To evaluate structural vulnerability and inform conservation, bricks from the most deteriorated Rătești monastic buildings were analysed. Samples from the Church (C, 3), Arcade House (AH, 3), House no. 66 (H66, 2), and House no. 25 (H25, 4) were examined to assess composition, production (i.e., firing) characteristics, and susceptibility to long-term degradation. An XRF analysis was performed using a portable Tracer 5i spectrometer to determine the elemental composition of the brick samples. Results show that Si, Fe, K, and Ca dominate the composition, consistent with typical clay-sand mixtures used for traditional brickmaking. A moderate positive sulphur-calcium correlation (Pearson correlation coefficient,  $r \approx 0.5$ ) suggests that sulphur is largely bound in calcium-sulphate phases such as gypsum (susceptibility to gypsum formation and salt crystallisation, especially under repeated wetting/drying or freeze-thaw cycles), which can promote efflorescence, flaking, and granular disintegration under moisture fluctuations. Notably, H25 shows markedly elevated sulphur (mean 1.33; up to 2.84 in H25-1) and high Ca (mean 4.25). To complement these observations, magnetic susceptibility measurements were carried out employing the Bartington MS<sub>3</sub> magnetic susceptibility-meter with an MS<sub>2</sub>F sensor. The results (in  $\mu\text{CGS}$ ) are quite variable: low at the Church (62–353) and House no. 66 (–0.3–78), moderate to high at the Arcade House (83–424), and consistently high at House no. 25 (246–366). As the XRF results indicate moderate to high Fe concentrations across all samples (mean 2.79), the observed variability in magnetic susceptibility is best explained by differences in bricks firing conditions rather than variations in bulk iron content. During firing, iron-bearing minerals in the clay undergo thermal transformations that produce ferrimagnetic phases such as magnetite and maghemite.

*Acknowledgements:* This work is part of the project RO-GEO4SDG, financed by the SEG Foundation. We express our gratitude to the Abbess of Rătești Monastery for granting permission to carry out the field measurement campaign on monastery grounds.



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## MAPPING LANDSLIDE SUSCEPTIBILITY USING GEOGRAPHICAL DATA IN PROTECTED CULTURAL LANDSCAPE

Andreea Andra-Topârceanu<sup>1</sup>, Florina Chitea<sup>2,3</sup>, Chaouki Benabbas<sup>4</sup>, Adriana-Bianca Ovreiu<sup>1</sup>,  
Yacine Benzid<sup>4</sup>, Matougui Zakaria<sup>4</sup>, Diana Popovici<sup>1</sup>, Eduard Mihai Răduț<sup>1</sup>

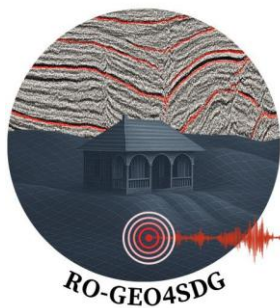
<sup>1</sup> Faculty of Geography, University of Bucharest, Romania; <sup>2</sup> Faculty of Geology and Geophysics, University of Bucharest, Romania; <sup>3</sup> Sabba Ștefănescu Institute of Geodynamics of the Romanian Academy, Romania;

<sup>4</sup> Centre de Recherche en Aménagement du Territoire (CRAT), Algeria

Historical heritage sites are increasingly threatened by landslide hazards, which jeopardize their preservation and cultural value. A striking example is the 2014 landslide at Rătești Monastery in Buzău County, a site of remarkable historical and artistic value. Founded centuries ago, the monastery houses a mid-19th century church adorned with significant architectural and artistic elements, reflecting the rich cultural heritage of the region. The landslide caused severe damage to this church, compromising its structural stability and highlighting the vulnerability of such irreplaceable heritage sites to natural hazards. However, this sequence is not an isolated incident within the Subcarpathian region.

The Curvature Subcarpathian region, as a transitional area between the Carpathians and the adjacent lowlands, is characterized by a mix of extensive depressions, varying piedmonts, structural hills, and continuous hilly massifs formed from Miocene-Pliocene sedimentary strata arranged in folds and faults. This complex morphological landscape experiences instability due to various factors, including river shaping, rainfall patterns, and changes in land use - such as deforestation, urban expansion, and intensive agriculture. The geomorphological instability of slopes manifests through landslides, accelerated erosion, and ravination processes, particularly in the Buzău study area. Each of the factors influencing this instability contributes differently to the variability in vulnerability to landslide hazards. Landslide susceptibility map delineates the potential areas for future landslides based on historical or past events and various environmental factors that contribute to instability. Geographic mapping of landslide susceptibility - which takes into account the triggering and reactivating factors affecting historical heritage - plays an essential role in management planning. This process includes documenting past landslides, inventory and mapping their characteristics, and assessing the related morphological features. Mapping landslide susceptibility in a protected area involves the use of geographical data to assess the risk of landslide as a local event or as a part of a larger phenomenon. This concept addresses both the singularity of a specific event and the probability of inadequate management, or broader regional context of susceptibility.

*Acknowledgements:* This work is part of the project RO-GEO4SDG, financed by SEG Foundation. We express our gratitude to the Abbess of Rătești Monastery for granting permission to carry out the field measurement campaign on monastery grounds.



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## GROUND STABILITY ANALYSIS IN THE RĂTEȘTI AREA USING SPACEBASED SAR INTERFEROMETRY

Valentin Poncoș, Delia Teleagă, Dan Birtaș

*Terrasigna, Romania*

Space-based Synthetic Aperture Radar (SAR) Interferometry (InSAR, PSInSAR) represents a technique belonging to the field of Space Geodesy and together with GNSS it is used to measure ground motion and infrastructure stability.

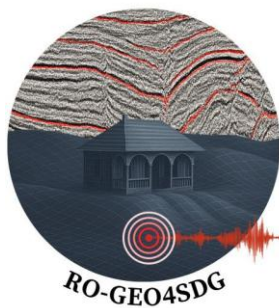
The network of SAR (radar) sensors keeps growing; presently, the European Space Agency (ESA) maintains two Sentinel-1 sensors in space at any time while NASA JPL just launched the largest SAR mission that will start acquiring data in November 2025. In addition to these free and open data sources, multiple missions maintained by the German Space Agency (DLR), Italian Space Agency (ASI), Spanish Space Agency (INTA) and the Canadian Space Agency (CSA) are available for research purpose or commercially.

ESA Sentinel-1 data was used for the site in Rătești; data is available from multiple orbits and two of them were selected for processing. Since the measurements are taken by a radar system, the measured dynamics is 1D, along the radar line of sight. With two different orbits (ascending and descending), two different directions of measurements are available and the ground motion vector can be more accurately determined.

The spatial resolution of Sentinel-1 data is 100 meters squared and the most accurate measurements can be made on infrastructure (metal, concrete), bare-rock and areas with sparse vegetation; in forested areas or over water bodies measurements cannot be made. Thus, the measurement points in the Rătești area were detected mostly on the Monastery and the adjacent buildings.

The measurement results do indicate a relatively high dynamic, with some areas moving on a vertical direction and some others sideways, along the slopes. Additionally, the measurement area was extended to include neighboring villages with the purpose of examining the ground stability on a wider scale.

*Acknowledgements:* Results are part of the project RO-GEO4SDG, financed by SEG Foundation



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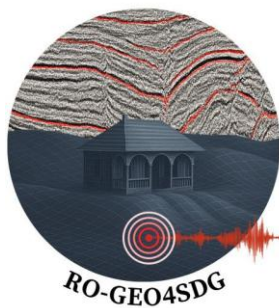
## RETRIEVING SHALLOW DEPTH GEOLOGICAL INFORMATION FROM MANUAL BORING TECHNIQUE AT RĂTEȘTI MONASTERY

Vladimir Gheorghief<sup>1</sup>, Mihaela Roca<sup>1</sup>, Ungureanu Constantin<sup>1</sup>, Gheorghe Turturea<sup>1</sup>,  
Tudor Geamăn<sup>1</sup>, DIRAC Team<sup>2</sup>

<sup>1</sup>Faculty of Geology and Geophysics, University of Bucharest, Romania; <sup>2</sup>DIRAC S.R.L., Romania

In 2014, in Buzău county, Rătești Monastery, located approximately 25km (birds-eye view) from Buzău municipality, on the left side of Buzău River, was destroyed due to a catastrophic landslide that continues to affect the area today. From a geological standpoint, the abbey is located upon upper Pleistocene fluvial deposits of clays and sandy clays. From a tectono-structural point of view, it's located on a syncline axis with the direction NNE-SW in the Quaternary-Romanian sedimentary cover identified in the Buzău area. In September of 2025, a group of students and professors from the University of Bucharest and the University of Thessaloniki, together with specialists in geology and geophysics, carried out a field study to analyze the affected zone and reconstruct the geological context. Multiple in-situ tests were conducted, including ERT, seismic, and photogrammetry. However, the most relevant dataset for understanding the failure mechanism was the geotechnical one, obtained from nearly 13 manual boreholes executed with portable boring equipment, positioned according to ERT profiles, to determine the lithology beneath the abbey and its immediate surroundings, and to directly correlate geophysical results with the extracted geological materials. The manual boring technique is one of the most easily available and reliable geotechnical data acquisition methods. Both disturbed and undisturbed samples were collected, with lithological logs compiled for each borehole. The lithological logs were correlated with ERT profiles, allowing validation of geophysical interpretations with direct lithological observations. The data revealed a heterogeneous subsurface, with lithological sequences varying significantly even between closely spaced boreholes. Lithology consists mainly of silty sand, sandy silt, silty clays and clays. Groundwater was intercepted in several boreholes within sandy horizons below or above clay strata, indicating a complex hydro-lithological configuration that may have contributed to slope failure. The geotechnical boreholes proved to be the key component of the investigation, providing direct evidence of the subsurface lithology and validating the geophysical interpretations. Their correlation with ERT profiles allowed for a more precise reconstruction of the stratigraphic architecture and identification of the layers most susceptible to instability. The lithological variability observed between boreholes emphasizes the importance of detailed, site-specific investigations in understanding slope dynamics. Ultimately, the geotechnical dataset offered the clearest insight into the relationship between soil composition, groundwater occurrence, and the instability phenomena at Rătești.

*Acknowledgements:* This work is part of the project RO-GEO4SDG, financed by SEG Foundation. We express our gratitude to the Abbess of Rătești Monastery for granting permission to carry out the field measurement campaign on monastery grounds.



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## GROUND-BASED GEOPHYSICAL SURVEY OF THE LANDSLIDE-AFFECTED ZONE AT RĂTEȘTI MONASTERY

Florina Chitea<sup>1,2</sup>, Ilias Fikos<sup>3</sup>, Chaouki Benabbas<sup>4</sup>, Ungureanu Constantin<sup>1</sup>, Mihaela Roca<sup>1</sup>, DIRAC Team<sup>4</sup>, Vibrometric Team<sup>5</sup>, Vaggelis Anagnostou<sup>3</sup>, Maria Noti<sup>3</sup>, Eleni Provata<sup>3</sup>, Ana Elena Suditu<sup>1</sup>, Gheorghe Turturea<sup>1</sup>, Alin Titus Serban<sup>6</sup>, Florin Pitea<sup>1,7</sup>, Tudor Geamăn<sup>1</sup>, Cristiana-Alexandra Ceașescu<sup>1</sup>, Gheorghiev Vladimir<sup>1</sup>, Maria-Manolache Timeea<sup>1</sup>

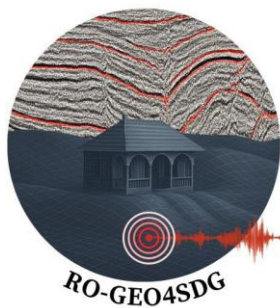
<sup>1</sup>Faculty of Geology and Geophysics, University of Bucharest, Romania; <sup>2</sup>Sabba Ștefănescu Institute of Geodynamics of the Romanian Academy, Romania; <sup>3</sup>University of Thessaloniki, Geological Department, Greece; <sup>4</sup>DIRAC, Romania; <sup>5</sup>Vibrometric, Romania; <sup>6</sup>Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering, Romania; <sup>7</sup>National Institute for R&D on Marine Geology and Geoecology – GeoEcoMar, Romania

This study presents a ground-based geophysical investigation conducted within the landslide-affected perimeter of Rătești Monastery, Buzău County, to improve subsurface characterization and assess slope stability. The mechanisms behind the destructive 2014 event - which severely impacted the church, monastic residences, museum buildings, and the access road - remain insufficiently understood. Among the most impacted structures is the mid-19th-century church, now exhibiting a partially collapsed roof and walls compromised by extensive cracking. Consequently, any plans for construction, land use, or infrastructure rehabilitation in the area require detailed geotechnical and geophysical assessment to ensure safety.

The 2025 geophysical survey integrated Electrical Resistivity Tomography (ERT) and seismic techniques to provide complementary insights into geological and hydrogeological conditions of the confined sector heavily affected by the 2014 mass movement, likely triggered by intense rainfall. The ERT survey employed 48 electrodes to delineate lithological variations and identify zones of elevated moisture content associated with instability. Seismic investigations employed 108 high-sensitivity geophones (natural frequency: 5Hz) and two controlled sources: a 5 kg hammer and the VIBSIST-50 system. Source points were spaced at intervals up to 5 m, and each VIBSIST location generated approximately 100 controlled impacts at 50–250 ms intervals. VIBSIST operates using the Swept Impact Seismic Technique (SIST), producing seismic signals through a sequence of timed impacts to enhance resolution and signal quality.

The integration of geoelectrical and seismic methods enabled high-resolution subsurface imaging, significantly improving geohazard characterization. Combined with remote-sensing observations and geotechnical data, these results provide a robust foundation for designing effective mitigation strategies in this highly sensitive area.

*Acknowledgements:* This work is part of the project RO-GEO4SDG, financed by SEG Foundation. We express our gratitude to the Abbess of Rătești Monastery for granting permission to carry out the field measurement campaign on monastery grounds.



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## GPR-BASED ANALYSIS OF ASPHALT DEGRADATION IN A CONFINED PERIMETER OF RĂTEȘTI

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<sup>1</sup>GeoLog, Romania; <sup>2</sup>Faculty of Geology and Geophysics, University of Bucharest, Romania;

<sup>3</sup>Sabba Ștefănescu Institute of Geodynamics of the Romanian Academy, Romania

The 2014 landslide at Rătești Monastery was a highly destructive geomorphological event that caused extensive damage to the historic monastic complex and its access road. In this study, we present Ground-Penetrating Radar (GPR) surveys carried out over an asphalt-covered section of the main access road.

The investigated perimeter exhibits clear signs of degradation, despite recent maintenance works and interventions aimed at improving runoff management, raising concerns regarding subsurface instability and overall infrastructure safety in the post-landslide context.

Data acquisition was performed using a RadSYS Georadar system equipped with a 500 MHz shielded, single-channel antenna (center frequency: 500 MHz; operational bandwidth: 200–900 MHz at –12 dB), operated in ground-coupled mode to obtain high-resolution imaging of near-surface structures.

The results highlight the effectiveness of GPR for diagnosing asphalt integrity in post-landslide environments and provide essential information to support the maintenance of the culvert, as well as other water-drainage and slope-stabilization structures in this vulnerable sector.

*Acknowledgements:* This work is part of the project RO-GEO4SDG, financed by SEG Foundation. We express our gratitude to the Abbess of Rătești Monastery for granting permission to carry out the field measurement campaign on monastery grounds.



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