II. Natural Hazards and Climate Change Conference

Session 4 Geohazards

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Assessing luminescence sensitivity and ESR parameters as indicators of geomorphological processes in fluvial and aeolian settings

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In recent decades, electron spin resonance (ESR) and optically stimulated luminescence (OSL) methods have been increasingly applied to sediment provenance studies. While their combined use in age dating is common, the relationship between ESR and OSL parameters in provenance studies, particularly in comparing quartz grains across sediment types, remains understudied, as does the extent to which various factors influence these parameters. Here, the separability of sediments from different source areas and transport processes is investigated using parameters of the ESR (E'_1, Ti-h, peroxy, Al-h) and OSL (CW-OSL, Total LM-OSL, LM-OSL fast and medium component, 110°C TL) methods. Additionally, potential relationships between ESR and OSL parameters are explored to enhance the distinction of sediment samples based on their origin. Quartz grains from modern fluvial and paleo-aeolian sediments of the Pannonian Basin offer a valuable opportunity for these measurements.

Based on the measured samples, aeolian and fluvial sediments can be clearly distinguished by the mean values of E'_1, while the Ti-h parameter proved to be the most effective in differentiating between Danube and Tisza sediments. The strongest correlation between the two methods was observed between the E'_1 and the LM-OSL medium component. A linear downstream variation of the Al-h parameter is evident in both rivers, while a clear trend in the E'_1 and Ti-h parameters was observed only in the Tisza River. In the case of the luminescence parameters, in the upper Tisza, the LM-OSL fast component and CW-OSL sensitivity are similar to those of the Danube and lower than in the middle and lower sections. This downstream increase is driven by high-sensitivity quartz grains supplied by tributaries. In the case of the Danube a recurring increase can be observed instead. The observed variations in luminescence sensitivity are primarily attributed to erosion.

Keywords: luminescence sensitivity, sediment provenance, ESR parameters, coarse quartz grains

Changes of the morphology of surface in the alluvial plane and loess plateau in the western part of Belgrade as a consequence of Pleistocene climate change and tectonic activity

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Within the Belgrade area north of Danube and Sava Rivers slow tectonic subsidence is accompanied by the fluvial, lacustrine and palustrine deposition. The constant tectonic lowering was accompanied by the fine floodplain material deposition during the period between two transitions, the thickness of which was increasing at the rate of tectonic lowering.

Their maximum surface elevation equals the river terrace along the alluvial plane of the Sava River near Belgrade – 73 m a.s.l. These deposits were fully or partially eroded down to the local base level (approximately 62 m a.s.l.) at the ends of glacial periods, and replaced to approximately 70 m a.s.l. by much coarser sediments – sandy gravel or sand. Cyclic climate changes caused the repeating of these processes, which together with tectonic lowering resulted in shortened cyclic deposits. The complete cycle is represented by Holocene sediments – last, youngest sedimentation cycle comprising floodplain silt and clay in the upper part, and well sorted riverbed sand at its lower part with the base at the elevation of approximately 62 m a.s.l., same as the elevation of the Sava River riverbed. In the tectonic block that stopped descending, on top of floodplain deposits, the aquatic loess-like sediments were deposited from 73 to 78 m a.s.l. forming the second terrace, or the base of loess.

Based on the results of absolute dating of aeolian, fluvial and glacial deposits a following sequence was derrived: before more than 700 ka a wide alluvial plain encompassed both Zemun and Batajnica areas west of Belgrade, then the tectonic blocks under Batajnica (farthest to the west) stopped subsiding at approximately 700 ka, the tectonic blocks under Zemun stopped lowering some 420 ka ago, with river staying within the subsiding blocks ever further to the east, in the ever-shrinking alluvial plane where new fluvial polycyclic sediments continued forming.

Sinkhole hazard in geoeducation: presentation of an online map

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Most karst processes operate at a slow rate and have a long-term effect in creating the typical dissolution morphology including sinkholes (dolines) and subsurface features, such as caves. However, there are also some rapid processes, of which the most important are the collapse processes. It should also be mentioned that among the karstifying rocks, the dissolution of evaporites is an order of magnitude faster than that of carbonates. Due to the above factors, the most important geomorphological hazards associated with karsts are the formation of collapse sinkholes and the subsidence sinkholes typical of evaporite karsts. Nonetheless, hydrological hazards are also significant in karst areas, but this topic is not examined in this presentation. In addition to the above natural factors, human interventions (e.g. mining, dam construction) can also increase the karst hazards. In our study, a global database of hazards associated with the formation of sinkholes has been created based on the scientific literature and public media. Further on, an online map was created using this database. This map can be used in geoeducation, primarily in higher education, but due to its intuitive interface, it can provide any interested person with scientifically sound information and spatial knowledge on the issue of sinkhole hazard. In our presentation, we demonstrate the types of sinkhole hazards, present some type localities and show the characteristic geographical distribution of these phenomena.

Use of frequency ratio method and GIS for landslide susceptibility modeling: a case study in the South-Western part of Tajikistan

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South-Western part of Tajikistan is more propensity to landslide compared to other regions (North, North-East, Central and South-East). New land reclamation, housing and industrial construction in the landslide-prone areas require regional-scale landslide susceptibility mapping. A landslide susceptibility map illustrates future zones of potential landslide occurrence. Thus, predicting areas propensity to landslide, which has recently been accomplish through the landslide susceptibility modeling using the Geographic information system (GIS) technology, has become a fixture part of landslide risk reduction investigation. Taking into consideration information given above, the aim of this research is to conduct GIS-based landslide susceptibility modeling using the frequency ratio method. To carry out the landslide susceptibility assessment, a landslide inventory map containing 1024 landslide was composed through field investigation and the interpretation of Google Earth Pro satellite images. A digital elevation model extracted from USGS site and data from laboratory seismic hazard assessments were used to obtain landslide conditioning factors such as slope degree, slope aspect, curvature, precipitation, elevation, distance from river, distance from faults, PGA, TWI, SPI and distance from earthquake location to complete our resultant susceptibility map. It was explored that all the landslide causative factors have a spatial relation with training landslides. The landslide susceptibility map of the area interest was classified into five zones: very low, low, medium, high and very high. The quality of outcome map was assessed using ROC-curve, which calculates AUC (area under the curve) value. The results indicate an AUC of value 0,83, which according to the statistical characteristic of AUC, indicates very good model performance.

The Influence of Mediterranean Hurricane Surges on Vertical Ground Motion Along the Southern Coast of Sicily, Italy

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Vertical land movement is an important aspect of coastal dynamics along the Mediterranean, influenced by both natural and human activities. One natural factor affecting coastal stability is storm-induced wave inundation. Storms occur annually in the Mediterranean, with the highest intensity in autumn. Besides regular storms, the region also experiences Medicane storms, which bring high waves and occur almost once a year. Sicily is one of the areas frequently impacted by both types of storms. This study examines the impact of Medicanes on vertical land movement along the southern coast of Sicily. The research uses interferometric TOPSAR analysis with the Sentinel Application Platform SNAP 8.0 to process Sentinel-1 satellite images from 2015 to 2021. The study compares medium-term vertical land movement from 2015 to 2020, annual displacement from 2020 to 2021, and vertical changes before and after Medicane Zorbas in September 2018 and Medicane Apollo in October 2021. The results show that vertical motion over the medium term, annually, and after Medicane Zorbas generally trends toward uplift. However, after Medicane Apollo, the southern coast of Sicily experienced subsidence between 0.005 and 0.06 meters. The findings indicate a relationship between storm-induced flooding and coastal subsidence. The different vertical land movements following Medicane Zorbas and Medicane Apollo are likely due to variations in storm paths. Medicane Zorbas moved toward the Ionian Sea, avoiding direct impact on Sicily. In contrast, Medicane Apollo traveled from North Africa across Sicily to Europe, causing significant coastal subsidence.

Keywords: interferometric, Sentinel-1, SNAP, subsidence

Paleotsunami records (?) and landscape reconstruction on the Western Black Sea coast (Mangalia)

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We present the first integrated sedimentological, paleoecological, geochemical, geophysical, and geomorphological evidence supporting a new hypothesis of multiple tsunami events along the southern Romanian coast, near the ancient site of Callatis (modern-day Mangalia), a Greek colony founded in the 4th century BC. Our combined geo-bio-chronological dataset confirms and enriches existing records—such as historical accounts—of past seismic activity and associated marine disturbances affecting the western Black Sea shoreline.

A multi-layered sandy package (also containing pebbles and thin layers of silts) was initially identified in a 40 × 15 x 1.6 m trench, then verified and analyzed based on a network of 9 sediment cores (up to 6 m long). These were retrieved from an almost horizontal surface, currently located at 8.5-9 m *a.s.l.* and 140-300 m inland from the coastline, north of the Romano-Byzantine wall of Calatis. The sand pack stands between 4.5 and 8 m *a.s.l.*, discordantly overlaying a silt and clay deposit infilling a karstic depression (sinkhole). The multi-proxy analyses and robust chronology based on both OSL and 14C dating allowed discrimination between several phases of landscape transformation since Antiquity, from the foundation of the Greek colony of Calatis to the end of the 20th century.