Succession from fluvial to aeolian environment recorded at westernmost part of the Wallachian basin, Serbia

Krsmanović, Petar; Radaković, Milica G.; Perić, Zoran; Thompson, Warren ; Ryan, Cathal; Marković, Rastko S.; Pilipović, Aleksandar; Marković, Slobodan B.

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SERBIAN ACADEMY OF SCIENCES AND ARTS

University of Novi Sad | Faculty of Sciences

DEPARTMENT OF GEOGRAPHY, TOURISM AND HOTEL MANAGEMENT

INTERNATIONAL CONFERENCE

NATURAL RESOURCES AND ENVIRONMENTAL RISKS: *Towards a Sustainable Future*

ABSTRACT BOOK

Novi Sad, 2023

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Content

City of Novi Sad – Urban Heart of Vojvodina

Novi Sad is the capital of the Autonomous Province of Vojvodina and the second largest city in Serbia. It is the industrial, cultural, scientific, educational, and administrative centre of Vojvodina.

Seen from above, City of Novi Sad reveals itself as a city located in a vast plain, spacious and open to all directions. Fortress of Petrovaradin, a historical site, is situated on the right bank of the River Danube, whereas a tall building of Central Post Office, massive construction of Spens Sports Centre, immense headquarter of Petroleum Industry of Serbia and elegant oval edifice of Banovina (a seat of Executive Council of Autonomous Province of Vojvodina) are situated on the left. What eyes could also perceive are green oases embodied in City parks, with labyrinth of streets and alleys meandering around them and cut across with wide and straight boulevards.

Moreover, there is the Danube as an unsymmetrical, potent axe of the City, embraced with long quay and Štrand, the most beautiful city beach along the Danube.

Nowadays, a widely recognizable symbol of the City is Exit Festival, while in the past, and even so today that place has been reserved for the Serbian cultural institutions: Matica srpska - the oldest cultural-scientific institution of Serbia, Serbian National Theatre, Sterijino pozorje Theatre Festival…

Furthermore, our City, in contrast to many other European destinations, has the reputation, by full right, of a multinational, multicultural and multi-confessional metropolis in which all differences are seen as advantages.

Department of Geography, Tourism and Hotel Management

Department of Geography, Tourism and Hotel Management was established 1962 by academician Branislav Bukurov. During previous almost half century, the Department has grown and developed, which brings it today amongst the most respectable Institutes of Geography in South-East Europe. The main professional activities of the Department are educational/teaching, scientific/research and publishing. Educational activity is provided through bachelor, master and PhD studying programmes.

Long lasting scientific researches have been conducted through several projects funded by governmental bodies, such as "Geographic research of municipalities in Vojvodina ", "Geomorphological map of Yugoslavia", "Condition and developing directions of Vojvodina", "Loess-palaesol sequences in Serbia", "Demographic transition in Serbia" and "Regional Water Resources Investigations In The Scope of Sustainable Development" (funded by UN).

The Department quarterly publishes two scientific journals: Geographica Pannonica and Turizam, and also the Department's Collection of papers with the longest tradition. Besides geoscience, multydisciplinary activities of the Department also involve research in tourism, sustainable development, marketing, management, etc.

Consequently, quality lectures, adequacy and eminence of the professors and assistants result with prosper and competitive students successfully employed worldwide.

International conference

NATURAL RESOURCES AND ENVIRONMENTAL RISKS: TOWARDS A SUSTAINABLE FUTURE

13-15th October 2023

Building of Branch of the Serbian Academy of Sciences and Arts in Novi Sad, Serbia

About the conference

The diversity of natural geo-ecosystems is the source of exceptional resources that has a key role in maintaining and improving living conditions on our planet, while ensuring the generation of multiple economic activities. The world demographic and economic growth and the industrialization increase would result in an exponential increase in the consumption of these resources and its degradation. The depletion of these natural resources combined with the effects of climate change results in a variety of negative consequences leading to un-sustainable practices. Contrary to this, climate variability challenges, disaster and risk management, and building resilience stand as major environmental tasks needed to be addressed in order to provide a sustainable future for next generations.

Therefore, management and preservation of natural resources is one of the major components of sustainable development. Faced with this situation, the scientific community should make their efforts to define priority action plans for the development and optimal use of natural resources and to maintain actions that significantly improve knowledge of the natural environment and its components from both a quantitative and qualitative point of view and those that ensure its conservation and resilience to multiple environmental risks.

The Conference aims to:

1. to bring together specialists in the field of natural resources, natural hazards and institutional actors to discuss the state of the art of the management and valorization of natural resources, in order to identify possible synergies for a closer cooperation and further exchange of knowledge between the different parties;
2. to highlight the status of scientific research on natural resources and environmental risks and to identify future needs for research and decision-making strategies for the management, preservation and mitigation actions;
3. to support scientific research;
4. to develop conceptual solutions for various problems related to the impact of environmental hazards and risks in different regions.

We honestly invite you to submit papers and share your ideas which would certainly broaden the importance of geospatial multidisciplinary research, promotion and implementation of the results into practical use.

Who may be interested?

- Academics and students, who are interested in the multidisciplinary research of the environmental problems.
- Members of professional societies and the general public with an interest in the given topic.
- Anyone who would like to be involved in the development of methodologies, multidisciplinary approaches, and contributions on a local, regional and global scale when analyzing natural resources and environmental risks.

Scientific Board

- Urdea Petru, corresponding member of the Romanian Academy, Romania
- Valjarević Aleksandar, Serbia
- Jef Vandenberghe, The Netherlands
- Veres Daniel, Romania
- Vukosavić Slobodan, academician, Serbia
- Wilby L. Robert, United Kingdom
- Zorn Matija, Slovenia

Local Organisational Board

- Kolundžija Jelena
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- Micić Ponjiger Tanja
- Mijatov Maja
- Marković Rastko
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- Nestorović Branka
- Pavlović Zoran
- Tešić Dajana
- Marjanović Miloš
- Tomić Nemanja
- Marković Slobodan
- Lukić Tin
- Ponjiger Igor
- Radaković Milica

The conference will be held at Building of Branch of the Serbian Academy of Sciences and Arts in Novi Sad, Nikole Pašića 6.

The event is supported by: Serbian Academy of Sciences and Arts, Department of Geography, Tourism and Hotel Management, Walter de Gruyter GmbH Open Geosciences (https://www.degruyter.com/journal/key/geo/html#latestIssue), Naftna Industrija Srbije – NIS, Specijalni rezervat prirode – Titelski breg.

CONFERENCE PROGRAM

12th October	
17.00-20.00	Ice Breaker party and registration
13th October	
8:30-9:00	REGISTRATION
9.00-9.30	OPENING CEREMONY
9.30-11.00	PLENARY SESSION
11.00-12.00	Coffee break and Poster presentation
12.00-13.00	PLENARY SESSION
13.00-14.00	Lunch break (Self arrangement)
14.00-16.00	THEMATIC SESSION – Petroleum, Gas, Renewable Energy and Resources
16.00-16.30	Coffee break and Poster presentation
16.30-18.30	PROTAGONIST
18.30-19.00	Public Discussion
20.00-22.00	CONFERENCE DINNER (At the venue)
14th October	
8.30-10.00	PLENARY SESSION
10.00-10.30	Coffee break
10.30-12.00	PLENARY SESSION
12.00-13.00	Lunch break (Self arrangement)
13.00-14.30	THEMATIC SESSION – Natural Hazards and Environmental Risks
14.30-15.00	Coffee break
15.00-16.30	THEMATIC SESSION – Natural Hazards and Environmental Risks
16.30-17.00	Coffee break
17.00-18.00	Business meeting
18.00-18.30	CLOSING CEREMONY AND DISCUSSION
18.30-20.30	CONFERENCE DINNER (At the venue)
15th October	
9:00 -17.00	Excursion – Titel Loess Plateau geotour

Conference program

12th October

Ice Breaker party and registration
17:00-20:00
Building of Branch of the Serbian Academy of Sciences and Arts in Novi Sad, Nikole Pašića 6.

13th October

8:30-9:00 REGISTRATION
Building of Branch of the Serbian Academy of Sciences and Arts in Novi Sad, Nikole Pašića 6.

9:00-9:30 OPENING CEREMONY
Building of Branch of the Serbian Academy of Sciences and Arts in Novi Sad, Nikole Pašića 6.

- Prof. Lazar Lazić, Director of Department for Geography, Tourism and Hotel Management
- Prof. Milica Pavkov Hrvojević, Dean of Faculty of Sciences
- Prof. Slobodan B. Marković, Corresponding member of Serbian Academy of Sciences and Arts

9:30-11:00 PLENARY SESSION
Chairmans: Velibor Spalević, György Sipos

1. **Govedarica, D.**
   Petroleum industry in Serbia: Planning, investments, and sustainable process integration
2. **Cvetković, V.**
   Geodynamic history unveiled from rock archives: the case of central Balkan Peninsula
3. **Vandenberghe, J.**
   Natural flooding evolution in relation with climate as recorded in past sedimentary sequences

11:00-12:00 Coffee break and Poster presentation
Guided tour: Tanja Micić Ponjiger, Milica Radaković

12.00-13.00 PLENARY SESSION
Chairmans: Jef Vandenberghe, Slobodan B. Marković

4. **Marković, K., Marković, S.B., Radivojević, A.R., Marković, R.S.**
   Natural and anthropogenic causes for intensive depopulation in Visok micro-region and possibilities for demographic and economic revitalization
5. **Smalley, I.**
   Loess as a resource; Loess as a hazard

6. **Milutinović, V.**
   DataFlow SuperComputing for BigData DeepAnalytics

13.00-14.00 LUNCH BREAK (SELF ARRANGEMENT)

14.00-16.00 THEMATIC SESSION – Petroleum, Gas, Renewable Energy and Resources
Chairmans: Dragan Govedarica, Nemanja Tomić

1. **Rašković, D., Eremić, S.**
   New petroleum refining challenge: Techniques for continuous improvement
2. **Shvarts, E., Karpachevskiy, M., Shmatkov, N., Baybar, A.**
   Problems and Challenges of Reforming Forest Policies and Management in Russia
3. **Govedar, Z.**
   State of forests and strategic goals of sustainable development of forestry of the Republic of Srpska
4. **Ptichnikov, A., Evgeny, S.**
   Russia climate net zero target: role of nature climate solutions
5. **Vranešević, D., Nedeljković, D.**
   Mining Climate Conversations: A Text Analysis Approach to Extract Key Narratives from Unstructured Climate Reports
6. **Đurić, A.**
   Geographical motives of the Sava river and Majevica mountains as a potential for the development of tourism in the Brčko District of Bosnia and Herzegovina
7. **Tomić, N., Antić, A., Marković, S.B., Tomić, T., Marjanović, M.**
   The role of geoheritage interpretation and geoeducation activities in UNESCO global Geoparks
8. **Tešić, D., Tomić, T., Tomić, N., Marković, S.B., Tadić, E., Marković, R.S., Bačević, N.**
   Using LiDAR technology for geoheritage inventory and modelling: Case study of Đavolja Varoš Geosite (Serbia)
9. **Nedeljkov, N., Marković, B.S.**
   Towards promotion of famous loess geo-heritage site Veliki Surduk, Titel loess plateau
10. **Pavlović, Z., Nikolić, A., Nestorović, B.**
    The Special Nature Reserve (SNR) "Titelski breg - Titel Loess Plateau", Vojvodina, North Serbia

16:00-16:30 Coffee break and Poster presentation
Guided tour: Tanja Micić Ponjiger, Milica Radaković

16:30-18:30 PROTAGONIST
Chairmans: Marjan Temovski, Binggi Cai, Slobodan B. Marković

1. **Soreghan, G. S., Steven, A., Pfeifer, L. S., Davila, L.**
   Glacial Loess in Equatorial Peru
2. **Soreghan, M. J., Soreghan, G. S.**
   Interpretation of past climate using provenance analysis of paleo loess in the Permian of the southwestern United States

3. **Krsmanović, P., Radaković, M.G., Perić, Z.M., Thompson, W., Ryan, C., Marković, R., Pilipović, A., Marković, S.B.**
   Succession from fluvial to aeolian environment recorded at westernmost part of the Wallachian basin, Serbia
4. **Jiang, L., Cai, B., Li, M., Gao, Y., Wang, F.**
   The relationship between cave temperature and local atmospheric mean temperature in a global view
5. **Li, M., Cai, B., Marković, S.B., Wang, L., Hao, Q., Baker, A., Gavrilov, M.B., Jiang, L., Wang, F., Wang, X., Wang, L., Ma, Z., Xiao, J., Guo, Z.**
   Strength of the winter North Atlantic jet stream has deviated from its natural trend under anthropogenic warming
6. **Milošević, S., Boev, Z., Dimitrijević, V., Mihailović, D.**
   First Fowlers of Europe: evidence for bird exploitation during MIS 8/7 from Velika Balanica cave (Serbia)
7. **Majkić, A.**
   Rocky road through the groove: Exploring the link between rock granularity and morphological features in engravings. The incised stone from Kozja cave, Serbia
8. **Sipos, G., Filyó, D., Magyar, G., Marković, S.B., Gavrilov, M.B., Marković, R., Kiss, T., Balla, A.**
   Comparing the age of dunes on two dune fields formed under different wind regimes and environmental conditions in the Pannonian Basin
9. **Radović, P., Lindal, L., Plavšić Gogić, S., Roksandić, M., Mihailović, D.**
   New hominin fossil molar from Velika Balanica (southern Serbia): a geometric morphometric analysis
10. **Mihailović, B., Mihailović, D., Dragosavac, S., Silva, L.O., Skinner, A.R., Roksandić, M.**
    Late Mousterian and Aurignacian lithic assemblages from Šalitrena Cave (northwest Serbia)
11. **Mihailović, D., Marković, S.B., Mihailović, B., Dragosavac, S., Plavšić Gogić, S., Roksandić, M.**
    Middle and Upper Paleolithic of the southern Pannonian Basin: lithic assemblages from Petrovaradin Fortress

18:30-19:00 Public discussion

20:00-22:00 Conference dinner (At the venue)

14th October

8:30-10:00 PLENARY SESSION

Chairmans: Michael Soreghan, Aleksandar Valjarević

1. **1. Hao, Q., Oldfield, F., Bloemendal, J., Gao, X., Song, Y., Wang, L., Marković, S.B., Guo, Z.**
   Hematite in loess bear the information of changing temperature of the Late Cenozoic

2. **Temovski, M., Molnár, K., Rinyu, L., Palcsu, L.**
   MIS8 to MIS7 sub-orbital-scale climate variability along the northern Mediterranean borderland recorded in a Macedonian mammillary speleothem
3. **Marković, S.B., Mihailović, D., Radaković, M.G., Krsmanović, P., Pilipović, A., Roksandić, M., Kolundžija, J., Gavrilov, M.B., Lukić, T.**
   The environmental reconstruction of the younger sequences of Petrovaradin fortress Palaeolithic site
4. **Cai, B., Wang, F., Lei, G., Li, M., Fang, K., Wang, X.**
   Variability of the East Asian summer monsoon rainfall in the southeastern China in the last two millennia revealed by high-resolution stalagmite δ18O records from western Fujian, China

10:00-10:30 Coffee break

10:30-12:00 PLENARY SESSION
Chairmans: Slobodan B.Marković, Jef Vandenberghe
1. **Vukosavić, S.N.**
   Energy transition and its impact on the consumption of mineral resources and on the environment
2. **Lukić, T., Wilby, L. R., Micić Ponjiger, T., Marković, B.S., Srećković Batoćanin, D., Milevski, I., Mărgărint, C. M., Spalević, V., Popov Raljić, J., Morar, C., Radaković, G.M., Allen, M., Batoćanin, N., Valjarević, A.**
   A Slippery Slope: Evaluating the Causal Factors of the Mramor Landslide (Southern Serbia)
3. **Spalević, V., Čurović, M., Lukić, T., Marković, S.B., Marković, R.S.**
   Soil Erosion Dynamics and Hydrological Impacts of Land Use-Induced Changes in the Berane Valley of Polimlje, Northeastern Montenegro

12:00-13:00 Lunch break (Self arrangement)

13:00-14:30 THEMATIC SESSION – Natural Hazards and Environmental Risks
Chairmans: Tin Lukić, Mihai Ciprian Margarint
1. **Živanović, M., Milanović, M., Trivić, B., Tomić, M., Grozdanić, G.**
   Analysis of the state of the vegetation cover in the zone of influence of the Kolubara mining basin using remote sensing methods
2. **Margarint, M.C., Niculita, M., Vaculisteanu, G., Necula, N., Tarolli, P.**
   Using RPAS derived images and LiDAR DEM's for the assessment of geomorphic changes in a cultural heritage site affected by recent landslides
3. **Sipos, G., van Leeuwen, B., Lábdy, J., Baksa, M., Tobak, Z.**
   Satellite-based river ice monitoring and parameters determining river ice formation on the Danube
4. **Sohrab, S., Csikos, N., Szilassi, P.**
   Seasonal Variability in PM_{10} Concentrations: A European-Scale Analysis of Urban and Suburban Land Cover Influences

5. **Milevski, I., Aleksova, B., Lukić, T., Valjarević, A., Micić Ponjiger, T.**
   Multi-hazard modelling of erosion and landslide susceptibility on the national extent of North Macedonia
6. **Đorđević, F., Marinković, M.**
   A Comparative Study of ML and FEM Models for the Prediction of Seismic Structural Behavior
7. **Hrvatin, M., Štaut, L., Volk Bahun, M., Komac, B.**
   Updating knowledge of avalanche prone areas in Slovenia
8. **Marković, R.S., Spalević, V., Đorđević, M., Marković, S.B., Radivojević, A.R.**
   The impact of climate and land use changes and on soil erosion in the river basin of Visočica river and accumulation of sediment in Zavoj lake

14:30-15:00 Coffee break

15:00-16:30 THEMATIC SESSION – Natural Hazards and Environmental Risks
Chairmans: Tin Lukić, Matija Zorn

9. **Margarint, M.C., Albulescu, A.C., Niculita, M.**
   The effects of droughts on livestock farms in NE Romania: an insight on risk perception and adaptive measures of the farmers
10. **Komac, B., Ciglič, R., Zorn, M.**
    Geographical atlas of natural disasters in Slovenia
11. **Marković, R.S., Spalević, V., Bogosavljević, M., Gocić, M., Radivojević, A.R.**
    Land use and environmental changes influence on erosion production, using IntErO model (Case study: Sokobanja basin, Eastern Serbia)
12. **Micić Ponjiger, T., Lukić, T., Wilby, R.L., Milevski, I., Spalević, V., Aleksova, B., Valjarević, A., Marković, S.B.**
    Cover-Management Factor, Slope Length and Steepness Factor (LS-Factor) for Modeling Water-Induced Soil Erosion in the Western Balkans
13. **Sabljić, L., Lukić, T., Bajić, D., Delić, D.**
    Application of Remote Sensing for Monitoring the Effects of Mining Activities on Land Use and Deforestation in Stanari Municipality, Bosnia and Herzegovina
14. **Živanović, M., Milanović, M., Trivić, B., Đurđić, S., Milinčić, M., Lukić, T.**
    Analysis of the intensity of erosive processes in the zone of influence of the Kolubara Mining Basin
15. **Vujović, F., Lukić, T., Bačević, N., Šiljeg, A., Valjarević, A.**
    Geospatial Modeling of Wildfire Susceptibility on a National Scale in Montenegro: A Comparative Evaluation of F-AHP and FR Methodologies
16. **Tičar, J.**
    Hidden in the dark: Uncovering the extent of cave pollution in Slovenia

16:30-17:00 Coffee break

17:00-18:00 Business meeting

18:00-18:30 CLOSING CEREMONY AND DISCUSSION

18:30-20:30 CONFERENCE DINNER (At the venue)

15th October

9:00 Excursion – Titel loess plateau geotour
(for those who applied by Google form by 26.9.2023.)

Poster presentations (13th October)

1. **Aleksova, B., Lukić, T., Milevski, I., Spalević, V., Marković, S.B.**
   Modelling water erosion and mass movements (wet) by using GIS-based multi-hazard susceptibility assessment approaches: a case study – Kratovska reka catchment (North Macedonia)
2. **Đeđanski, V., Durlević, U., Kovjanić, A., Lukić, T.**
   GIS-based Landslide Susceptibility Mapping and Assessment using MCDM-BWM: A Case Study – City of Smederevo (Serbia)
3. **Kričković, E., Lukić, T., Srejić, T., Stojšić-Milosavljević, A., Stojanović, V., Kričković, Z.**
   Spatial-temporal and Trend Analysis of the Traffic Accidents in the AP Vojvodina (northern Serbia)
4. **Grozdanić, G., Milanović, M., Cvetković, V., Vujačić, D.**
   Model of resistance of the local community of Nikšić municipality to earthquake hazards
5. **Ouakhir, H., Ennaji, N., Spalević, V., Marković, R., Sestras, P., El Ghachi, M.**
   Assessing of the effect of land use and land cover changes on the intensity of soil erosion and sediment transport applying the IntErO Model within Mkhdach catchment (Middle Atlas/ Morocco)
6. **Sabljić, L., Lukić, T.**
   Spatial-Temporal Monitoring and Analysis of Drought: A Case Study of the Sana River Basin in Bosnia and Herzegovina
7. **Gagić Jevtić, D., Trivković, I., Nikolić, J.**
   Effect of heat stable salts on amine treating unit's regenerator performance
8. **Gagić Jevtić, D., Trivković, I., Nikolić, J., Govedarica, D.**
   Delayed coking unit: A case study of Pančevo Oil Refinery
9. **Glišić, S.B., Orlović, A.M.**
   Hydrothreting of used vegetable oil for green diesel production: process simulation and optimization
10. **Glišić, S.B., Đukić, M., M. Orlović, A.M.**
    Influence of process parameters on the reaction of dibenzothiophene hydrodesulfurization in the hydrotreatment of petroleum medium distillates catalysed by coMo/AL2O3 catalyst
11. **Govedarica, D., Marković, S.B., Radaković, M.G., Gavrilov, M.B., Govedarica, O., Blagojević, J.**
    Mapping of geothermal potentials in Serbia (Vojvodina)

12. **Grishin, D.F., Pavlovskaya, M.V., Dolganov, E.D.**
    Synthesis of Depressant Additives for Diesel Fuel Based on Stearyl Acrylate and Stearyl Methacrylate Copolymers with Nitrogen-Containing Monomers by the Reversible-Addition Chain Transfer
13. **Karadžić, N., Govedarica, O., Žeravica, J., Govedarica, D.**
    Simulation and Optimization of Fluid Catalytic Cracking unit
14. **Kilmamatov, A.A., Tripković, M.M.**
    Determining the optimal resin concentration for stabilization of weakly consolidated near-well zone during oil and gas production
15. **Latas, G., Nikolić, I., Govedarica, D.**
    Effect of the additive for increased olefine content on the FCC catalyst circulation and product distribution
16. **Nešić, S., Blagojević, J., Jovičić, M., Govedarica, O., Streletskaya, V., Sonja Stojanov, S. , Glišić, S., Govedarica, D.**
    Chemical demulsification of water-in-paraffinic crude oil emulsion
17. **Nešić, S., Karaš, D., Fominykh, S., Božović, U., Džankić, J.**
    Towards a Greener Path: Exploring CCUS Perspectives in Serbia's Industrial Decarbonization
18. **Sarvari, D.I., Rakitin, A.**
    Digital twin
19. **Stanar, D., Fominykh, S.**
    Evaluating the Serbian Paradox: CO_2 Emissions of Electric Vehicles vs. Fossil Fuel Vehicles by 2030
20. **Stojanov, S., Jovičić, M., Govedarica, O., Žeravica, J., Govedarica, D.**
    Recycled carbon black's contribution to the curing and properties of newly formulated natural rubber composites
21. **Stojanov, S., Jovičić, M., Govedarica, O., Žeravica, J., Govedarica, D.**
    Significance of recycling of polyethylene terephthalate wastes for new materials production and conserving natural resources
22. **Žeravica, J.R., Govedarica, O., Jovičić, M., Stojanov, S., Govedarica, D.**
    Surface tension of rubber process oils
23. **Radaković, M.G., Gavrilović, B., Marković, R.S., Lukić, T., Gavrilov, M., Marković, S.B.**
    The oldest glacial environmental archive in Serbia – from gastropod perspective
24. **Magyar, G., Bartyik, T., Marković, R.S., Tóth, O., Kiss, T., Marković, S.B., Homolya, V., Balla, A., Filyó, D., Sipos, G.**
    Downstream change of quartz luminescence sensitivity and the rearrangement of OSL components along large rivers, a case study from the Pannonian Basin
25. **Roksandić, M., Radović, P., Lindal, J., Mihailović, B., Mihailović, D.**
    Corridors of interaction in the Balkans
26. **Wang, L., Hao, Q., Zhang, D., Zoe, Y., Rioual, P., Zhang, E., Li, J., Lou, H., Li, J., Chu, G., Gu, Z.**
    Meltwater Pulse1A Triggered an Extreme Cooling Event: Evidence From Southern China

27. **Aleksandar, A., Maković, S.B., Tomić, N., Marjanović, M.**
Integrating Geoethical Principles for Sustainable Management of Subterranean and Surface Karstic Geoheritage
28. **Bačević. N.R., Nikolić, M., Valjarević, A., Stevanović, V., Kićović, D., Radaković, M.G., Lukić, T., Marković, S.B.**
Determination of changes in the total amount of precipitation using the Mann-Kendall trend test in Central Serbia for the period from 1949 to 2018
29. **Radaković, M. G., Marković, R. S., Basarin, B., Antić, A., Lukić, T., Marković, S. B.**
Wrong investment? Climate prediction of snow free ski resort on Stara planina, Serbia
30. **Filyó, D., Sipos, G., Marković, S.B., Marković, R., Perić, Z.M., Magyar, G.**
Dust mass accumulation rates calculated for the Surduk loess profile, Serbia
31. **Sheishah, D., Kiss, T., Borza, T., Fiala, K., Kozák, P., Abdelsamei, E., Tóth, C., Grenerczy, G., Gergely Páll, D., Sipos, G.**
Risk Evaluation by Using High-Resolution Geophysical Techniques Along the Artificial Levee of Tisza River (Hungary)
32. **Grozdanić, G., Cvetković, V., Milanović, M., Živanović, M., Manijlović, B.**
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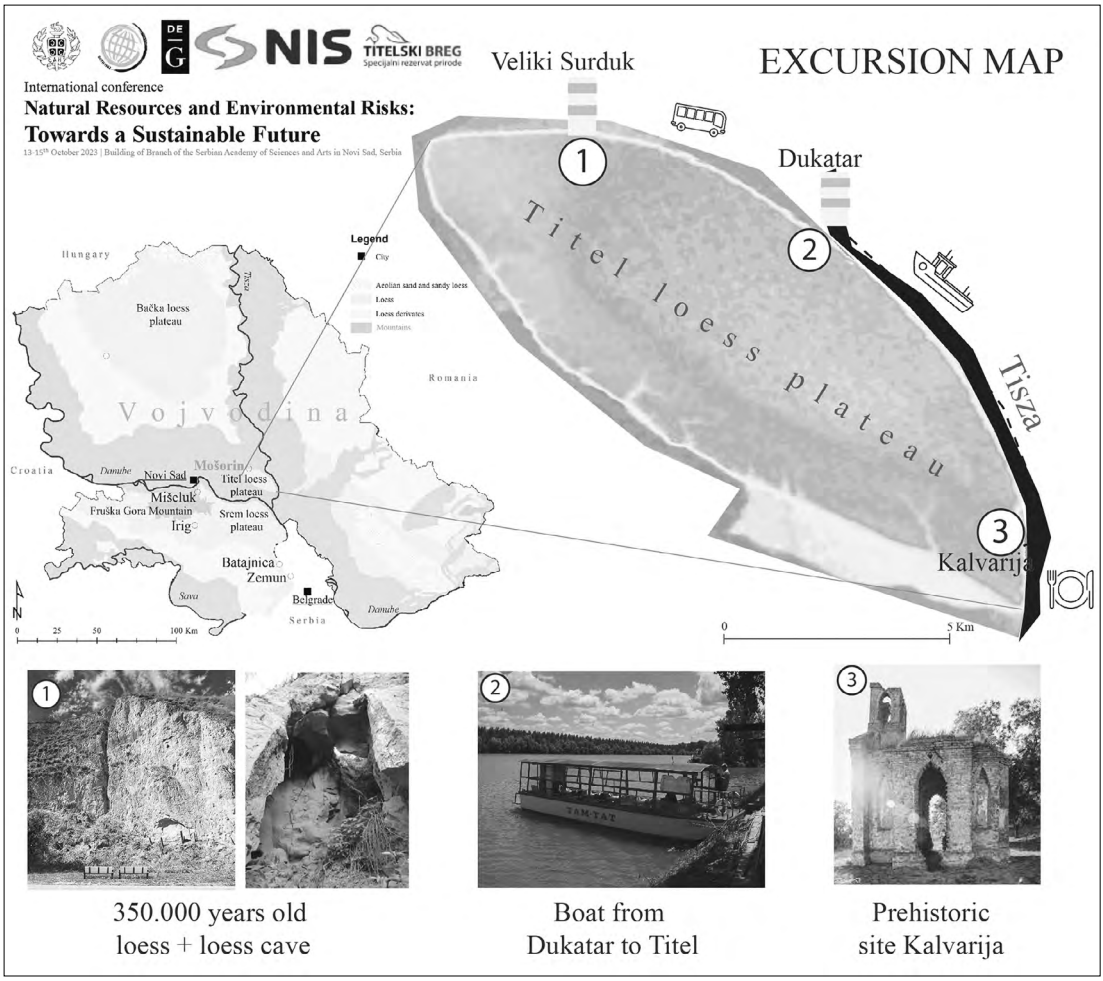
TITEL LOESS PLATEAU GEOTOUR INFO

Titel loess plateau

Near the confluence of the Tisza and Danube rivers is the Titel loess plateau. It is a prominent relief feature that stands out from the rest of the alluvial plain due to its relative height of about 50 meters with a length of 16 kilometers and a width of 7 kilometers. The shape of the plateau can be seen on the excursion map. At the edges of the plateau are gullies through which material was transported down from the plateau and accu-



mulated in the form of alluvial fans. These fans formed the basis for the formation of settlements such as Mošorin, which we will visit during the excursion. The loess-palaeosol profile in this gully is known as "Veliki Surduk" or "Mošorin" or in English as "Big Gully". In any case, these names denote a profile with a depth of 30 meters. Along the edges of the plateau there are sections that do not slope evenly in all directions. Vertical cliffs are located at the point of contact between the Tisza and the plateau. Just two centuries ago, the plateau was still an island, because the rivers flooded and the land was not drained, as evidenced by military surveys (First: 1763-1785, Second: 1806-1869). Another indication that the river once flowed around the plateau on both sides is a digital elevation model map showing the plateau surrounded by low terrain on all sides, indicating abandoned riverbeds with clearly defined meanders. On a 19th century map of Europe, the toponyms for slightly elevated terrain in the lowest part of the terrain were "siget" or "insel," which translates as "island". Today, the Tisza River surrounds the plateau on the eastern side. During the excursion we will visit this attractive place by boat.

Veliki Surduk

The Veliki Surduk is a 30 m loess palaeosol sequence near the Mošorin village. It is represented by three loess units and three paleosols which were formed over the last 340 ky. It terminates with the S3 paleosol, which has a thickness of one meter. Within this paleosol, there are Ah1 (granular structure, carbonate concretions) and Ah2 (lighter, with the same characteristics as the previous) horizons. Above it is the L3 loess, typical loess with carbonate concretions of maximum diameter 3 cm, featuring iron and manganese nodules and bioturbation at the contact with the S2 paleosol. The pale yellow L2 loess unit is situated between 13.2 m and 21.7 m depth and lies over the pedocomplex S2. The contact between the L2 unit and the S1 paleosol above it is characterized by carbonate concretions (1–4 cm in diameter) and numerous humus infiltrations in root channels. There is no evidence of interstadial paleosol within the L2 loess unit. Presence of tephra is indicated at a depth of 17.55 to 17.58 m. The red-brown pedocomplex (S1), with a thickness of 230 cm, consists of three parts: a brown horizon (degraded chernozem) at the base represented by a fossil AB horizon and two poorly developed fossil A horizons (chernozem). The L1 loess unit has a depth of over 10 meters but can be divided into two parts, L1LL1 and L1LL2 (more porous and coarser granulation). The poorly developed pedocomplex L1LL1 has been influenced by intense bioturbation in some parts. Initial pedogenic layers suggest development during wetter climatic conditions. The Holocene soil covering the Titel plateau is typical chernozem with a thickness of 50 cm.

Kalvarija

This multi-layered archaeological site at the southeast end of the Titel loess plateau was a place to establish early settlements, wisely taking advantage of all Titel loess plateau benefits (it dominates the terrain in the broader area of Bačka, Banat, and Srem regions). Over the course of many years, movable archaeological materials have been discovered here. In addition to these finds, at the far eastern part of the plateau, there is a ring-shaped fortification with a defensive ditch that is preserved for more than ⅔ of its length. The diameter of this fortification is approximately 150 meters, and based on partial damage to the surface layer (humus), it can be inferred that the fortification was surrounded by a stone wall and lime mortar, which is visible in several places. By eroding the northern slope of the plateau, towards the Tisza River, the northeastern periphery of the fortification has been damaged, and in this part, the outer wall of the fortification has been uncovered at several locations. Based on the terrain's configuration, it can be inferred that such a wall or rampart exists along the entire preserved perimeter of the fortification.

Dukatar

The Dukatar site is located 500 m downstream from the settlement of the same name and represents the most complete series of loess-palaeosol sequences of the TLP (Fig. 1). It is situated at the foot of a loess section and is available for sampling only during the low water level of the Tisa River. The sampled S5 pedocomplex part of the Dukatar sequence, is approximately 2.7 m thick and was formed during the Early Middle Pleistocene. This site belongs to the highest protected zone of the Special Nature Reserve Titel Loess Plateau. The site is situated in the contact zone of the Tisa River and TLP. After building the dam at Novi Bečej, north of the TLP, the Tisa River has a controlled regime. When the water level is high (April-May), it is not possible to reach the Dukatar LPS, while in September and October it is accessible. Both the oldest loess unit (L5) and the oldest exposed pedocomplex (S5) of TLP are observed within this site. The unique S5 pedocomplex, with a total thickness of approximately 2.7 m has reddish color. Beneath the A horizon there is a well-developed dark brown rubified cambic Bw horizon, with moderately developed coarse polyhedral structure that is approximately 110 cm thick. In the central part of the pedocomplex, S5 is a Ck horizon containing many carbonate concretions, and bioturbation caused by roots that are now preserved as rhizoliths. The lower Bw is a weakly rubified horizon disturbed by many hydromorphic features. In the bottom part of the pedocomplex S5 there is a horizon containing massive carbonate concretions overlying loessoid material of alluvial origin (also with numerous hydromorphic forms). This S5 pedocomplex is very similar to the same unit at Chinese loess plateau, thus opening up the possibility for a transcontinental correlation of European, Central Asian and Chinese LPSs, using a standardised nomenclature and chronostratigraphic model.

For those who want to know more

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Petroleum industry in Serbia: Planning, investments, and sustainable process integration

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The best European refineries are petrochemical in configuration, which means that they can market petrochemical products in addition to fuels (diesel, gasoline, kerosene) as well. The global market has been unpredictable in recent years, and only those petroleum companies that have diversified and expanded their product range and added high-quality petrochemical products have been able to survive in the market. The Pančevo oil refinery is one of the most modern refineries in the region. Year after year, the Pančevo oil refinery recorded an increase in processing capacity. 2022 was a record year for oil refining in Serbia- about 4.42 million tons of crude oil were processed and we are slowly approaching the maximum refining capacity of 4.8 million tons. This strong growth is clearly illustrated by the fact that 66% more crude oil and semi-products were processed in 2022 compared to 2009. As a result of the integration of HIP Petrohemija and NIS a.d., the construction of a new unit for the production of polypropylene can also be expected. Polypropylene is an important petrochemical product for the construction industry and is in high demand on the world market. The feed streams for such a unit should come from the pyrolysis unit of HIP Petrohemija and fluid catalytic cracking (FCC) from the Pancevo Oil Refinery. This paper analyzes the possibilities for the development of the petroleum industry after the integration of the facilities of HIP Petrohemija into the NIS system, using the latest technologies and well-established facilities of the Pančevo oil refinery.

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Keywords: petroleum refining, petrochemical products, polymers

Geodynamic history unveiled from rock archives: the case of central Balkan Peninsula

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In order to successfully address challenges such as natural resources management, environment protection or geohazards, every responsible society must take care about the quality of the geological knowledge both in the academic and public sectors. This is the responsibility of geoscientists, who must always speak the same language among themselves and understand each other at all scales. This paper aims at contributing in this respect, by demonstrating how very complex geodynamic interpretations can be presented in a way comprehensible for experts in all geodisciplines. The Central Balkan Peninsula is part of the globally-wide Alpine-Mediterranean orogeny. Its geotectonic framework consists of rock series formed from late Proterozoic to Holocene, which are characterized by a broad compositional spectrum. Because of such strong tectonic and lithological variability of the Serbian part of the Balkan Peninsula, the geologists who have worked in this area offered a plethora of complex geotectonic interpretations, most of them barely understandable for non-specialists. Here, I propose a much simpler division that consists of only four mega-units: the Dinarides, the Tethyan Mega Suture, the Carpatho-Balkanides, and the Pannonian Basin. The concept is based on all available data gathered from our rock archives, summarizing all generally accepted opinions and leaving behind all poorly constrained and still debatable issues. It focuses on geodynamic events that produced the actual geological assemblage of the Balkans, which were merely controlled by ~150 million years of convergence between the African and Eurasian plates; this convergence ultimately (Cenozoic) led to the disappearance of the Vardar branch of the Tethys Ocean (called Vardar Tethys) and the collision of the two above mentioned plates. The central point (event) of this geotectonic interpretation is the evolution of the Vardar Tethys. Hence, all geological and lithological entities that constitute the four mega units listed above are grouped into: i) the units that had existed before the opening of the ocean (hereafter: pre-Tethyan units), ii) those that formed simultaneously with the Vardar Tethys Ocean (syn-Tethyan units), and iii) those that originated after the Ocean's closure (post-Tethyan units). The pre-Tethyan geological entities comprise the metamorphic basement of the marginal parts of the colliding plates; these metamorphic series had originally formed in different times and various geological settings but they were brought together by late Mesozoic – early Cenozoic collision; they are now part of the same orogeny but can be distinguished as relicts of ancient Africa/Adria (Dinarides) and Eurasia (Carpatho-Balkanides). The syn-Tethyan units are mainly situated within the Vardar Tethys Mega Suture; they comprise parts of the Triassic-Jurassic oceanic bottom (ophiolites), open-sea se-

diments (cherts) or siliciclastic sediments that deposited along marginal-sea subduction troughs (deformed flysches). The post-Tethyan units encompass all rock complexes that originated after the collision; they widely range in composition: from Cretaceous–Palaeogene siliciclastic sediments deposited within relict troughs (non-deformed flysches), through Cenozoic marine, brackish and lacustrine deposits, to widespread Oligocene-Miocene volcano-intrusive complexes. Albeit rudimentary, the presented geotectonic division can be used as a pattern for dealing with more detailed geological information. In such a way, the experts primarily interested in studying topography can acquire a solid understanding of the geological development of the central Balkans. Simultaneously, they can place in an adequate geological context most (if not all) specific rock series and complexes that appear in our geological literature, such as, for instance: the Diabase-Chert Formation (origin: relicts of the Mesozoic oceanic bottom/relative time: syn-Tethyan/actual position: Tethyan Mega Suture), Mid-Bosnian schists (parts of the ancient Adria plate/pre-Tethyan/central Dinarides), the Serbo-Macedonian Mass (metamorphic basement of the European plate margin/pre-Tethyan/Carpatho-Balkanides) or various Oligocene-Miocene sediments (post-collisional sedimentary cover/post-Tethyan/ Pannonian Basin or overlying all other three mega units).

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Keywords: geodynamics history, natural resources management, lithological variability, central Balkan Peninsula.

Natural flooding evolution in relation with climate as recorded in past sedimentary sequences

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Terrace formation starts when the river channel, transporting coarse-grained sediments, starts incision within its former floodplain. This start of incision is often driven by a climatic change with increasing temperature and density of the vegetation cover. From that time onward that terrace surface is only reached by floods, containing fine-grained sediment, during peak disc-

harges. In general, the flood deposits become gradually finer-grained when the river incises progressively deeper. This means in fact a delayed effect of flood deposition compared with the (climatic) event that initiated the incision, However, this long-term fining-upward of the flood deposits is often superposed by shorter-term events of flooding or non-deposition, Those events are expressed by coarse-grained deposits from small flooding channels due to short peak discharges or incipient soils during periods of low flow. These short events may be due to short climatic episodes, e.g. low or high precipitation, or to intrinsic river evolution (e.g. lateral river migration). This natural evolution of terrace flooding after river incision sets the background to evaluate the risk for evaluation of flood hazards on low terrace levels.

Keywords: fluvial terraces, flood deposits, incision, lateral river migration

Natural and anthropogenic causes for intensive depopulation in Visok micro-region and possibilities for demographic and economic revitalization

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The Republic of Serbia belongs to the group of countries with extremely intensive depopulation, the number of inhabitants decreased by more than half a million between the most recent two census cycles. This decline in population is not uniformly distributed across the entirety of the nation. Visok micro-region represents one of the worst cases of demographic dying in Serbia. The main goal of this investigation is to scrutinize the demographic viability of the micro-region and discern its capacity for both demographic and economic revitalization. The fundamental analytical unit in this paper is the settlement. Using the method of descriptive statistics, the general demographic characteristics of the Visok area, as well as the basic demographic dynamics are presented for the period from 1948 to 2023. Commencing from the year 1961, all 23 villages in the microregion are in constant decrease of population. Notably, each of these villages records a populace numbering less than 100 individuals and average age of population is very high. In February of 1963, one of the biggest landslides in Serbian history occurred in this region. It formed Zavoj lake accumulation and consequences of dam creation on Visočica river, submerged 3 whole villages. Goal of this study is to examine how this natural di-

saster accelerated the demographic catastrophe of the Visok area. The authors will conduct a survey about the perceptions of the local inhabitants regarding the causes of the depopulation and the chance for the revitalization of the micro-region Visok. However, intensive depopulation created an ecosystem with great potential for creating unique tourist destinations, based on pure and untouched nature. Due to less anthropogenic influence, on CORINE land cover data, older publications and previous papers it is clear that forest percentage is rising and erosion in watersheds of Visočica and Toplodolska rivers is decreasing. Touristic potential of this region is on a very high level and it is represented by 70 waterfalls, ski center, famous hiking routes and many hydro-geomorphological localities with great touristic potential. The domain of active tourism burgeons in allure with each passing year, and through judicious planning, this micro-region stands poised to ascend as one of the preeminent tourist centers in Serbia.

Keywords: Zavoj accumulation, Visok, Stara planina, landslide, depopulation, revitalization

Loess as a resource; Loess as a hazard

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The mineral content of the loess material provides the greatest resource; the open windfall soil structures of the loess deposits provide the greatest hazard. Loess provides agriculturally exploitable ground and it provides it on a large scale- it is a major resource. A 'good' soil from an agricultural point of view needs three things: a good soil structure to allow good root penetration and plant support; a high nutrient content, particularly of the critical elements N, K & P; and sufficient water. Loess delivers structure and nutrients- and if there is adequate and constant water supply a consistent crop. The loess soils of North America have fed much of the world; the loess soils of Ukraine can feed large parts of Africa. The hazard that accompanies agricultural virtue is ease of erosion, and that must be constantly guarded against. The windfall nature of a loess deposit produces a metastable soil structure. The soil structure can collapse if loaded and wetted. Prevention or mitigation of this collapse has provided most of the intellectual focus in the geotechnical loess community. Aeolian sedimentation provides an open metastable structure which is able to collapse but the actual 'collapsibility' depends on subsequent events. The open packing of primary mineral particles is modified soon after deposition by the precipitation at the particle contacts of carbonate minerals, often in a filamentary form. These trap clay mineral par-

ticles at the particle contacts and a local clay concentration develops. This clay concentration controls the collapsibility. A.M.Assallay showed clearly from his studies on model loesses that there is a low but critical range of clay mineral content which facilitates structural collapse. Deposits with low clay mineral content do not collapse, those with high clay mineral content do not collapse. A range between 5-125% clay minerals allows collapse. R.L.Handy noticed the clay mineral range requirement many years ago but it required the precise model experiments of Assallay to provide a mineral range (probably still fairly approximate). The rigorous application of the Coulomb equation meant that soils were either seen as cohesive (a large clay factor C) or cohesionless with C = 0 i.e. the sandy soils. The silts, including loess, provided problems. It needs to be appreciated that loess, even when remoulded and with depositional structural factors removed, still provides geotechnical problems. Loess is typically a low-clay system and manipulations that require a certain clay mineral content may not be effective. The classic loess material failure was probably the collapse of the Teton Dam in Idaho in 1976. The very large eaerth dam on the Teton River had a loess core- and loess was not a suitable core material; largely because it could not be satisfactorily compacted. This requires current awareness; a large amount of remoulded loess engineering is underway in China. Here be hazards.

Keywords: loess substrate, collapsibility, Teton Dam, North America

DataFlow SuperComputing for BigData DeepAnalytics

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This presentation, possibly followed by an on-line mini-course or a full-blown course on DataFlow Programming, analyses the essence of DataFlow SuperComputing, defines its advantages and sheds light on the related programming model that corresponds to the recent Intel patent about the fu-

ture Intel's dataflow processor. The stress is on issues of interest for general science and engineering and on the problems of interest for this and related audiences. Acording to Alibaba and Google, as well as the open literature, the DataFlow paradigm, compared to the ControlFlow paradigm, offers: (a) Speedups of at least 10x to 100x and sometimes much more (depends on the algorithmic characteristics of the most essential loops and the spatial/temporal characteristics of the Big Data Streem, etc.), (b) Potentials for a better precision (depends on the characteristics of the optimizing compiler and the operating system, etc.), (c) Power reduction of at least 10x (depends on the clock speed and the internal architecture, etc.), and (d) Size reduction of well over 10x (depends on the chip implementation and the packiging technology, etc.). The bigger the data, and the higher the reusability of individual data items (which is typical of Machine Learning), the higher the benefits of the dataflow paradigm over the control flow paradigm. However, the programming paradigm is different, and has to be mastered. The follow-up mini course or a full-blown course (which could be organized on-line, for the interested faculty and students of science and engineering) explains the programming paradigm details, using the Maxeler project products (in contrast with Google TPU, via Amazon AWS or MS Azure) as an example and sheds light on the ongoing research, which, in the case of the speaker, was highly influenced by four different Nobel Laureates: (a) from Richard Feynman it has been learned that future computing paradigms will be successful only if the amount of data communications is minimized; (b) from Ilya Prigogine it has been learned that the entropy of a computing system could be minimized if spatial and temporal data get decoupled; (c) from Daniel Kahneman it has been learned that the system software should offer options related to approximate computing; and (d) from Tim Hunt it has been learned that the system software should be able to trade between latency and precision. The follow-up course also includes hands-on opportunities for attendees (examples related to the interests of the audience).

Keywords: DataFlow SuperComputing, Machine Learning, Maxeler project products

Thematic Session – Petroleum, Gas, Renewable Energy and Resources

New petroleum refining challenge: Techniques for continuous improvement

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An operational management system is a structured set of interrelated practices, processes and procedures used by managers and employees at every level of an organization to plan, manage and execute their activities within manufacturing operations in a petroleum refinery. The goal is to ensure the maximum operational efficiency of the company thanks to the reliability and safety of production operations and the inclusion of all employees in the process of constant improvement. This paper shows the techniques used in the Pančevo oil refinery that should enable the refinery to be among the best refineries in the world (safety, efficiency, reliability), to ensure the constant improvement of operational indicators, and to involve all employees in achieving better results. Such techniques enable the development of employees' knowledge, as well as the motivation of employees for new ideas and solutions. An operational management system ensures readiness to respond, manage incidents, investigate causes, and learn lessons.

Keywords: petroleum refining, management, continuous improvement

Problems and Challenges of Reforming Forest Policies and Management in Russia

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The future development of forest industries in Russia, besides geopolitical issues, could be seriously undermined by depletion of forest resources available under the current model of forest management that mainly relies on clearcutting mature coniferous forests and leaving these areas for natural

regeneration. The introduction of a new model that prioritizes efficient forest regeneration faces many problems on the ground. The efficiency of the use of funds allocated by both governmental and private logging companies for forest regeneration and subsequent tending of young stands should be urgently significantly increased. The government should also develop pragmatic economic incentives to encourage logging concession holders to switch to the new model and to address the problem of spatial shift (demarginalization) of the country's forest complex from northern and eastern "green fields" to secondary mixed and southern taiga forests of the European part of Russia. The inclusion of carbon sequestration indicators materials in forest management will contribute to this process. Economic sanctions against the export of products from the Russian forest sector are becoming a serious barrier to the transition to intensive use and restoration of forests. The area of forests leased for timber production may begin to decline in 2023. The transition towards resilient forestry could gain economic benefits only in the regions with developed wood-processing infrastructure, productive mixed and broadleaf forests, and high forest roads density. Instead of harvesting low productive northern taiga forests of the European Russia and remote areas of Central and Eastern Siberia, wood sourcing should mainly concentrate in the immediate vicinity of the existing mills. Respectively, the development of "greenfield" projects in wilderness forest areas that currently lack any kind of infrastructure should not be encouraged.

Keywords: spatial demarginalization of the Russian forest complex, intact primary forests, reforestation and afforestation, forest management intensity

State of forests and strategic goals of sustainable development of forestry of the Republic of Srpska

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The total area of the forest fund in the Republika Srpska is 1,352,961 ha or 54.4% of the total area of the Republika Srpska. On the territory of Republika Srpska, 9 basic groups of forest vegetation, 27 subgroups and 169 basic forest types were recorded. Most forests (about 60%) are located in the mountain zone (1000-1500 m above sea level) dominated by beech and fir forests with spruce (71%). The total volume of forests is 257,823,104 m^3 (conifers 34% and deciduous 66%). The largest share in the total volume is beech with 40%, fir with 15%, spruce with 14% and oak with 10%. The average volume

in tall forests with natural regeneration is 324 m^3/ha, and in coppice forests it is 128 m^3/ha. The new Forestry Development Strategy of the Republika Srpska is harmonized with the legislative framework and procedures on the development of strategic documents in the Republic of Srpska. The content of the Strategy is defined by the Law on Strategic Planning and Development Management in the Republic of Srpska and the Regulation on Strategic Documents in the Republic of Srpska. The measures defined in the Forestry Development Strategy of the Republika Srpska are harmonized with the measures of the New EU Forestry Development Strategy until 2030, the needs of the realization of related strategic and planning documents of the Republika Srpska. The EU Forest Strategy affirms and seeks to strengthen the overall sustainable forestry that works in synergy with the increased ambitions of the EU in the area of climate and biodiversity. Republika Srpska/BiH undertook to implement Agenda 2030, which consists of a total of 17 sustainable development goals. The strategic objectives of the sustainable development of forestry in the Republic of Srpska are:

(1) Increasing forest cover, productivity and forest quality including increasing contribution to global efforts to mitigate climate change;
(2) Improvement of multifunctional (economic, ecological and social) benefits from forestry, including improvement of living conditions of the population in rural areas;
(3) Preservation of biodiversity, increase in areas of protected forests and other special purpose forest areas;
(4) Increasing new and additional financial resources from all sources for sustainable forest management and strengthening education, scientific-technical cooperation and partnership;
(5) Sustainable forest management including public promotion, international agreements, cooperation, coordination, coherence and synergy with sectors, partner organizations and relevant actors related to forestry at all levels

Keywords: Forestry, sustainable development, strategy, management goals

Russia climate net zero target: role of nature climate solutions

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Russia has 20% of global forest growing stock and 8% of global arable land and, probably, has one of the largest potentials in the world to use natural-climate solutions in decarbonization of economy. Russia's Low Carbon Development

Strategy (LT LEDS) envisages achieving carbon neutrality by 2060 at a residual GHG emission level of 1.2 billion t CO_2 eq. This volume of emissions should be offset by sequestration in LULUCF sector in 2060. Currently, LULUCF has a net sink of 535 million t. CO_2 eq, which means that it should be increased by 665 million t CO_2 eq in 2060. Our calculations show that measures to better account the absorption capacity of forests, in combination with better assessment of forest fire emissions can increase the absorption capacity of forests by 70-100 million t. Economically feasible implementation of forest and climate projects may add 200 million t CO_2 eq in GHG avoidance and removal projects. But such measures would yield only half of the decarbonization volume needed. The study explores the potential of mitigation and adaptation measures in the LULUCF sector to achieve carbon neutrality. The main conclusion of the study is the need to strengthen the use of decarbonization measures through new technologies in the next version of Russia's Low Carbon Development Strategy, as the potential for mitigation and adaptation is clearly overestimated. Another conclusion is need to deploy full potential of forests in mitigation and adaptation. That may be achieved by changing the paradigm of forest management. Forestry should be reoriented to reduce forest fires and abandon artificial coniferous monocultures that are not leased for timber industry purposes. Extraction of timber should be complemented by "extraction" of verified carbon units (VCU) for mitigation, and climate smart forestry in adaptation area. Special attention should be given to forest conservation and restoration, including abolishment of legal constrains for private forestry on abolished agricultural lands (around 70 mln ha).

Keywords: LT LEDS, carbon neutrality, potential of forests, mitigation and adaptation

Mining Climate Conversations: A Text Analysis Approach to Extract Key Narratives from Unstructured Climate Reports

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In the age of information, a significant portion of the data produced—particularly in critical areas such as climate change—is in unstructured form. From informal discussions to expert analyses, vast reserves of valuable insights are encapsulated within textual data, largely remaining an untapped reservoir of knowledge. While structured data, often presented as tables or charts, efficiently provides the 'what' in any narrative, it's the unstructured text that frequently holds the answer to 'why'. This distinct nature of

unstructured data, however, poses analytical challenges given its inherent complexity and non-standardized format. In this study, we embark on an exploratory journey to harness the potential of text analysis techniques, including key term/phrase extraction, sentiment analysis, and topic detection, to mine unstructured climate reports. The objective is two-fold: firstly, to shed light on the wealth of information contained within such reports, often overlooked due to the daunting nature of text data, and secondly, to illustrate a methodological framework that can be utilized to decipher these reports. By doing so, this paper endeavors to bridge the gap between the vast, intricate narratives of climate change and the empirical methodologies of text analysis. In extracting key narratives and sentiments, we aim to provide a clearer, more comprehensive picture of climate discussions and their implications. Our approach underscores the importance of tapping into unstructured data, advocating for a more inclusive data analysis strategy that takes both structured and unstructured data into account for a holistic understanding of global issues like climate change.

Keywords: textual data, text analysis techniques, climate change

Geographical motives of the Sava river and Majevica mountains as a potential for the development of tourism in the Brčko District of Bosnia and Herzegovina

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The Brčko District's natural resources include the relief, geology, climate, vegetation and hydrology features of the area. The northern part is a lowland area located in the Sava River basin, while the southern part is hilly and located on the slopes of Majevica Mountain. The largest river Sava determine the hydrological features of the Brčko District. There are also many small rivers, canals and watercourses in this area, such as , the Brka, the Tinja, the Lomnica, the Lukavac, the Rašljanska River, the Štrepačka River and the Zovičica (these river sources are mainly located in the area of Majevica Mountain). The Sava is an international waterway. The only port in Bosnia and Herzegovina, which has maintained its international status since 2006, is located on the river's banks in Brčko. The Sava has great tourism potential in terms of offering possibilities for many different activities, including sports, recreational activities, swimming, fishing, day-trips, powerboating, etc. The organization of sporting, cultural and fair events with international, regional and domestic participants significantly increases the tourist attractiveness of the Sava Ri-

ver in Brčko. The Brka and the Tinja are no less attractive. Bridges on the Brka in the city centre have a certain charm, as they serve not only for pedestrian and vehicle traffic but also remind many Brčko people of their first love, promenades and school days. We should not ignore the fact that the Sava River is very rich in a variety of fish, which is not only the subject of motivated visits by numerous fishermen, but is also an important part of gastronomic events and menus in restaurants and hotels in Brčko. In addition to the plains in Brčko, the hilly mountainous area of the Majevica mountain stands out as particularly attractive for the development of various types of tourism. Mount Majevica stands out in the area with developed relief, as a climatic and biogeographical zone. Majevica is one of the most accessible mountains in Bosnia and Herzegovina whose slopes gradually descend towards the Sava Valley through a picturesque area of beautiful villages with preserved rural architecture. Rich in streams and rivers that have created natural approaches and roads, this mountain is characterized by gentle, sloping foothills and plateaus that enable spatial valorization for various contents of an excursion, camping and manifestation significance. Majevica represents the climatic and plant boundary between the Sava and Spreča regions, as a result of which a special cliomatic type "Majevicka type" was formed, which significantly alleviates excessively high temperatures from the Sava valley and temperature inversions from the Spreča basin. The area rich in hunting game, accessible forest complexes stands out as a proctor for the development of hunting, excursion and recreational tourism. The rural areas of this mountainous region cherish different customs, culture and tradition and as such are particularly interesting for visiting tourists.

Keywords: Sava river, Majevica mountain, geographical attractiveness, tourism, development

The role of geoheritage interpretation and geoeducation activities in UNESCO global Geoparks

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UNESCO Global Geoparks are unique sites recognized by UNESCO for their exceptional geological heritage and their commitment to conservation, education, and sustainable development. They play a key role in promoting geoheritage interpretation and geoeducation activities. Heritage interpre-

tation includes the communication of information and stories about the natural, cultural, and geological heritage of a site to enhance visitors' understanding and appreciation and it should stimulate them to want to know more by balancing education and entertainement. It helps visitors to understand the geological, ecological, and cultural significance of geopark sites. Geoeducation refers to the educational efforts focused on promoting an understanding of the Earth's geology, landscapes, natural resources, and the interactions between humans and the environment. It encompasses the study of geological processes, landforms, rocks, minerals, and the interconnectedness of Earth's systems. These activities contribute to the preservation of local heritage and promote a sense of stewardship among visitors. Absence of these activities can often lead to mythical storytelling and shifting all the focus to these elements rather than scientific facts. Modern interpretation and geoeducation activities should include the use of multiple interpretive techniques as guided tours, audiovisual presentations, tactile exhibits, and storytelling as well as tailoring the activities to different audiences by adapting the content and delivery style to cater to the needs and interests of diverse visitor groups. Additionally, interpretive and geoeducational activities should foster community engagement and incorporate local perspectives and narratives, including local knowledge, stories, and cultural traditions to enhance authenticity and cultural appreciation which often leads to a sense of pride, ownership, and stewardship towards the geopark.

Keywords: UNESCO, Geoparks, Geoheritage, Geotourism, Interpretation, Geoeducation

Using LiDAR technology for geoheritage inventory and modelling: Case study of Đavolja Varoš Geosite (Serbia)

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Terrestrial laser scanning (TLS) brought a big step forward in the research of landform processes. TLS enables detailed, precise and accurate representation of terrain and all other natural or manmade structures. For this study, the Đavolja Varoš geosite was scanned and modelled with the help of

TLS and areal photogrammetry. This geosite was chosen due to rapid morphological changes occurring on seasonal level. The scanning of the Đavolja Varoš geosite was conducted in October 2021 at 198 points, resulting in a cloud of 1,281,664,716 points. By classifying and analyzing the obtained data, an ultra-high resolution digital elevation model (DEM) was obtained, on the basis of which surface and hydrology analysis were performed using ArcGIS Pro software. This research represents the first complete and thorough documentation of the number, structure and dimensions of earth figures. The geosite consists of 2 hidromorphological units - Đavolja and Paklena gully. Based on the processed data, Paklena gully has a larger number of earth figures (pillars), their number reaches 124, while Đavolja gully has 77 earth figures. In total, 131 earth figures have andesite cap rock and 70 are without caprock. The average height of the figures in Đavolja Gully is 5.64 m, while the average height in Paklena gully is 4.2 m. The highest earth figure in Đavolja Varoš is 15.5 m, and the lowest is 0.8 m. Gully erosion is more intense in Đavolja gully and thus the figures are much higher. This research laid the foundations for further investigation of site erosion, where future studies will compare the time series of processed lidar point cloud data, therefore, our understanding of how earth figures change will be greatly enriched by results of further research.

Keywords: Đavolja varoš, Lidar, Badlands, Erosion, TLS, Surface process

Towards promotion of famous loess geo-heritage site Veliki Surduk, Titel loess plateau

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The principal aim of this study is to emphasize the geo-tourism potential and geo-conservation values of the Veliki Surduk site in Mošorin village, Titel Loess Plateau, Serbia. Veliki Surduk loess-paleosol sequence (45°17'40'' N and 20°11'17'' E) exposes the last 3 glacial loess horizons and 3 fossil interglacial paleosols at steep loess cliffs with a total thickness of approximately 30 m. This remarkable loess-paleosol sequence preserves one of the most detailed European continental paleoclimatic and paleoenvironmental records. This extraordinary elongated geomorphological feature rising from the terraced alluvial fan of the Mošorin village provides a unique opportunity for interpretation of the complex evolution of dramatic ice age climatic fluctuations during the last 350,000 years. Therefore, it is planned to create visual and informational elements at the location where the visitors and (geo)

tourists can be introduced to this phenomenon. An adequate interpretative panel, markers for loess horizons, and an internet-based application will visually display the entire Loess Plateau. This display will not only present the main scientific data but also provide detailed information related to it. This approach will make information about the locality readily available on-site to both experts and the general public, ensuring that the significance of this location receives the recognition it deserves.

Keywords: loess, geosite promotion, Titel loess plateau, Veliki Surduk

The Special Nature Reserve (SNR) "Titelski breg - Titel Loess Plateau", Vojvodina, North Serbia

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The Special Nature Reserve (SNR) "Titelski Breg - Titel Loess Plateau" is located within the municipality of Titel, in the heart of Vojvodina (North Serbia), along the banks of the Tisa River and not far from its confluence with the Danube. The Institution for Nature Protection "Titelski Breg - Titel Loess Plateau" manages this protected area and also serves as a cornerstone for the tourism development and offerings of the Titel municipality. This Loess Plateau is a geological and archaeological phenomenon known as the "Witness Hill". Segments of the Titel Loess Plateau preserve a paleoecological and paleoclimatic record spanning 620,000 years, depicting the shifts between ice ages and interglacial periods. On the periphery of the Plateau, traces and continuity of life from prehistory to the late Middle Ages are conserved. The distinctive relief and geomorphic forms possess narratives painted with mystical colors. The Plateau's periphery safeguards a relic steppe that accommodates numerous rare, endangered, and protected species, providing a home for diverse fauna. Recognized as an important botanical area, it is part of the national IPA (Important Plant Areas) region of Central and Eastern Europe, and it is also situated within the internationally significant Important Bird and Biodiversity Area (IBA). Titel Embankment holds potential that is, or can be, inspiring for enthusiasts of active recreation such as hiking, walking, cycling, and birdwatching. The biodiversity and cultural diversity of Titel Embankment hold the potential for new content and layered insights for visitors, both official and those seeking a touch of mystery. As legal guardians of the SNR Titel Loess Plateau, we too are eager for new knowledge hidden within the loess-palaeosol sequences, knowledge gained through scientists from Serbia and around the world who seek to un-

cover its secrets. New insights about turbulent geological and climatic processes, the changing landscape, and the Plateau dynamics that provided refuge and protection for ancient humans allow us to see Titel Loess Plateau again and again, discovering new potentials for its promotion and presentation to the world. During spring and autumn, the most interesting viewpoint for visitors is "Kalvarija" a site with great potential, even as an archaeological location. In the winter months, bird enthusiasts and photographers have access to a bird-watching facility at the feeding site established at the "Titel Old Brickyard – Stara Ciglana" location. The periphery of the Titel Loess Plateau, along the Tisza River, holds immense potential for establishing geological and educational trails. Within the informative-visitor center of the Institution, an interactive model is available, and ongoing activities include several projects such as dioramic displays of the Loess Plateau sections and exhibitions on geological, archaeological, and historical heritage. At the site of Veliki Surduk in Mošorin village, preparations are underway for the creation of "Staircase Through Epochs", which will follow the visible geological layers.

Keywords: Titel Loess Plateau, Special Nature Reserve, Conservation, Promotion, Vojvodina, North Serbia

Glacial Loess in Equatorial Peru

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In the Quaternary record, loess is especially common in mid-high latitude regions, owing to its known association with glacial grinding, which is an effective agent for silt production. Although less volumetrically dominant, loess has also been documented in sub-tropical arid regions unassociated with glaciation, such as the Negev loess of Israel, possibly associated with downwind sorting from eolian and fluvial systems. Loess is poorly known from the equatorial belt (<~15o latitude). Here, we document non-volcanic loess in truly equatorial latitudes, that we hypothesize relates largely or entirely to glaciation. The Cordillera Blanca region of Peru (~8-10° S) consists mostly of Miocene granodiorite bedrock within a north-south trending range hosting numerous alpine glaciers emanating from peaks that rise to >6000 m. This region is the most extensively glaciated of any tropical region today (Kaser et al., 1990). During the Last Glacial Maximum (LGM), terminal moraines indicate glaciers descended to elevations of ~3800 m (Rodbell et al., 2009). The glaciers occupied valleys flowing from east to west toward the Rio Santa, an axial fluvial system flowing from south to north subparallel to the Cordillera Blanca. We have identified discontinuous deposits of massive (internally structureless) silty to very fine grained sandy deposits of suspected eolian (loess) origin in both proximal and medial regions of this system. Proximal to the mouths of the glacial valleys, thin (<1 m) very fine sandy-silty deposits mantle moraines external to glacial valleys (e.g. near Quebrada Llaca). These valleys host moraine-dammed (now artificially dammed) glacial lakes. About 80 km downstream (north), along the axially flowing Rio Santa, massive silt ~2 m thick mantles bedrock in rare, patchy exposures. In addition to these examples of loess, we sampled sediment from proglacial lakes, and glacial moraines of glacial valleys near and north of Huaraz, Peru, and from floodplain areas of the Rio Santa along its course. Glacial sediment here is derived mostly from the relatively coarse-grained Cordillera Blanca granitoids. Sediment samples were processed for removal of organic and carbonate material before particle-size analysis of the <2000 μm fraction using a Malvern Mastersizer 3000 LPSA. All samples contain a significant population in the silt fraction. We also conducted provenance analysis using detrital zircon geochronology for the moraine exhibits a primary mode at 12 Ma, the same as the loess collected ~80

km downstream (north), although the loess includes a number of other older age populations. The predominant age populations of the moraine and loess overlap (~12 Ma), indicating connectivity between proximal and distal deposits in this system. Older grains in the loess indicate downstream contributions from other sources along the Rio Santa system. Glacial processes associated with this system are producing abundant fine-grained sediment with the potential to form loess, although few suitable areas for deflation and traps occur owing to the extraordinarily high relief. However, where (low) relief enables it, the abundant silt in this system provides a rich resource for agricultural uses.

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Keywords: equatorial loess, Cordillera Blanca, Rio Santa, Peru

Interpretation of past climate using provenance analysis of paleo loess in the Permian of the southwestern United States

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Both the Quaternary and late Paleozoic are noted for significant continental glaciation, extreme climate change, and extensive mountain building, albeit global paleogeography differed significantly between the two time periods. Another commonality is that both time periods contain extensive deposits of loess/paleoloess. Quaternary loess has been extensively studied to derive information on glacial-interglacial climate change as well as Holocene climate. Late Paleozoic paleoloess (ancient loess) has been less studied overall, but also appears to house information on glacial-interglacial climate change as well as longer-term changes in tectonics and atmospheric circulation. In low-latitude western Pangea (western United States) these climate fluctuations are recorded by abrupt changes in paleoenvironments. Inferred paleoloess occurs in several locations within western Pangea, interbedded with paleosols, reflecting climatic variations that appear to have tracked glacial-interglacial shifts. By applying similar analytical techniques as those used in the Quaternary, such as sedimentology/granulometry, pa-

leopedology, magnetic susceptibility as well as new techniques such as U-Pb geochronology on detrital zircons, our group has been able to reconstruct past climate for low-latitude Pangea on several time scales. For example, detrital zircon (U-Pb) geochronology data from several paleoloess and capping paleosols in western Pangea suggest that provenance, and thus wind direction, fundamentally changed between the time of loess accumulation and the time of paleosol formation. This change in wind regime is also characterized by a change in magnetic susceptibility and grain size of the detrital zircons and quartz fraction between the paleoloess and paleosol. These changes in wind regime likely reflect temporal changes in monsoonal circulation that existed over western equatorial Pangea during this time. In addition, in very thick sections of paleoloess that span a large portion of the Permian we observe changes in provenance that record long-term changes in tectonic evolution of Pangea, as well as a trend toward increasing aridity. Further study of the late Paleozoic paleoloess using long drill cores may provide very high-resolution records of past climate in the Late Paleozoic.

Keywords: paleoloess, paleosols, paleoclimate, provenance, Paleozoic

Succession from fluvial to aeolian environment recorded at westernmost part of the Wallachian basin, Serbia

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The Danube fluvial terrace in Velika Vrbica is situated at the westernmost edge of the Wallachian basin, Serbia. The profile is positioned in a gully valley with a base consisting of point bar sands interlayered with overbank clay deposits, which are together covered by loess sediments. The investigated loess-paleosol sequence (LPS) has a height of 11.15 m and has been sampled at 5 cm intervals for geochemical analysis using XRF. Fluvial sediments were sampled and analysed as well. Weathering indices such as Al/Sr, Rb/Sr and Zr/Sr for LPS clearly correlate with the first 5 MIS stages. Zr/Rb and Si/Al ratios were used

as grain size proxies and they indicate that the largest sediment grain sizes correlate with the MIS 1 and MIS 2 stages. Chemistry of fluvial sediments was analysed in the context of loess provenance which was investigated using (Al/Ti)/(Fe/Ti) plot, principal components analysis, k-means clustering and discriminant analysis. Prior to analysing, the sediments were divided up in 5 groups: loess, paleosol, aeolian sand, point bar sands and overbank deposits. The results show that most of the chemical variability can be attributed to differences in grain size and different weathering intensities, which is furthermore illustrated by the fact that fluvial and aeolian sands are the groups which share the most similar chemical composition. Analysis showed that Zr concentrations are generally lower in fluvial sediments compared to aeolian, with loess containing more Zr than point bar sands which is contrary to what is expected, having in mind the properties of zircon (most abundant Zr-bearing mineral). This leads to a conclusion that Danube's alluvium is not the only source for loess at Velika Vrbica and that low Zr concentrations for aeolian sand illustrate that it mostly originates from point bar sands which experienced aeolian transport before being deposited.

Keywords: loess, fluvial sediments, Wallachian basin, geochemistry, loess provenance

The relationship between cave temperature and local atmospheric mean temperature in a global view

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It is widely claimed that temperature inside a deep karst cave without significant human influence is similar to local mean atmospheric temperature, and can be even used to generally represent the annual surface air temperature of the region. To test this hypothesis, we collected temperature data for 314 caves around the world from published documents. The difference between cave temperature and local annual mean temperature (ΔT) were then calculated. Results show that relationship between cave air temperature and local annual mean is positive and strong. Taken ±2.5 °C (1σ) as the threshold of ΔT, however, only 73.9% of caves in the world within this threshold. In China, the proportion is only 60.4%, and ΔT for caves from northern China are larger than

those from Southern China in general. In contrast, ΔT for most of caves in Europe, America and Oceania are smaller than ±2.5 °C. Although air circulation is one of the major factors affecting cave temperature, it is noticeable that the influence of cave length and subterranean streams on cave energy balance should be taken into account. This observation that cave temperature may excurse from local mean atmospheric temperature should be considered in paleoclimate reconstruction using cave deposits such as speleothems.

Keywords: Karst cave, Cave air temperature, Mean annual air temperature, Temperature difference

Strength of the winter North Atlantic jet stream has deviated from its natural trend under anthropogenic warming

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The North Atlantic jet stream (NAJ) has a profound impact on the climate of the North Atlantic–European sector, especially in winter. Observations show that the winter NAJ (NAJ_w) has strengthened over the past ~140 years. However, it remains unclear whether this long-term trend has deviated from the natural variability. Here, we present a 2500-year-long reconstruction of NAJ_w strength using high-quality stalagmite $\delta^{18}O$ records from southeastern Europe. Our results show that NAJw weakened during both the Roman Warm Period (300 BC–200 AD) and the Medieval Warm Period (900–1250 AD), but it has strengthened under anthropogenic warming (since 1850 AD), indicating that its current trend has already deviated from the natural variability. The best explanation for this present anomalous trend of NAJ_w strength is that it was triggered by the appearance of the North Atlantic Warming Hole under anthropogenic forcing. This anomalous trend suggests that continued global warming may further strengthen the NAJ_w in the future.

Keywords: winter North Atlantic jet stream, stalagmite, $\delta^{18}O$, southeastern Europe

First Fowlers of Europe: evidence for bird exploitation during MIS 8/7 from Velika Balanica cave (Serbia)

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European early hominins have typically been pictured as hunter-gatherers relying on the large mammalian prey that they hunted or scavenged using heavy hafted stone or sharpened wooden implements to bring down and dismember the prey/carcass, while fowling is regarded as a subsistence adaptation that occurs rather late in Neanderthal and modern human cognitive evolutions. Here we explore the ways in which early Neanderthals from Velika Balanica (VB) might exploited birds for food – as they are considered elusive prey for humans up to MIS 5 due to their flight escaping capabilities/low caloric return rates, or for feathers – as some of identified cutmarks are found on passerine birds so small that meat removal would not require any tools. From layer 3, dated to MIS 8/7, out of 25 identified bird bones 5 specimens contain cutmarks – 2 of them on medium sized birds, and 3 on tiny passerines. Bird remains from VB layer 3 are narrowly confined to the eastern cave wall interior, while two pairs of different processed bird bones were recovered very close to each other, together with other mammal processing activities. Interestingly, one of the small passerine wing bones contains both cutmarks and human toothmarks. Apart from human processing, one bird ulna contains a raptor beak puncture, while 2 talons of a medium sized raptor have also been recovered. A complete archaeozoological study of VB material is currently under way, but even at this point it can be concluded – based on a high proportion of human processed bones, high lithic density, and burnt fires – that early Neanderthals inhabiting VB were a numerous band and fearful masters of their environment, capable of catching fowl.

Keywords: Birds, Processing, Neanderthals, Middle Pleistocene, Central Balkans

Rocky road through the groove: Exploring the link between rock granularity and morphological features in engravings. The incised stone from Kozja cave, Serbia

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The engraved objects carry important implications for the understanding of the hominin cognitive evolution. Yet, they are not as common in the periods preceding the Upper Paleolithic. In some cases the poor preservation, and consequentially, difficulty in differentiating anthropogenic from natural grooves on different media, mostly stone and bone, complicate the matter. This task can be even more challenging for the certain types of raw material, for instance, on rocks of grainier texture, the incisions can have less sharp outlines and less detailed internal morphology, especially with the increasing grain size. In the absence of clear key diagnostic markers, many such objects remain disregarded and excluded from the debate. The case in point is represented by a medium-grained stone bearing parallel encircling grooves found in the Middle Paleolithic layer of Kozja cave, Serbia. Relying on experimental work, this paper explores the possibility of partially overcoming the limitations imposed by differing preservation, with the aim of refining the methodology and assessing the feasibility of bringing some of these ambiguous objects out into the open. The experimental engraving was conducted on rocks of both comparable and finer grain sizes, followed by systematic recording of morphometric data. Subsequent analyses juxtaposed the lines' features on the experimental pieces and archeological specimen against naturally occurring grooves found on stones of analogous compositions. The concurrence between the preservation of the diagnostic traits commonly relied upon to identify the incisions made with a lithic implement and the rock granularity is discussed. Finally, the incised object from Kozja cave is assessed in the light of the obtained experimental and comparative results.

Funding: NEEMO project of the Science Fund of the Republic of Serbia (7746827).

Keywords: Middle Paleolithic, incisions, Kozja cave, Serbia

Comparing the age of dunes on two dune fields formed under different wind regimes and environmental conditions in the Pannonian Basin

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The investigation of Late Pleistocene geomorphological processes can provide insight into the environmental parameters affecting the development of the present landscape. The reconstruction of past processes is only possible by the numerical dating of landforms. Besides, eolian landforms record contemporary wind regimes, which had and have a crucial role in determining regional climate patterns. The distance between the Deliblato Sands in Eastern Serbia, and the Illancs Dune Field in Southern Hungary is less than 200 kilometres. Still, based on the orientation of dune forms, opposite directional winds formed them. The major question addressed in the present study is whether the formation of these dune fields was simultaneous or whether periods of major wind activity have a temporal difference. To answer these questions, dune forms at both dune fields were sampled for OSL dating at several locations. Several tests were performed concerning thermal treatment, signal characteristics, dose recovery, and dose distributions to assess the suitability of sediments for luminescence dating. Based on our results, the main dune formation phase came to an end earlier, at about 12 ka on the Illancs Dune field. In contrast, the formation of elongated parabolic dunes in the Deliblato Sands lasted till the end of the Early Holocene. During the second half of the Holocene, both dune fields were partially reactivated, though at a different degree and at different times due to differences in geomorphic sensitivity and the intensity of human impact.

Keywords: Deliblato Sands, Illancs Dune Field, OSL, eolian landforms

New hominin fossil molar from Velika Balanica (southern Serbia): a geometric morphometric analysis

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During the 2020 field season, a fragmented hominin maxillary molar (BH-6) was recovered from Layer 2b of Velika Balanica cave in southern Serbia. A comparative geometric morphometric analysis of BH-6 against the sample of Neanderthal and anatomically modern human maxillary first molars (M1) indicated that this specimen could be attributed to Neanderthals. Features such as the distal contour shape (indicating a rhomboid crown), a relatively large protocone, and a relatively small yet protruding hypocone, are all in accordance with the Neanderthal-like derived morphology. The age of the fossil molar is still unknown since there are no available dates for Layer 2b at the moment. Stratigraphically, Layer 2b is younger than Layer 3a, which has been dated to about 300 ka (via thermoluminescence) and yielded (early) Neanderthal remains. Furthermore, in contrast to Layer 3a, which produced an Early Quina assemblage, Layer 2b contains Mousterian with Levallois artifacts. If correct, the results presented here show that members of the Neanderthal lineage inhabited the Velika Balanica cave in at least two distinct chronological phases.

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Keywords: Velika Balanica, Neanderthals, maxillary molar BH-6, Serbia

Late Mousterian and Aurignacian lithic assemblages from Šalitrena Cave (northwest Serbia)

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Šalitrena Cave represents a key site for the study of the late Middle and early Upper Palaeolithic in the Peripannonian region of the Northern Balkans. Here we present the findings from the cave entrance as well as the new (ESR) dates obtained for the Middle Palaeolithic sequence of the site. The Middle Palaeolithic layers (6e-6a), dated between the end of MIS 5 to c. 40 ka, contained Mousterian assemblages with a moderately prominent Levallois component, in which the Quina aspect is completely absent. A rich Upper Palaeolithic artifact assemblage attributed to the middle Aurignacian was collected from Layer 5, which has been radiometrically dated to c. 35 ka. The assemblage contains different core types (conical, single- and double-platform), twisted and straight bladelets and different tool types – including carinated and nosed endscrapers, burins, pointed blades and retouched blades. The Mousterian and Aurignacian chronology of the Šalitrena Cave and the data on other Palaeolithic sites in the region support the notition that the expansion of modern humans towards the Central and Western Europe occurred along the Danube and Sava corridors and that Neanderthal groups survived longer in the western than in the eastern part of the Balkan peninsula.

Note: Initial sample collection was performed by Dr. Bonnie Blackwell (deceased in 2021).

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Keywords: Middle and Upper Palaeolithic, ESR, MIS5-3, Mousterian, Aurignacian

Middle and Upper Paleolithic of the southern Pannonian Basin: lithic assemblages from Petrovaradin Fortress

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Rescue excavations of Petrovaradin Fortress near Novi Sad, conducted at several different locations, revealed loess layers with Middle and Upper Paleolithic lithic material, which were dated using optically stimulated luminescence (OSL). The c. 90 ka old Layer 2b contained Middle Paleolithic massive bifacially flaked sidescrapers, which are similar to the types documented in the early Micoquian of the Pannonian Basin. Layer 2a, dated to about 43–40 ka, yielded an artifact assemblage with Levallois and Quina components present, while Layer 1 in the southeastern sector of the site contained numerous Gravettian artifacts. According to the OSL dates, the Gravettian layer is between 31 and 26 ka old, which is in accordance with the radiocarbon age of around 28 ka cal BP. The archaeological materials recovered from the Petrovaradin Fortress site provided completely new insights into the Palaeolithic of the southern Pannonian Basin, showing that Middle Paleolithic industries with bifacial tools, which are typical for the northern areas, also occur in the southern parts of the basin. Furthermore, Charentoid industries persist into the late Middle Paleolithic, just prior to the appearance of the early Upper Paleolithic. Lastly, the southern Pannonian and Peripannonian areas (where several Gravettian sites have been investigated) were densely populated in the period immediately before the beginning of the Last Glacial Maximum.

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Keywords: Petrovaradin, OSL, Middle Paleolithic, Charentoid, Micoquian, Gravettian

Hematite in loess bear the information of changing temperature of the Late Cenozoic

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We present here a short review on the progress in the hematite study of aeolian deposits in Chinese Loess Plateau (CLP). In recent years, increasing interest in loess studies has focused on qualitative and quantitative paleoclimatic reconstruction using the imperfect antiferromagnetic mineral hematite. However, the linkage between the hematite formation and climatic variables remains controversial. Several studies have linked the hematite and hematie-based proxy with the precipitation changes. However, our temporal and spatial evidence robustly supports that the temperature is dominant controllling factor. We introduce a modified L-ratio, $Hard_{300mT}$/$Hard_{100mT}$, obtained by DC rather than AF demagnetization, intially proposed by Liu et al (2007). The ratio reflects the relative changes of coercivity of hematite. Our two sequences of the modified L-ratio during the periods of 22 Ma to 0 and 21 Ma to 11 Ma show the trend in the L-ratio parallels the long-term trend in global temperature inferred from $\delta^{18}O$ records in marine sediments (Zachos et al., 2001). Another line of the evidence comes for the studies of the surface soil samples from 257 sites over the CLP and adjacent regions (Song et al, 2014). We find clues in study of Song et al (2014), further make detaild analysis on the same suite of the samples (Gao et al., 2018). Our results show that only the pedogenic clay fraction, obtained by pipette extraction, shows a strong correlation with climatic variables. The application of redundancy analysis helps to distinguish the climate variables controlling the formation of ferrimagnetic minerals and hematite during pedogenesis. On the CLP, pedogenic ferrimagnetic minerals are sensitive to mean annual precipitation, while pedogenic hematite formation is preferentially dependent on mean annual temperature. The confirmation of the temperature-dependent nature of hematite on the CLP provides a new possibility for quantitatively reconstructing the paleotemperature history of Chinese

loess/paleosol sequences. Our ongoing effort is to develop an climofunction bebween hematite-based proxy and temperure in the CLP region.

Keywords: Chinese Loess Plateau, hematite, L-ratio

MIS8 to MIS7 sub-orbital-scale climate variability along the northern Mediterranean borderland recorded in a Macedonian mammillary speleothem

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The central parts of Southeastern Europe (Balkan Peninsula), located along the northern boundary of the Mediterranean region, represent a transient zone affected by both Mediterranean and continental atmospheric influences. An impressive record of past climate variations in this region has been obtained mainly from lacustrine sediments in the southern parts and loess deposits in the northern parts. Although these records cover long periods, their chronology is mainly based on tephrostratigraphy, cyclostratigraphy and orbital tuning, with relatively lower resolution, making it difficult to identify sub-orbital-scale climate variability. Radiometrically dated speleothems provide higher resolution records with superior chronological constrains, although generally have lower timespan. However, not many published speleothem records are available from this region, with none covering Marine Isotope Stage (MIS) 7. We present here a record of MIS8-MIS7 sub-orbital-scale climate variations obtained from a U-Th dated Macedonian subaqueous speleothem composed of mammillary calcite that deposited between 246.0±6.2 ka and 225.8±5.4 ka, covering Termination III (T-III), MIS 7e and MIS 7d. Proxy records were obtained from conventional and clumped isotopes, with an additional insight from uranium isotopes. The stable isotope data has relatively high resolution (60-310 yr) allowing identification of millennial to centennial-scale climate variations. The speleothem record reflects an increased Mediterranean influence, as suggested also by other proxy records from the region, especially during MIS 7e. However, periodically increased continental influences are also identified during T-III and MIS 7d, and at the end of MIS 7e. The calcite $\delta^{18}O$ values seem to reflect mainly temperature-controlled precipitation $\delta^{18}O$, with changes between Mediterranean and Atlantic moisture source also noticeable. The $\delta^{13}C$ values mainly reflect the alternating influence of continental and Mediterranean climates, expressed by summer moisture availability, partly overprin-

ted by temperatures. The abrupt climate change during T-III is represented in the stable isotope record with an event that corresponds to the S8.1 stadial event, as identified in a speleothem from NW Spain, and the Younger Dryas-III weak monsoon interval, as identified by Chinese cave records, considered analogous to either Heinrich 1 or Younger Dryas in Termination I, respectively.

Keywords: speleothems, Termination III, calcite $\delta^{18}O$, Mediterranean climate, Macedonia

The environmental reconstruction of the younger sequences of Petrovaradin fortress Palaeolithic site

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Three phases of archaeological investigations have been performed in the zone of the Novi Sad city museum at the Petrovaradin fortress. In this study, we summarize the results of geo-archaeological investigations related to the third period of excavation inside the Novi Sad city museum building. The investigations covered an area of 27 m2 in the southwestern part of the building. The approximately 60 cm thick loessic sequence at a slope of the Petrovaradin rock provides a unique opportunity to reconstruct the last glacial environmental evolution of this area. This sedimentary interval corresponds well with two uppermost units I and II at a previously investigated (just 20 m distant) section of 195 cm depth also located in the southeastern part of the Novi Sad city museum building. In both sectors, findings from the Upper Paleolithic (Gravettian) were found, while artifacts from the Middle Paleolithic were confirmed in the southwestern sector and north of the museum building. All analyzed land snail malacofauna and magnetic proxies indicate mostly similarities with L1LL1 the Upper Pleniglacial loess unit at the nearby loess sections Mišeluk and Petrovaradin brickyard. This chronostratigraphic interpretation is independently confirmed by one

radiocarbon date. However, the main part of the profile was most likely formed during Marine Isotope Stage 2 and possibly the youngest part of Marine Isotope Stage 3. The identified snail assemblages show more humid and relatively colder environments than in other sites of the Vojvodina region. Therefore, we think that the north slopes of Fruska Gora mountain had an important role during the Late Pleistocene. It was perhaps a refugium, i.e. one of those rare places in the southeast part of the Carpathian Basin where the Paleoillyrian snail assemblage survived. This rich identified malacofauna represents a highly diverse environmental mosaic ranging from humid forest to dry steppic elements. This temporally and spatially variable transitional ecotone associated with steep Danube bank provided suitable environmental and strategic conditions for human occupation.

Keywords: malacology, loess, MIS2-3, Petrovaradin, Serbia

Variability of the East Asian summer monsoon rainfall in the southeastern China in the last two millennia revealed by high-resolution stalagmite $\delta^{18}O$ records from western Fujian, China

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The East Asian summer monsoon (EASM) have an important impact on the economic development and ecological environment of its dominant region. Fujian Province is located in the pioneer area of the EASM. The detail variability in EASM rainfall over this region during past 2000 years can improve our understanding of the EASM. In this study, we firstly established high-resolution (averaged 0.6 year) stalagmite $\delta^{18}O$ series during last 300 years using two actively growing stalagmites from Xianyun Cave, western Fujian Province, and then we reconstructed yearly tree-ring cellulose $\delta^{18}O$ chronology in the past 200 years using *Cryptomeria fortunei* near the Cave. Correlated to meteorological records, the tree-ring $\delta^{18}O$ chronology shows significantly negative relationship with the relative humidity and precipitation in April and August-September. The stalagmite $\delta^{18}O$ series shows similar variation with the tree-ring $\delta^{18}O$ chronology on decadal-multidecadal scales. These relationships reveal that both the tree-ring $\delta^{18}O$ and stalagmite $\delta^{18}O$ series can be used as a good index of EASM rainfall in southeastern

China. We then reconstructed the high resolution (2-3 years) EASM rainfall history during the last 2000 years with two long stalagmites. The stalagmite $\delta^{18}O$ record shows obvious multi-decadal-centennial scale changes, with relatively less EASM rainfall during intervals of 350 - 500 AD; 600 - 750 AD; 1150 - 1250 AD; 1550 - 1750 AD and 1850-2020 AD. In contrast, relatively more precipitation in summer monsoonal season occurs in the time periods of 1 - 150 AD, 800 - 1060 AD, 1350 - 1460 AD; 1740-1840 AD and 1740-1840 AD. The Xianyun $\delta^{18}O$ record is similar to other stalagmite records from EASM dominant in most time of last 2000 years, but they show clear discrepant during two intervals of 1350 - 1500 AD and 400-950 AD. The comparisons between our record with the dry - wet changes in different regions of China (eastern and central China, North China, Jianghuai region and Jiangnan region) derived from the historical literature, illustrate that the moisture changes in the northern east China and the southern east China are in-phase on the multi-decadal scale in cold episodes. Inversely, moisture changes in the north and in the south are more different during warm time periods. The tree-ring $\delta^{18}O$ and stalagmite $\delta^{18}O$ records in the past 300 years show significant 16-year and 2-3-year cycles, indicates the ENSO influence on the interannual scale and AMO and PDO modulation on decadal scale. The power spectral analysis of 2000-year long $\delta^{18}O$ record shows significant frequency of ~200 years, which is similar to the total solar irradiance (TSI) cycles, indicating that solar activity is the dominant forcing of the summer monsoonal rainfall in this area on centennial scale.

Keywords: EASM, last 2000 years, stalagmite $\delta^{18}O$, tree-ring cellulose $\delta^{18}O$, southeastern China

Energy transition and its impact on the consumption of mineral resources and on the environment

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The development of human society has been intertwined with our methods of harnessing and consuming vital energy resources. The consumption of primary energy could be 50% higher by the middle of the century. The share of fossil fuels still exceeds 80%, with their growth of the absolute amount significantly larger than the growth of solar and wind power plants. The implementation of the green agenda requires considerable amounts of critical minerals and essentially depends on their availability and price. As we embark on the arduous journey to realize our green agenda, we must gra-

pple with a critical conundrum – the exponentially escalating demand for essential minerals. Depletion of reserves, loss of hegemony over resources and numerous changes at the global level make essential minerals increasingly unavailable. In the conditions of a widespread struggle for resources, visible climate changes and population decline, society's interest is in the suppression of pollution and dirty technologies and the sustainable use of natural resources. The needs of the ongoing energy transition for minerals lead to the uncontrolled realization of mining projects and to irreversible ecosystem disturbances and serious environmental degradation. Beyond the well-founded reservations about the efficacy of our green agenda, a pertinent question looms large: is it feasible in its current incarnation? And, concurrently, we ponder alternative avenues that might pave the way towards climate neutrality, all while preserving the sanctity of our environment.

Keywords: fossil fuels, essential minerals, energy transition

A Slippery Slope: Evaluating the Causal Factors of the Mramor Landslide (Southern Serbia)

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This research aims to depict the characteristics and causal factors influencing the Mramor creep landslide, typically found in Neogene formations in southern Serbia, especially along the left bank of the South Morava River. Given that this particular landslide has been active for more than 70 years

and covers an area of approximately 1 km², it directly impacts the lives of inhabitants in the settlement of Mramor, which is part of the broader area of the city of Niš. Additionally, it affects surrounding infrastructure. Our investigation is focused on the main causal factors, recognizing that continuous landslide events involve complex components, including climatological characteristics, properties of the geological substrate, and human activities that have contributed to significant landscape changes and the acceleration of terrain instability. For this analysis, daily precipitation and air temperature datasets from the European Climate Assessment and Dataset (ECA&D) for the Niš meteorological station for the period 1950-2019 were used. Selected meteorological parameters were employed to calculate rainfall erosivity indices (indicators of soil loss risk) such as the Precipitation Concentration Index (*PCI*), Modified Fournier Index (*MFI*), Rainfall Erosivity (*RE*), and Erosivity Density (*ED*) over the investigated period. Additionally, the Standardized Precipitation Index (*SPI*) and Lang aridity index (AI_{Lang}) were obtained to evaluate the relation of air temperature, precipitation, and possible groundwater conditions and their influence on landslide dynamics. The Mann–Kendall (MK) trend test was applied to identify potential rising and/or declining trends in both meteorological parameters and calculated indices. Online news reports of pluvial flooding and landslide occurrences were used to quality assure daily rainfall outliers and compare extreme precipitation events (exceeded rainfall erosivity thresholds) with pluvial aggressivity/climate change indices/indicators. This was achieved by examining online news reports and academic literature during the period 2000-2019 using research-related keywords. To examine the relationship between the obtained index values and the potential rainfall erosivity causal climate driver, the North Atlantic Oscillation (NAO), Pearson (*r*) and Spearman correlation (ρ) with confidence levels of 0.1, 0.01, and 0.05 were utilized. The authors also implemented advanced numerical, Geographic Information Systems (GIS), modified Analytic Hierarchy Process (M–AHP), and remote-sensing techniques to monitor and assess temporal changes in topographical features and landslide events at the local level. It can be noted that the Mramor landslide serves as a compelling case study for examining the intricate interplay between geological processes, environmental factors, and human activities in landslide-prone areas in southern Serbia. The initial results from the research offer insight into the broader implications of the Mramor landslide and underscore the significance of ongoing research and monitoring in the field of hydro-meteorological hazards and risk management. In this way, the obtained results related to the interplay of causal landslide factors can inform future strategies for disaster preparedness and sustainable land management in the region, with implications for mitigation strategies at local to regional scales.

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Keywords: Mramor, hazard, landslide analysis, landslide monitoring, causal factors, rainfall erosivity, southern Serbia.

Soil Erosion Dynamics and Hydrological Impacts of Land Use-Induced Changes in the Berane Valley of Polimlje, Northeastern Montenegro

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Alterations in land use across river basins cause modifications in hydrological responses, tendencies in soil erosion intensity and the characteristics of sediment dynamics. Often these changes are identified as the primary catalyst behind increased rates of erosion intensity. This research examines the impact of land use changes on soil erosion processes in the Berane valley of northeastern Montenegro. The study focuses on 10 watersheds in the subject region and employs the Intensity of Erosion and Outflow (IntErO) model of Professor Spalević, mathematically simulating responses of the intensity of soil erosion and runoff from the watersheds for 2011 and 2021, taking into account different land use settings of the subject area. To validate the results of sediment yield calculation bathymetric measurements were executed on the Potpeć reservoir, which is about 17 km long, with a maximum depth of about 30 m on the Lim River, in order to calculate the sediment accumulation by recording the bottom of the river bed. According to the research findings, the maximum runoff (Q max) remains relatively stable at an average of 154 m3 s–1 for the 100-year incidence. Runoff from the basin displays a slight increase due to hydrological responses to climate factors like precipitation and air temperature. However, this increase is counterbalanced by a decrease resulting from enhanced vegetation cover within the same decade. The study identifies the potential for the occurrence of large flood waves in the examined basin. The river basin's erosion coefficient (Z) rises from an average of 0.494 to 0.520. A comparison between

the 2011 analysis and the 2021 results reveals that actual soil losses elevate from 134,479 $m^3 km^{-2}$ per year to 144,224 $m^3 km^{-2}$ per year, indicating a decade-long increase of 9,745 $m^3 km^{-2}$ per year. The specific actual soil losses per km2 in the Berane basin rise from 304.7 $m^3 km^{-2}$ per year in 2010 to 328.2 $m^3 km^{-2}$ per year by the end of 2021, which represents an increase of 7.7%. The IntErO model›s results align with previous research on other river basins in the region, thus validating its applicability for the studied research area. While the calculated erosion intensity rates are relatively low by international standards, they also reflect the nature of the examined watershed. Comparable values have been reported in other pertinent studies, such as the investigation conducted by the Jaroslav Černy Institute team, which recorded 350 $m^3 km^{-2}$ per year for the entire Lim River basin in 2003. Furthermore, Spalević reported an average of 331.78 $m^3 km^{-2}$ per year for 57 river basins in Polimlje, Montenegro, in 2011, employing the identical IntErO model developed by the University of Montenegro›s research team. This correspondence strengthens the applicability of the IntErO model for assessing soil erosion in both the study area and the broader Western Balkans region.

Keywords: Soil erosion, Water erosion, IntErO, Modeling, Land use change, River basins, Hydrological response, Montenegro

Thematic Session – Natural Hazards and Environmental Risks

Analysis of the state of the vegetation cover in the zone of influence of the Kolubara mining basin using remote sensing methods

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Quality protection of geospatial elements consists of environmental control and the desired control can not be achieved without the results of measurements. By processing satellite imagery, we can obtain information related to the state of vegetation cover in the researched area. This paper evaluates the application of the Normalized Difference Vegetation Index (NDVI) in monitoring and estimating changes in weather cover in the period 1992-2022 in the zone of influence of Mining Basin Kolubara, Serbia. NDVI is one of the earliest analytical products of remote sensing used to simplify the complexity of multispectral images and is today the most popular index used to estimate vegetation. The application of this method is based on the interrelationship between surface assessment and analytical decryption of remote recordings. The obtained results using remote detection methods indicate the necessity of adequate monitoring with the aim of establishing a single register of environmental pollutants in the impact zone of the Kolubara Mining Basin. Numerous studies have found that NDVI is effective for researching vegetation status and quantified vegetation attributes and its widespread use is effective as long as limitations and opportunities are understood.

Keywords: Environmental control, Vegetation, Remote sensing, Zone impact RB Kolubara

Using RPAS derived images and LiDAR DEM's for the assessment of geomorphic changes in a cultural heritage site affected by recent landslides

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The recent advances in the acquisition of aerial images using Remotely Piloted Aircraft Systems (RPAS) offer an efficient and low cost solution for the assessment of permanent changes of the topography in highly dynamic areas (landscapes with the dominance of landslides, gullies and rill erosion, river channel migration). The quality of images allow us to create accurate Digital Elevation Models (DEM's) in every critical moment linked with heavy rainfalls which may trigger the reactivation of old landslides. Despite many advantages of DEM's obtained through Structure from Motion (SfM) method (resources, availability, high resolution - spatial and temporal), they can be achieved for small surfaces, usually under 100-200 ha. Therefore they are realized in areas with a significant representation of the dynamics of the processes and the value of the threatened sites. The present study focus on the area of Poiana Mănăstirii – Între Şanţuri thraco-getic fortress (2550-2050 yr BP), located in the central part of Moldavian Plateau, NE Romania. Covering a surface of 12 ha, the fortress is partially surrounded by a 2-3 m high wall, with a 10 m wide base, and a 1 m deep and 4-6 m wide trench. In its southern part, the landslides destroyed these remnants, and due to the deforestation of the slope in the last 30 years these processes recorded almost yearly reactivations. A DJI Phantom 4 Pro UAV was flown over the study area in October 2019 and acquired images with 80% side and forward overlap at 20 MP resolution. Visual SFM open source software was used to obtain the point cloud and a Ground Control Point network (determined with a Trimble GeoExplorer 6000 GPS) was used for georeference. In order to detect and to map geomorphic changes, LiDAR point clouds (2012) was used as reference dataset (with a spatial resolution of 0.25m, and a vertical accuracy of 0.13 m). A detailed map showing the changes in topography between 2012 and 2019 has been carried out. The most dynamic portions of the landslide are accompanied by dense micro-topographic features like secondary scarps, longitudinal and transversal cracks, which have been mapped using ortophoto image. The dynamic of some active parts of the landslide indicate that the southern part of the fortress will be affected in the near future. Alongside the identification of the most active parts of the landslide, we conclude that the entire recently deforested area must return as quick as possible to the initial land use (forest).

Keywords: Remotely Piloted Aircraft Systems, Structure from Motion, Poiana Mănăstirii, Romania

Satellite-based river ice monitoring and parameters determining river ice formation on the Danube

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Due to extreme weather, Hungary's main rivers and lakes occasionally grow an ice cover, causing severe damage to infrastructure and increased flood hazard. During cold periods in 2017 and 2022, a dangerous layer of ice developed on the main rivers in the country. Since river ice is rare in this region, no permanent ice monitoring system operates. Due to their all-weather capabilities, active remote sensing instruments provide a good opportunity to monitor ice coverage. ESA's Sentinel-1 radar satellites acquire relatively high spatial and temporal resolution data. A method was developed to provide ice coverage information at a regular interval; depending on the satellite revisit, at least once every five days. In 2017, maps were created for sections along the Danube and in 2022, for another section of the Tisza River. The ice coverage was calculated with a spatial resolution of 10 metres and visualised with a spatial density of 100 metres. Based on the 2017 data, the interplay of various parameters determines the location of ice jam development on the study reach. Among all, flow velocity, primarily governed by water surface slope, determines the intensity of ice accumulation and static ice cover formation at most. However, the role of channel geometry is also important, as increased channel width variability, high sinuosity or the presence of mid-channel islands are key parameters in the development of ice jams. The severity of the ice event is also greatly determined by the amount of ice arriving on the tributaries. The survey has also shown the dynamic character of ice formation and congestion. The appearance of ice floes on the upstream sections was quickly followed by the formation of packed ice on geometrically variable or low slope sections downstream. The data obtained in this study can help engineers to identify better critical cross-sections where preventive interventions are needed to manage ice events in the future.

Keywords: ice coverage, Danube, Tisza, Hungary

Seasonal Variability in PM_{10} Concentrations: A European-Scale Analysis of Urban and Suburban Land Cover Influences

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In this research, we investigate how different types of land use in urban and suburban landscapes influence the levels of particulate matter (PM_{10}) concentration in the air, which can affect air quality. We analyze data from the 2018 Urban Atlas and the European Environmental Agency to identify specific land-use categories that either reduce or increase PM_{10} levels in urban and suburban landscapes, with a focus on sustainability. Our study reveals Urban areas exhibit significantly higher mean PM_{10} concentrations compared to suburban regions, particularly during the heating period in European cities and certain types of land use, such as water bodies, forests, and urban parks near PM_{10} monitoring stations, consistently help lower PM_{10} levels throughout the year. Conversely, Bare lands and mine, dump and construction sites have a permanent positive significant correlation with average monthly PM_{10} concentration. Additionally, Roads and built-up areas display varying effects on PM_{10} quality during heating and non-heating periods. Motor vehicle emissions are found to be a significant factor in higher PM_{10} concentrations during the summer, while traffic corridors reduce PM_{10} concentrations during the heating season. Our research highlights the importance of considering different land use and land cover patterns in urban planning to improve air quality and promote sustainability.

Keywords: Land use, Urban Atlas, Stepwise GLM model, landscape pattern, PM

Multi-hazard modelling of erosion and landslide susceptibility on the national extent of North Macedonia

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Due to favorable natural conditions and anthropogenic factors, the territory of North Macedonia is very susceptible to natural hazards. Steep hillslopes combined with soft rocks (schists on the mountains; sands and sandstones in depressions), erodible soils, semiarid continental climate and sparse vegetation cover give a high potential for soil erosion and landslides. For this reason, the paper presents a multihazard approach to geohazard modelling on the national level in North Macedonia. Utilizing Geographic Information Systems (GIS), relevant data pertaining to the entire research area were employed to analyze and assess the extent of excessive erosion, and susceptibility to landslides, and identify areas prone to multi-hazards. Using the Gavrilović EPM - Erosion Potential Method, an average value of 0.43 was obtained for the erosion coefficient Z, indicating moderate susceptibility to erosion. However, according to the implemented model, a significant area of the country (22.1%) is susceptible to high and excess erosion rates. For the landslide susceptibility assessment (LSA), the Analytical Hierarchy Process (AHP) approach is combined with the statistical method (frequency ratio). This combination is shown to be very promising for regional and national landslide susceptibility modelling with weak landslide inventory. Then, the accuracy assessment is performed for both procedures (EPM and LSA), showing acceptable reliability. In the end, by overlapping areas highly susceptible to erosion and landslides, multihazard model is prepared. According to this model, 5.15% of North Macedonia territory is at high risk of landslides, and excess erosion. The primary objective of multi-hazard modelling is to identify and delineate hazardous areas, thereby aiding in activities to reduce the hazards and mitigate future damage. This becomes particularly significant when considering the impact of climate change, which is associated with increased landslide activity and excessive erosion. The approach based on a national level presented in the paper has the potential to provide valuable information for regional planning and decision-making processes.

Keywords: Multi-hazard modelling, Natural hazard assessment, Geo-hazards, Excess erosion, Landslides, GIS, North Macedonia

A Comparative Study of ML and FEM Models for the Prediction of Seismic Structural Behavior

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During the last several decades, the finite element method (FEM) is the most commonly used numerical method for performing seismic structural analysis. It requires careful structural modeling, but also the adjustment of small computation steps, especially for highly complex nonlinearities, which leads to significant time consumption, to ensure the stability and accuracy of the results. The development of new techniques based on machine learning (ML) models attracts considerable attention, due to the possibility to overcome the limitations of traditional techniques. This study presents an implementation of the long short-term memory (LSTM) deep-learning recurrent neural network (RNN) for the estimation of nonlinear seismic structural response. It is established in a data-driven manner. The LSTM model has shown considerable success in capturing structural response during nonlinear dynamic time-history (NDTH) analysis. Even in the case of an insufficient number of data, it shows better performance and greater adaptation to experimental results than the robust FEM model. In order to secure the consistency of the dataset for different ground motion records and increments, resampling and filtering of data is recommended. Such an innovative approach can enable the prevention of catastrophic consequences from devastating earthquakes. That can be achieved by fast and accurate pre-earthquake response prediction, damage state forecasting, and accelerated development of fragility curves based on previously conducted incremental dynamic analyses (IDA) or experimental tests. The predictive capabilities of the developed model were demonstrated through a comparative analysis of the behavior of two adjacent interacting unreinforced masonry structures (URM), tested on a shaking table. Even with the relative lack of experimental data, LSTM showed superiority over SAP2000 software. In all sequences of the time history records, the LSTM model gave closer results to the experimental ones than the SAP2000. The lack of a massive amount of data was observed as the main reason for the deviation of the results obtained by the LSTM model in certain time intervals, so the expansion of datasets is proposed for upcoming simulations. In future research, to model the dynamic response of different material and structural types, the formation of such models in a physics-driven fashion is recommended.

Keyword: seismic structural analysis, machine learning, long short-term memory

Updating knowledge of avalanche prone areas in Slovenia

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Snow avalanches are an annual phenomenon in Slovenia. They are common in the high mountains and in the upper parts of the low mountains, and in lower altitudes during heavy snowfall. Although they threaten less than one percent of the territory, they are problematic due to their local and temporal variability. Occasionally they cause significant damage and are the deadliest natural disasters of all. On average, there are 1 to 2 victims per year, more during snowy winters. In the past, the victims were mainly locals, today they are mainly mountain visitors. Avalanches can be triggered anywhere there is enough snow and a steep enough slope. Although this rule is simple, it is difficult to determine the trigger zones. Triggering depends on many weather and topographic factors and their interplay, which is difficult to measure. The most reliable method for determining avalanche trigger zones is field surveys and a review of historical records. An important database on avalanches is the avalanche cadastre, which was started in the middle of the 20th century at the Hydrometeorological Service of the Republic of Slovenia and later at the Society for the Regulation of Torrents in cooperation with the ZRC SAZU Geographical Institute Anton Melik. Currently, 1257 avalanches are recorded in the cadastre. Only the most problematic avalanches are included in the compilation, leaving a relatively large area untreated. Due to the expansion of settlements, the construction of new communication facilities, and especially the increasing number of winter visitors to the mountains, consideration should be given to extending the avalanche cadastre to these untreated areas. Since it is not possible to complete it in the short term, we are trying to solve this problem by modelling and simulating avalanches within GIS. Avalanche modelling is mainly done with Rapid Mass Movement Simulation (RAMMS) software, while simulations of GIS take into account several morphometric indicators based on a detailed digital lidar elevation model (slope gradient, vector ruggedness measure, wind exposure index, multiscale topographic position index) and detailed forest vegetation data (digital canopy model).

Keywords: avalanches, GIS, Slovenia, Rapid Mass Movement Simulation

The impact of climate and land use changes and on soil erosion in the river basin of Visočica river and accumulation of sediment in Zavoj lake

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Alterations in land use across the world in all river basins bring about shifts in hydrologic response, soil erosion, and sediment dynamics attributes. Such transformations are frequently perceived as the primary drivers of accelerated erosion rates. Study area of this paper is represented as Visočica river basin, Eastern Serbia, with ending point as the dam of Zavoj lake. This are very specific area because this lake represents one of the biggest landslides in Serbia. Erosion processes in the Visočica river basin are being monitored so that disasters do not occur again. Besides very dynamic physical-geographical components, this region is interesting in social-geographical properties. Main characteristic is very intensive depopulation, especially in the rural areas. Due to rapid population decline and decrease in agricultural activity, erosion in this area is weaker. In this paper changes in intensity of erosion will be assessed using the Intensity of Erosion and Outflow (IntErO) model, employing GIS software and official statistical parameters. Land use will be analyzed using Corine Land Cover and older publications.

Keywords: Stara planina, IntErO model, erosion, Zavoj accumulation

The effects of droughts on livestock farms in NE Romania: an insight on risk perception and adaptive measures of the farmers

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Droughts represent the main climatic hazard in NE Romania, affecting all agricultural activities to different extents, depending on their timing and intensity. This paper investigates the drought risk perception of livestock farmers, together with their coping strategies, through a downscaled approach. An extensive fieldwork complemented by interviews and a survey were carried out during the summers of 2022 and 2023, with the main goal

of gathering data from the most drought-sensitive and impacted farmer typology: livestock farmers that practice grazing, depending entirely on the amounts of precipitation and their distribution during the grazing period. The questionnaire was applied to 185 farmers with different farm settings. This included 64 questions (with response types grouped in: 5-point Likert scale, dichotomic, multiple choice, or open items), structured as: (i) the risk perception of the farmers regarding climate-related hazards (awareness, perceived trends of climate hazards, impacts on water and feed supply, animal health, pasture quality, preparedness, trust in authorities); (ii) farm settings (type, size, water supply, restrictive factors, production specificity, animal breed, partnership status, perspectives), and (iii) farmer profile (age, education level, experience, implication, place of living, heat vulnerability, satisfaction level). The statistical analysis was performed in R (univariate, bivariate and multivariate analysis). The results include a broad range of correlations and insights, from which we selected an initial subset. Respondents considered droughts the most impactful climatic hazards, followed by heat waves, both in the last and the next 10 years. Also, about 75% of the farmers observed an increase in drought intensity and frequency in the last 10 years. In terms of preparedness, 58% of the participants reported that they implemented drought preparedness measures, although they estimate their preparedness level as medium (2.82 mean, 1.1 std). Medium to low levels were also reported by farmers when talking about trusting authorities at county (1.85 mean, 0.82 std), national (2.29 mean, 1.15 std) or European (2.34 mean, 1.26 std) scales to reduce the impact of droughts. As drought risk perception is a prominent factor to be acknowledged and integrated into drought mitigation strategies, these findings can inform decision-making at regional scale. This study marks the start of drought risk perception research in Romania, being the first to address this topic in the country of reference and one of the few and most detailed in Europe.

Keywords: drought risk, livestock, Romania

Geographical atlas of natural disasters in Slovenia

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Within the framework of the Department of Natural Hazards at the ZRC SAZU Anton Melik Geographical Institute, we have created an online Geographical Atlas of Natural Disasters in Slovenia. The atlas contains basic data on natural hazards and natural disasters in Slovenia and aims to inform the public about the types and frequency of natural disasters that have

occurred on the territory of Slovenia since the 14th century. With the atlas, we want to raise awareness of the frequency and diversity of natural hazards in Slovenia, improve risk assessment of various landscape elements, and facilitate decisions about interventions in space in order to optimize prevention measures. The atlas includes databases on various natural disasters at the level of a single phenomenon or event between 1750 and 2020, data on damage from various natural disasters at the level of selected administrative units, maps of earthquake, flood, landslide and forest fire hazard at the national level. A special focus at the national level is devoted to avalanche hazard. The atlas is supported by the ArcGIS Online tool from ESRI.

Keywords: geographical atlas, natural disasters, GIS, Slovenia.

Land use and environmental changes influence on erosion production, using IntErO model (Case study: Sokobanja basin, Eastern Serbia)

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Due to the continuous erosion of fertile topsoil, leading to a decline in agricultural production, soil erosion emerges as a critical environmental concern impacting the entire planet. In many municipalities in Serbia, during the second half of the 20th century, there were intense land use and environmental changes. Massive industrialization and urbanization were used as the main tools to increase living standards. The consequence of such processes is intensive depopulation of rural areas, an inadequate way of using the agricultural surfaces, and thus changes in the degree and intensity of erosion. Study area of this research represents river basin of Sokobanjska Moravica river, total surface 515,5 km^2. Watershed of Sokobanjska Moravica river is developed in very unique karst terrain (karst bare). Changes in this region will be analyzed through the Intensity of Erosion and Outflow (IntErO) model, using GIS softwares and official statistical parameters, during the second half of the 20th century and the beginning of 21st century. The main goal of this study is to help policymakers in formulating more robust soil and water conservation regulations, this study contributes to safeguarding the soils within river basins, ensuring their preservation.

Keywords: Bovan lake, CORINE land cover, soil erosion, IntErO model

Cover-Management Factor, Slope Length and Steepness Factor (LS-Factor) for Modeling Water-Induced Soil Erosion in the Western Balkans

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In light of recent studies projecting a potential increase in water-induced soil erosion (ranging from 30% to 66% by 2070) and due to future land use and climate changes, there is a pressing need for new research to enhance our understanding of the primary driving factors behind soil erosion. This necessity is particularly pronounced in under-researched regions like the Western Balkans (WB). Within the context of the Revised Universal Soil Loss Equation (RUSLE), the cover management factor (C-factor) plays a pivotal role in governing the extent and variability of soil erosion, while the combined slope length and steepness factor (LS-factor) exert the most substantial influence on soil loss across Europe. This research aims to compare the estimations of C-factor and LS-factor for five WB states: Albania (ALB), Bosnia and Herzegovina (BIH), Montenegro (MNE), North Macedonia (MKD), and Serbia (SRB), over the period of 2011-2020. For the C-factor, we adopted the LANDUM methodology proposed by Panagos et al. (2015a). This model estimated the C-factor mosaic for arable lands (C_{arable}) and all other land uses ($C_{non\text{-}arable}$), while excluding artificial surfaces, water bodies, bare rocks, wetlands, beaches, and glaciers from the study area. The LS-calculation followed the equation proposed by Desmet and Govers (1996) and utilized an upper slope angle limit of 50% (Panagos et al., 2015b). Our study relied on four prominent data repositories: (1) Copernicus Corine Land Cover (Change CHA 2012-2018) as data vectors, (2) European Space Agency (ESA) MERIS Fraction of Vegetation Cover (F_{cover}) for remote sensing data, (3) EUROSTAT for agricultural statistical data at the national level, and (4) EU-DEM at the pan-European level by Copernicus Land Monitoring Service. The mean C-factor in the WB region was estimated to be 0.04, with an extremely high variability; the highest mean C-factor is obtained for arable land (0.40) and Permanent crops (0.16), while forests have the lowest mean C-factor (0.00115). On a state level, BIH and MNE are showing lowest mean C-factors estimations (0.02), in contrast to the highest ones for SRB and ALB (0.04). Observing the LS-factor, the WB region exhibited a high mean value

(3.66), with max in MNE (3.74) and min for SRB (3.28). The coefficient of variation (CV) of LS-factor, as an indicator of the degree of heterogeneity within a country, has the greatest variation in SRB (0.73), while the least variation was found in MNE (0.63). Arable land displayed the lowest LS-factor values (from 0 to 2.33), whereas open spaces with little or no vegetation had the highest values (from 2.47 to 3.89). By conducting a comparative analysis between LS and C factors, this research significantly contributes to the development of effective soil mitigation and conservation strategies in the WB region. Furthermore, it represents a part of the first systematic study of the WB region, following the RUSLE methodology.

Keywords: soil erosion, cover management factor, slope length, steepness factor, modeling, RUSLE, Western Balkans

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Application of Remote Sensing for Monitoring the Effects of Mining Activities on Land Use and Deforestation in Stanari Municipality, Bosnia and Herzegovina

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The research's paper main topic concerns the implementation of remote sensing for the purpose of monitoring changes in land use within the Stanari municipality situated in the Republic of Srpska, Bosnia and Herzegovina. The aim is to detect spatial changes during the specified research timeframe (2017–2023) through the analysis of the remote sensing "product." In the context of shifts in land use, the focus is directed towards changes arising from surface mining activities, which have the potential to adversely affect the environment. Within the research area, designated zones for approved exploitation and exploration have been recognized. The aggregate extent of the authorized exploitation zone measures 3846.35 ha, constituting approxi-

mately a quarter of the municipality's land (23.89%), and displays a tendency for further augmentation. The observation of land use changes was conducted by analyzing remote sensing datasets (Dynamic World and Hansen Global Forest Change) using the Google Earth Engine platform. Substantial forest area losses were documented, exhibiting a decrease of -2759.51 ha (-17.14%) at the municipal scale and a decrease of -808.03 ha (-21.02%) within the exploitation zone. Mine areas have experienced a twofold increase, encompassing 597.34 ha (3.71%) within the municipal boundaries, and 575.79 ha (14.97%) within the extent of the exploitation zone. As a component of the study, the spatial dimensions of deforestation were identified and examined. During the investigated timeframe (2001–2021), the deforested area resulting primarily from mining activity in Bosnia and Herzegovina totals 977.94 ha, with 264.25 ha (27.02%) situated within the Stanari municipality. The approved exploitation area contains over 90% of the deforested land within the Stanari municipality. An evaluation of the environmental impact was conducted for the spatial changes, encompassing both natural elements and human-made structures. Ultimately, an analysis was performed within the endorsed exploitation zone to explore potential land restoration for degraded areas. Several previously recultivated regions were identified, and recommendations were provided for guiding future steps in the recultivation process. The study enhances comprehension of spatial transformations induced by mining operations, and the presented data holds significance for numerous practical considerations, including conscientious land use planning, spatial arrangement, safeguarding forest ecosystems, and environmental preservation.

Keywords: land use, deforestation, environment, remote sensing, Stanari municipality, Bosnia and Herzegovina.

Analysis of the intensity of erosive processes in the zone of influence of the Kolubara Mining Basin

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Soil is an important natural resource and proper use of this resource requires adequate knowledge of both exogenous and endogenous factors that influence various processes of its violation. A commitment to land conservation is essential for the progress and survival of the living world. Soil ero-

sion is an important factor to consider when analyzing and using some space. Soil erosion processes are complex and the spatial and temporal factors that affect them are highly variable. Spatial and temporal land degradation in this paper was investigated in the zone of influence of the Kolubara Mining Basin, Serbia. The studied area includes the zone of influence of RB Kolubara with exploitation space. Remote sensing occupies an important place in the world of science, especially in the field of degraded surface research. By using multispectral images, we can provide data for long-term environmental management. Remote sensing shows the degree of endangerment by erosion processes, using the Erosion Potential Method (EPM). There are many models in use today to help assess soil erosion. The EPM model shows satisfactory results and the obtained indicators can be used for more adequate land management, sustainable planning and environmental protection. A map of erosion in the GIS (Geographic Information Systems) environment was created, which shows the state of erosive processes of different intensity in different periods of time, the current situation compared to the situation in 1983. when the Map of Erosion of Serbia was made. The results show that the observed space-time area is exposed to erosion as a result of land use changes.

Keywords: Land use, Remote sensing, Erosion Potential Method, RB Kolubara

Geospatial Modeling of Wildfire Susceptibility on a National Scale in Montenegro: A Comparative Evaluation of F-AHP and FR Methodologies

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Wildfires pose a significant ecological, environmental, and socioeconomic challenge in southeastern Europe. The preservation of wildland is not only essential but also a foremost priority for Montenegro, a country recognized as the world's first ecological nation. Consequently, the development of optimal methodologies and models is of paramount importance to enhance fire protection measures. With this objective in mind, this study strives to cre-

ate a wildfire susceptibility model on a national scale for Montenegro. The modeling process integrates both natural and human-induced factors, employing the Fuzzy Analytic Hierarchy Process (F-AHP) and Frequency Ratio (FR) within a geoinformatics environment. The outcomes of the F-AHP model reveal that 73% of the total area is categorized as having high to very high susceptibility. Conversely, based on the FR model, only 29% of the area falls within these susceptibility levels. In terms of validation, the AUC values indicate the good performance of the F-AHP model. In contrast, the FR model demonstrates poor performance. These novel findings, pertaining to Montenegro at a national scale, offer valuable insights for preemptive wildfire safeguarding efforts. Moreover, the methodologies employed, with necessary modifications, hold potential for application in geographically diverse regions worldwide.

Keywords: Wildfire susceptibility, F-AHP, FR, Montenegro, Wildfire management, Geoinformatic, GIS.

Hidden in the dark: Uncovering the extent of cave pollution in Slovenia

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Cave pollution is neglected, but it is the clearest evidence of man's relationship with karst areas in the Anthropocene. Large amounts of unknown waste lie beneath our feet, posing a threat to reliable sources of drinking water and harming unique and fragile underground life. Having access to the Slovenian Cave Registry database, we created a comprehensive collection of Big Data on cave pollution and related it to various spatial factors. A number of statistical methods were applied, supported by geographic information systems. The results, based on the study of 6965 caves in 17 regions with about 1.2 million data entries, show the importance of population density, proximity to buildings, altitude, etc. This approach forms the basis for the development of a model to predict cave pollution and, on the other hand, for the development of a model to prioritise cave pollution remediation. For the more than 2800 polluted caves in Slovenia, a strategic and organised approach is needed to tackle the most critical cases. The applicability of the model can cross borders and connect cavers, scientists, and decision makers in their noble efforts to clean up the darkness.

Keywords: pollution, caves, Slovenia

Modelling water erosion and mass movements (wet) by using GIS-based multi-hazard susceptibility assessment approaches: a case study – Kratovska reka catchment (North Macedonia)

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Kratovska Reka is a short (17.3 km) left tributary of Kriva Reka, whose watershed (68.5 km^2) is located on the northwestern slopes of the Osogovo Mountains (North Macedonia). Due to the favorable natural conditions and anthropogenic factors, the Kratovska Reka catchment is under a high risk of natural hazards, especially water erosion and landslide occurrences. For this reason, the paper presents an approach of modelling of potential erosion and areas susceptible to the above-mentioned hydro-meteorological hazards in the Kratovska Reka catchment. Firstly, this study analyzed the main geographical features that contribute to intensive erosion processes in the area. Then, using the Gavrilović EPM erosion potential method, an average value of 0.56 was obtained for the erosion coefficient Z, indicating areas prone to high erosion risk. Furthermore, by using landslide susceptibility analysis (LSA), terrains susceptible to landslides were identified. The results shows that ⅓ of the catchment is very susceptible to mass movements in wet conditions (landslides). According to the combined multi-hazard model, 3.13% of the total area of the Kratovska Reka catchment is both at high risk of landslides and under severe erosion. Thus, the Kratovska Reka catchment is significantly endangered by the excessive water erosion processes (39.86%), especially on the steep valley sides, i.e., terrains that are completely exposed, under sparse vegetation, and open to the effects of distribution/concentration of the rainfall amounts throughout the year. Identifying locations with the highest erosion risk serves as the initial step in defining and implementing appropriate mitigation measures across local and regional scales, thus enhancing overall resilience to environmental challenges.

Keywords: hydro-meteorological hazards, water erosion, mass movement (wet), multi-hazard modelling, GIS, risk assessment, geohazard mitigation, watershed, Kratovska Reka, North Macedonia

GIS-based Landslide Susceptibility Mapping and Assessment using MCDM-BWM: A Case Study – City of Smederevo (Serbia)

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Landslides and slope processes constitute one of the most frequent natural hazards in valleys near major rivers and mountainous regions. The surface layer, characterized by its relatively loose composition, is prone to sliding due to a combination of distinct natural and human-related factors (i.e. landslide causal factors (CF)). Along the right bank of the Danube River, specific sections of Smederevo city face considerable susceptibility to landslide activation, frequently resulting in substantial material losses and posing a risk to the local populace. This study entails on-site investigation, involving the mapping of recent landslides, coupled with database analysis through Geographic Information Systems (GIS) and advanced remote sensing techniques. The initial analysis encompasses geological characteristics, morphometric conditions, hydrological and climatic factors, as well as anthropogenic influences such as land use, all contributing to soil instability. Employing GIS alongside the Multi-Criteria Decision-Making (MCDM) technique, specifically the Best-Worst Method (BWM), yielded insights into landslide susceptibility within the territory of Smederevo city respectively. By visualizing areas highly prone to such disastrous occurrences, policymakers are empowered to enact more suitable environmental protection measures and institute sustainable management practices for agricultural parcels in this region.

Keywords: landslides, City of Smederevo, causal factors, GIS, MCDM, BWM, natural and anthropogenic factors, visualization.

Spatial-temporal and Trend Analysis of the Traffic Accidents in the AP Vojvodina (northern Serbia)

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The objective of this paper is to analyse the spatial-temporal pattern of traffic accidents using ten years of data from 2011 to 2020 for the Autonomous Province of Vojvodina, northern part of Serbia. The spatial pattern of traffic accident hot spots and their temporal evolution were identified on the municipality level of the study area using hot spot analysis (Getis–Ord Gi*) techniques within the GIS environment. Trends in the traffic accidents on the municipality level were analysed using Mann-Kendall statistic. In majority of municipalities there were no trend detected. In 15 out of 45 local administrative units some kind of trend in the number of traffic accidents, fatalities and injuries was detected. In only two municipalities, Bački Petrovac and Žabalj, trend in the number of traffic accidents is decreasing, while in seven is increasing, Bačka Palanka, Bačka Topola, Kanjiža, Kikinda, Mali Iđoš, Novi Kneževac and Vrbas. In only three municipalities decreasing trend in the number of traffic fatalities was detected, Bačka Topola, Novi Bečej and Titel. Also, five municipalities have decreasing trend in traffic injuries, Opovo, Sečanj, Vršac, Zrenjanin and Žabalj. Hot spot analysis on the number of traffic accidents and traffic injuries detected hot spots in seven municipalities – Bački Petrovac, Beočin, Irig, Novi Sad, Sremski Karlovci, Temerin and Žabalj. In the hot spot analysis on the number of traffic fatalities, there were no hot spots detected. The hot spot analysis on the traffic casualties weighted number showed similar results to the hot spot analysis on the traffic accidents, with only difference regarding persons in tractors. In this category, hot spots were detected in two municipalities – Nova Crnja and Žabalj. This research holds potential to enhance traffic safety by directing targeted safety measures toward identified hot spots. Such measures could ultimately lead to a reduction in traffic accidents, consequently curbing the number of both fatalities and injuries.

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Keywords: Traffic accidents, hot spot analysis, trend analysis, GIS, AP Vojvodina.

Model of resistance of the local community of Nikšić municipality to earthquake hazards

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The subject of the research is the examination of the impact of certain physical-geographical and social-geographical characteristics on the resilience of the local community in the municipality of Nikšić to disasters caused by earthquakes. Through this research, we can get answers to the questions of which factors affect the resilience of the local community, as well as the implementation of certain strategies to influence the improvement of the situation in that area. The goal of the research is to determine the factors that affect the degree of danger of local communities in the event of a disaster caused by earthquakes, as well as to create prerequisites for the development and implementation of various strategies that will contribute to improving the situation. in that area. Based on the results of preparedness for disasters in the event of danger, which we will obtain through a survey of citizens, we can contribute to improving the resilience of the local community in the area of the municipality of Nikšić to natural disasters. Also, the results can be used for further research, as well as for municipal and state bodies, local communities, as well as citizens themselves in order to improve response in case of natural disasters and disasters caused by earthquakes.

Keywords: earthquake, geotectonics, local community, geohazards, resilience

Assessing of the effect of land use and land cover changes on the intensity of soil erosion and sediment transport applying the IntErO Model within Mkhdach catchment (Middle Atlas/ Morocco)

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The change in land cover is recognized as a primary determinant of the processes of soil erosion and sediment transport. The purpose of this article is to assess the effect of land cover change on the generation of soil loss and sediment transport within a small Mediterranean headwater (Mkhdach catchment) in the Middle Atlas of Morocco. The Intensity of Erosion and Outflow (IntErO) model was applied to estimate soil erosion and sediment transport. Besides, the normalized difference vegetation index (NDVI) was applied to detect the change in land uses. Hydroclimatic data, encompassing rainfall, air temperature, and discharge, were sourced from meteorological stations near to the studied catchments and managed by the Hydraulic Agency of the Oum Err Bia River (HOBER). The obtained results indicate that within the studied period of 1990–2023, the forest cover decreased by 13%, while the other forms of land use, including rainfed crops, open forest, and bare land, increased by 15%, 6%, and 17%, respectively. The maximum potential outflow was 371.73 m^3/s^{-1}. The study area registers 417484.70 m^3 god^{-1} of erosion material, which influences sediment transport and landscape changes. Moreover, soil erosion exhibits substantial intensity and volume, reaching 417484.70 m^3 annually. The coefficient of deposit retention, determined using the IntErO model, equates to 0.34. Moreover, the actual annual soil loss (sediment yield) within the catchment has escalated, registering at 43368.44 m^3 and 6859.73 m^3/km^2, respectively. Consequently, measuring these processes holds paramount importance in formulating scientifically grounded strategies for soil and water conservation and comprehensive land management. The acceleration of soil erosion driven by both natural elements and human interventions worldwide has resulted in amplified sediment transport across numerous regions within the Middle Atlas of Morocco.

Keywords: Land cover change, NDVI, Soil erosion potential, IntErO model, Mkhdach catchment, Middle Atlas/Morocco

Spatial-Temporal Monitoring and Analysis of Drought: A Case Study of the Sana River Basin in Bosnia and Herzegovina

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The research presented in this paper focuses on the application of remote sensing in spatial-temporal monitoring and the analysis of the impact of drought in the Sana River Basin in Bosnia and Herzegovina. The aim is to utilize remote sensing "products" to identify occurrences of meteorological, agricultural, and socio-economic droughts. This includes the calculation of indices: the Standardized Precipitation Index (SPI), Temperature Condition Index (TCI), Vegetation Condition Index (VCI), and Vegetation Health Index (VHI) respectively. Meteorological drought monitoring was conducted using the Climate Hazards Group InfraRed Precipitation with Station Data (CHIRPS) data through the Google Earth Engine (GEE) platform. A 30-year time period (1992–2022) was compared with reference years (2016 and 2017). A precipitation deficit was observed and SPI was calculated. Agricultural drought monitoring was executed using Moderate Resolution Imaging Spectroradiometer (MODIS) satellite data, specifically MOD13Q1 and MOD11A2, to calculate TCI, VCI and VHI. Results of this study indicate negligible drought occurrences in 2016, while an extreme drought event was identified in 2017. The consequences of agricultural drought on socio-economic drought are examined. Results highlight a significant decrease in yields of wheat, barley, corn, potatoes, pears, and plums in 2017 compared to 2016. This initial research contributes to a better spatial-temporal understanding of drought occurrences in Bosnia and Herzegovina, and the presented data and results hold significance for numerous practical considerations in the fields of monitoring, prevention, and mitigation of the adverse effects of drought in river basins.

Keywords: drought, remote sensing, CHIRPS, MODIS, Sana River Basin, Bosnia and Herzegovina

Effect of heat stable salts on amine treating unit's regenerator performance

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Operational problems of the amine regeneration unit with the quality of the regenerated amine (pH, content of heat stable salts, mole ratio H2S/amine, concentration, content of suspended solids) were investigated. These problems can result in increased corrosion/erosion, as well as fouling of the equipment. In this paper, the consequences of increased corrosion/erosion due to leakage on the pipe bundle of the rich/lean amine exchanger were analyzed. The main cause of corrosion and erosion is the presence of heat-stable salts (HSAS), which are found in the amine solution in a higher concentration than is allowed (max 3 wt % HSAS). Amine with a high amount of heat-stable salts (HSAS) should not be used in LPG and fuel gas washing columns, but it is recommended that when the impurities in the amine reach undesirable values in the solution, the reclaiming process is carried out. The presence of HSAS in the amine system can cause a decrease in the capacity of the amine unit, excessive corrosion, and process problems caused by foaming and by-products of corrosion, which results in excessive losses of amines, higher operating costs due to more frequent replacement of filter units and generally unfavorable functioning of the amine system. At delayed coking units, the most common heat-stable salts are the ones that originate from HCN, which in contact with amine hydrolyses to ammonia and formate. To solve these problems and remove heat-stable salts, the technology of reclaiming (Amine Purification Unit-APU) was applied. The reclaiming process is a continuous separation process that is based on the use of ion exchange membranes located in the electric field to enable the removal of ionizing substances in the MDEA solution. Semi-permeable membranes contain charged active centres that are selective for the passage of either anions or cations. In the case of a high concentration of heat stable salts, reclaiming begins with neutralization, where potassium bicarbonate is used to break the bond between the amine and the anion (formate, thiosulfate, thiocyanide, acetate, sulfate, chloride, etc.) and replace the amine with the K+ cation. After electrodialysis and passing through the appropriate membrane, anions and cations pass into wastewater (brine), and the purified amine solution is recirculated to the plant in columns for amine washing. This paper analyses the problems in the operation of membranes and their impact on the quality of wastewater.

Keywords: amine treating unit, heat stable salts, corrosion

Delayed coking unit: A case study of Pančevo Oil Refinery

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The Delayed Coking Unit in Pančevo Oil Refinery was built in 2020. The coking unit is a semicontinuous process that takes place in a fired heater and two chambers in the Pančevo Oil Refinery. Although it is a batch process, the delayed coker unit operates continuously, with one chamber in the coking sequence and another one in the decoking sequence. The construction of the delayed coking unit had a positive financial impact by increasing the depth of crude oil refining to 99.2%, and in addition, it has a positive environmental impact because high-sulphur fuel oil is no longer produced. The greater depth of refining means that the production of white petroleum products: fuel gas, gasoline, diesel, and LPG will also be increased, and the petroleum coke generated as a commercial product is a high-calorie fuel that is used to be imported in the Republic of Serbia. The coking sequence implies a cycle that lasts 18 hours and during which the heated feed, a mixture of vacuum residue and decant oil, enters the reactor where petroleum coke and lighter fractions are produced. The decoking sequence includes the preparation of the reactor for opening, cutting the coke and subsequent preparation of the rector for the coking sequence. Unlike other plants in Pančevo Oil Refinery, the feed first enters the main fractionator bottom section, and after that, it is directed to the fired heater. At the Delayed Coking Unit, there is one process heater which consists of four radiant and two convective zones. The feed from the bottom of the main fractionator enters the convective zone and then descends lower into the radiant zone. After the coker heater, the heated feed is directed to the coking chambers. The commercial product from the Delayed Coking Unit is petroleum coke. After cutting, petroleum coke is sent to the coke pit and then transferred by closed conveyors to the steel silos for further storage and shipping. This paper analyses the effects of the construction of the Delayed Coking Unit on the distribution of petroleum products. Moreover, the operational problems of this unit and key equipment were analysed, as well as the impact of the nature of the feed mixture on the quality and distribution of the delayed coking products.

Keywords: delayed coking unit, petroleum coke, petroleum products

Hydrothreting of used vegetable oil for green diesel production: process simulation and optimization

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Hydrotreating reaction of vegetable oil is an alternative method for the production of renewable biodiesel fuel commonly known as green diesel. The reaction involves conversion of triglycerides into normal alkanes, leads to a deoxygenated and stable product, which is fully compatible with petroleum derived diesel fuel. The hydrotreating process uses hydrogen to remove oxygen from triglyceride molecules at elevated temperature in the presence of heterogenous catalyst. As a mixture of n- and iso- paraffins, green biodiesel exhibits higher heating value, higher cetane number and increased oxidation stability over conventional ester-based biodiesel. Waste vegetable oil hydrogenation reactions were evaluated from the aspect of pressure and temperature influence, hydrogen consumption and kinetic reactions. Hydrotreating of triglycerides proceeded via the hydrocracking of triglycerides into diglycerides, monoglycerides and fatty acids. Then fatty acids were subsequently deoxygenated to hydrocarbons. Hydrotreating of fatty acids occurred primarily via hydrodeoxygenation and the main liquid products were octadecane and heptadecane. Process optimization of triglycerides hydrogenation are simulated using Aspen plus software. Complete conversion of the fatty acid hydrotreating reaction was achieved at a reaction temperature of 325 °C nd pressure of 35 bars. Hydrotreating of fatty acids occurred primarily via hydrodeoxygenation and the main liquid products were octadecane and heptadecane. Fatty alcohol, fatty acid and long chain esters were formed as reaction intermediates. Hydrotreating of triglycerides proceeded via the hydrocracking of triglycerides into diglycerides, monoglycerides and fatty acids. Then fatty acids were subsequently deoxygenated to hydrocarbons. The conversion of fatty acids and triglycerides increased with increasing temperatures. When the temperature increased, the conversion of vegetable oil, isomerization selectivity, alkane selectivity, cracking selectivity, together with the selectivity of decarboxylation plus decarbonylation increased. Obtained results showed that hydrodeoxygenation could be promoted by pressure increasing and a higher amount of n-C18 would be formed. Influence of pressure and hydrogen to oil molar ratio is also analyzed.

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Keywords: Waste vegetable oil hydrotreating, Green diesel, Refinery co-processing, Optimization Technique, Aspen plus process simulation, Kinetic parameters.

Influence of process parameters on the reaction of dibenzothiophene hydrodesulfurization in the hydrotreatment of petroleum medium distillates catalysed by coMo/AL_2O_3 catalyst

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In modern oil refineries, hydrogen refining processes, performed under high pressure and in presence of catalysts, have one of the key roles in processing. Their main role in refinery processing is the removal of sulphuric components, stabilization of the products, and removal of other undesired impurities (hydrotreating reactions), as well as conversion of heavier fractions into lighter ones (hydrocracking reactions). The hydrodesulfurization takes place in a reactor with a fixed layers of catalyst in the presence of hydrogen, at elevated pressure (typically up to 60 bar) and temperature (up to 633 K). Process of hydrodesulfurization of gas oil and light cycle oil fractions has been modelled and simulated in ASPEN Plus software. Based on kinetic data for the commercial CoMo/Al2O3 catalyst, the behavior of the reactor system over a wide range of operating conditions was examined using the Aspen Plus software package. Iterative simulations resulted in data on the vapour-liquid phase equilibrium in the reaction mixture, mass flows of the components of the reaction mixture at the output, as well as the degree of conversion for the range of process parameters. The reaction of hydrodesulfurization occurs in the liquid phase at the active centers of the catalyst. The mole content of hydrogen in the liquid phase greatly affects the degree of conversion of dibenzothiophene. The hydrogen content in the liquid phase can be adjusted by changing the pressure, temperature and the hydrogen/oil fraction ratio in the input mixture. During the simulations, the pressure varied from 20 to 60 bar, while temperature variations ranged from 510 to 600 K. It was found that the highest conversion rate, about 45%, is obtained for a pressure of 40 bar and a temperature of 570 K, 580 K, which suggests the choice of optimal operating conditions so as to achieve the desired degree of conversion with a minimum emission of SO_2 oxides in accordance with current environmental regulations.

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Keywords: Hydrodesulfuriaztion, Multiphase catalytic reactor, Process optimization, Aspen Plus process simulation.

Mapping of geothermal potentials in Serbia (Vojvodina)

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The reliable statistical models for the estimation of utilities of geothermal potential in Serbia are scarce in the literature due to the complex geological structure and lack of data. Therefore, this work addresses the use of classical and robust principal component analysis to map and preliminary estimate available geothermal potentials and point to the necessity of sustainable managing of geothermal resources. The boreholes and geothermal water data set were collected from available literature. In this work, mapping and statistical analysis are conducted based on the available data and key features of 78 hydro-thermal boreholes and wells in Vojvodina. These hydro-thermal boreholes were drilled during crude oil and natural gas exploration activities. The following features of boreholes were used for mapping and statistical analysis: location, depth of the borehole, temperature, flow rate, thermal power, mineralization, and salinity. The proposed approach was successfully applied to conduct the classification of geothermal sources in Vojvodina. The approach is based on a comparison of geothermal sources data by applying classical and robust principal component analysis. It can be concluded that Vojvodina a northern part of the Republic of Serbia is a region with rich geothermal sources. Presented statistics led by robust PCA analysis successfully analyze the hydro-thermal boreholes in Vojvodina. The approach was based on a comparison of geothermal sources to achieve a good analysis and visualization of available geothermal boreholes. Figures and maps from this study now can be a good guide for the potential use of geothermal sources.

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Keywords: geothermal energy, geothermal resources, principal component analysis

Synthesis of Depressant Additives for Diesel Fuel Based on Stearyl Acrylate and Stearyl Methacrylate Copolymers with Nitrogen-Containing Monomers by the Reversible-Addition Chain Transfer

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Research in the field of low-temperature properties of diesel fuel (DF) is in the focus of attention of representatives of the oil refining industry. The priority way to control the low-temperature characteristics of DF is the use of depressant and depressant-dispersant additives. We have proposed to use copolymers based on higher alkyl methacrylates and nitrogen-containing monomers as additives for diesel fuel of Euro 5. Since an important parameter that determines the effectiveness of the influence of additives on the depressant properties of fuels is their molecular weight characteristics, methods of controlled radical polymerization were used to synthesize copolymers. Using the Reversible Addition-Fragmentation Chain Transfer method, we synthesized copolymers of stearyl methacrylate (SMA) and stearyl acrylate (SA) with N-isopropylacrylamide, N-tert.butylacrylamide, N,N-dimethylacrylamide, and N-vinylpyrrolidone in a wide range of monomer mixtures. Dibenzyltrithiocarbonate and 2-cyano-2-propyldodecyltrithiocarbonate were used as the RAFT agent. It has been established that the copolymerization of CMA and SA with a number of nitrogen-containing monomers proceeds in a controlled mode, as evidenced by the data on the kinetics of polymerization, as well as an analysis of the molecular weight characteristics of the synthesized copolymers. Thus, the polydispersity coefficients for copolymers of SMA and SA with N-isopropylacrylamide, N-tert. butylacrylamide, and N,N-dimethylacrylamide are 1.2–1.5. The effect of the above copolymers on the low-temperature properties of diesel fuel was studied when they were introduced in the concentration range from 200 to 1600 ppm. It has been established that the synthesized copolymers significantly (by more than 20°) reduce the pour point, as well as the limiting filterability temperature and the freezing point of the hydro treated diesel fuel. In addition, they increase the antioxidant stability of the fuel. In this regard, they may be of interest as complex additives to diesel fuel. The proposed additives are not inferior in efficiency to known industrial analogues and surpass them in the complex nature of the action.

Keywords: diesel fuel, depressant-dispersant additives, Reversible Addition-Fragmentation Chain Transfer

Simulation and Optimization of Fluid Catalytic Cracking unit

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Fluid catalytic cracking (FCC) is still an important process in many petroleum refineries. Due to the complexity of the multiphase reacting flow system present in the riser reactor, its modeling and simulation are challenging. The success of modeling and simulation of the whole process is also influenced by the strong interaction between the riser and regenerator and the large number of operating variables. The common feedstock for the process is vacuum gas oil. In this paper, the AspenTech Dynamics software package was used for simulation, optimization, and analysis of the fluid catalytic cracking process. The influences of vacuum gas oil composition, and riser reactor conditions on the yield of products were investigated. The simulation was performed using the available data from commercial FCC units and literature. The calibration of the reactor was performed to increase the yield and quality of products, i.e. light cycle oil (LCO), gasoline, and gases. Considering crucial equipment and operating constraints, the dynamics simulations of stripping, stabilization, and absorption columns were examined. Furthermore, the influence of the valve opening for the aforementioned columns on product mass flow was investigated. The simulation results revealed some of the relationships between process variables that can enlarge the profit of FCC units.

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Keywords: fluid catalytic cracking, petroleum refining, simulation, optimization

Determining the optimal resin concentration for stabilization of weakly consolidated near-well zone during oil and gas production

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Sand removal in the formation fluid, related to the broken structure of weakly bound (consolidated) collectors is a serious problem and represents an important aggravating factor for many oil and gas fields. Particles from the

collapsing collector are deposited in the lowest section of the well and in the collection and preparation system. This leads to a decrease of well productivity and an increase in the erosive wear of the equipment. In the period from 2018 to 2023, several stabilization technologies were tested, the most efficient technology was selected for field tests. In this work, after analysis of failure in field tests we present proposal for improvement of the resin treatment. That include performing a scope of laboratory experiments with different concentration of resin. These results were used in mathematical model for determinations of critical decay radius value of rock and critical depression of weakly consolidated collector after resin treatment. These results as well as the development of an idea concept for the improvement of the resin treatment were used to propose an optimal concentration of resin. By implementing all the proposed concentration of resin, the effectiveness of resin treatment in the near-well zone has been increased. This can be confirmed by the preservation of collector productivity, stabilization of the near-well zone of the layer, and prevention of sand appearance in the formation fluid.

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Keywords: Petroleum production, Sand removal, Resin Treatment, Mathematical model

Effect of the additive for increased olefine content on the FCC catalyst circulation and product distribution

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OlefinsUltra additive at the FCC unit was dosed with the aim of increasing the yield of propylene and the octane number of gasoline. With the specified additive, the low-octane gasoline is cracked into olefins, thereby increasing the yield of liquid petroleum gas (LPG). According to the previous investigations, increasing the amount of OlefinsUltra additive by 1 wt% in the catalyst circulation leads to the following changes: 1) increase in research octane number by 0.5 units, 2) increase in engine octane number by 0.2 units, 3) increase in propylene yield by 0.6 wt%, 4) increase in iso-butane yield by 0.1 wt%, 5) increase in yield of C4 olefin by 0.5 wt%, and 6) decrease in gasoline yield by 1.2 wt%. The content of the OlefinsUltra additive in the fresh catalyst before the start of additive dosing was 2.5 wt%. The target of

adding additive was to reach an OlefinsUltra concentration of 5.0 wt%. The increase in the amount of OlefinsUltra additive in the system is monitored by the content of P2O5 in the equilibrium catalyst. P_2O_5 in the equilibrium catalyst before the start of additive dosing was about 0.2 wt%. Additive dosing and monitoring lasted for one year, after which a value of P_2O_5 in the equilibrium catalyst of 0.5 wt% was reached, which corresponds to the amount of additive in the system of 4.25 wt%. After finishing the dosing, the results were as follows: light cracked gasoline RON increased by 0.8, light cracked gasoline MON increased by 0.6, heavy cracked gasoline RON increased by 0.7, heavy cracked gasoline MON increased by 0.5, propylene yield increased by 1.8 wt%, Iso-butane yield increased by 0.8 wt%, C4 olefin yield increased by 2.0 wt%, and gasoline yield decreased by 3.5 wt%.

Keywords: fluid catalytic cracking, petroleum refining, simulation, optimization

Chemical demulsification of water-in-paraffinic crude oil emulsion

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Chemical demulsification is a widely used method to address challenges related to water-in-oil emulsions. In this study, emulsion samples were acquired from oil production sites, each having distinct compositions and properties. The main sample analyzed was a combination of two different crude oils. The research focused on examining how demulsifier concentration, residence time, and temperature affect the effectiveness of demulsification for water-in-oil emulsions. In this study, several essential properties of the crude oil were determined or estimated using standard methods. These properties include the ASTM D86 distillation curve, API density, kinematic viscosity, paraffin content, total asphaltene content, mean relative molecular mass, pour point, and salt content. Additionally, the properties of a blend of two paraffinic crude oils were calculated using Aspen Hysys, a widely used process simulation software. The basic sediment and water (BSW) content of the crude oil for each emulsion were measured by the centrifuge method. Chemical demulsification was carried out using the bottle test method, which allowed for a wide range of demulsifier concentrations and temperatures to be tested. Statistical analysis was performed to identi-

fy the optimal demulsifier concentration and working temperature that would yield the best results for achieving effective demulsification.

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Keywords: Demulsification, Crude oil, Water-in-oil emulsion, Separation of water

Towards a Greener Path: Exploring CCUS Perspectives in Serbia's Industrial Decarbonization

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The Republic of Serbia has various sources of industrial CO_2 emissions, such as coal-fired power stations, combined heat and power plants, cement plants, oil and gas refineries, the iron and steel sector. Additionally, Serbia has significant potential for Carbon Capture, Utilization, and Storage (CCUS). Annually, the country generates 23 $MtCO_2$ from 25 industrial sources, which accounts for over half of its CO_2 emissions. The primary contributor to these emissions is the generation of electricity in coal-powered power plants. In line with EU regulations, the new energy strategy aims to reduce CO_2 emissions and decarbonize the industry. This paper highlights the current efforts of the Petroleum Industry of Serbia j.s.c. (NIS) in implementing CCUS projects to reduce CO_2 emissions and contribute to Serbia's sustainable development goals. Serbia's potential storage areas for CO_2 include saline aquifers and depleted/partially depleted oil and gas sources. In 2015, the first carbon capture project in Serbia was initiated at the gas refinery Elemir, utilizing High Pressure Acid Capture Technology (HiPACT) at an estimated cost of 30 million euros. Following the construction of the HiPACT unit, a CO_2-EOR project was undertaken in the Rusanda oil field. The second project, focused on CCUS in Panchevo's oil refinery, commenced in 2022. The Scientific Technological Center, a subsidiary of NIS, the parent company, is actively involved in conducting a benchmarking analysis of the latest CO_2 capture, transport, usage, and storage technologies. NIS is actively seeking to expand its current portfolio of CCUS projects and encourage participation from other stakeholders, such as the Electric Power Industry of Serbia (EPS), which operates multiple coal-fired thermal power plants (25 operational units), as well as the iron and steel and cement sectors. With on-

going projects and promising prospects in the region, Serbia has the potential to become one of the leading countries in industrial decarbonization.

Keywords: CO_2, coal-fired power stations, Serbia, oil fields

Digital twin

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Due to unconsolidated fractured rocks and their mineralogical composition, cylindrical samples required for measuring the key petrophysical characteristics of the rocks cannot be drilled on about 20% of the core. The data we get from the drilled samples are crucial for further research and planning of new wells. In order to collect data and research, we applied the capabilities of 3D scanning technology and created digital twins of samples that cannot be measured by standard methods. with the data we received from our digital twins, we calculated the key petrophysical characteristics of the core samples and filled in the missing information in our database of existing wells. we showed a clear advantage of applying 3D technology compared to the standard method. We have shown that 3d technology is accurate, that it is possible to use 3D technology to obtain precise petrophysical characteristics of rocks. We presented the possibility of creating a digital collection of cores, which can be used by our geologists and petrologists, but also by future colleagues who are still at the college.

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Keywords: 3D Tehnology, Digitization, Geology, Porosity, Density

Evaluating the Serbian Paradox: CO_2 Emissions of Electric Vehicles vs. Fossil Fuel Vehicles by 2030

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This article delves into the intriguing paradox emerging in Serbia's transportation landscape, where electric vehicles (EVs) are projected to generate more carbon dioxide (CO_2) emissions than their fossil fuel counterparts until 2030. The study unveils the underlying factors behind this paradox, including Serbia's energy mix dominated by lignite. By contrasting this with the European Union's cleaner energy sources, the article underscores the delayed CO_2 emissions reduction from EVs in Serbia. Furthermore, it explores the carbon footprint associated with EV production and highlights the challenges posed by the country's energy infrastructure and vehicle fleet. The article concludes with insights into potential solutions, emphasizing the need for Serbia to accelerate its transition to renewables, aiming to align with 2030 targets, while parity with EU emissions levels is projected by 2040.

Keywords: energy, sustainability, CO_2 emissions, carbon, renewable, electric vehicles.

Recycled carbon black's contribution to the curing and properties of newly formulated natural rubber composites

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This paper aims to study the effect of adding recycled carbon black (rCB), generated from waste rubber, on the curing process and properties of new composite based on natural rubber. Pyrolysis is the most suitable method for recovering the necessary chemicals from the waste rubber by decomposing the rubber components into gas, oil, and carbon-rich solid fractions. The rCB and conventional CBs were characterized to find elemental constituents present. The experiments were performed by adding rCB instead of CB to the NR matrix at different loads, which regards the preservation of natural petrochemical resources and sustainable waste management. Cure characteristics were determined by rheometer and differential scanning calorimeter (DSC). The kinetic parameters of the crosslinking reaction were

obtained based on DSC data using mathematical models that do not require prior knowledge of the reaction model (Ozawa-Flynn-Wall, Kissinger-Akahira-Sunose, Starink, Friedman, and Vyazovkin isoconversional methods). The degrees of swelling, mechanical properties, thermal properties, and thermal stability of prepared vulcanized rubber composites were determined. The values for the specific heat capacity of vulcanized rubber composites with rCB are lower than those with CB, suggesting that more rubber chains are immobilized surrounding commercial CB than those surrounding the rCB. The thermal degradation curves for all samples showed a gradual reduction of up to 250 °C by weight. The residue (ash) of the composites was obtained at 480 °C. The char yield is positively correlated with the percentage weight content of rCB in the prepared composites. In order to reduce the production of CB manufacturing from non-renewable petrochemical materials, numerous efforts have been devoted to exploring novel alternatives for CB obtained with low environmental pollution and high performance for the rubber reinforcement.

Keywords: recycled carbon black, rubber waste

Significance of recycling of polyethylene terephthalate wastes for new materials production and conserving natural resources

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Recycling polyethylene terephthalate (PET) waste is crucial to sustainable waste management and resource conservation. PET is a commonly used thermoplastic polymer primarily used to produce plastic bottles, containers, and various types of packaging materials. Mechanical and chemical recycling are two prominent approaches to reutilizing PET waste, each with merits and limitations. Mechanical recycling excels in simplicity, established infrastructure, and lower energy consumption. However, it struggles with maintaining material quality over multiple cycles and processing complex PET waste. Chemical recycling offers the potential to produce high-quality rPET from challenging sources, but it faces energy and scalability challenges. To maximize the benefits of PET waste recycling, a combined strategy considering the merits and limitations of both approaches could pave the way for a more sustainable plastic waste management system. This work shows the merits and limitations of both mechanical and chemical recycling of PET waste. PET chemical recycling has experienced different recycling methods (glycolysis, hydrolysis, and methanolysis), with glycolysis being the most success-

ful. Products of chemical recycling are precursors for manufacturing polyurethanes, unsaturated polyester resins, epoxy resins, saturated polyesters, paints, and additives for various applications. It shows that PET recycling not only assists as a partial resolution to the solid waste problem but also imparts the preservation of natural petrochemical resources, products, and energy.

Keywords: PET, mechanical recycling, chemical recycling

Surface tension of rubber process oils

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The surface tension is the amount of energy required to increase the area of a droplet surface. Besides intermolecular forces, surface tension is also affected by temperature, where it decreases with the increasing temperature almost linearly for most of the liquids. Liquids with low surface tension have a small contact angle, and therefore a higher degree of surface coverage. Those properties are valuable for extender oils used for rubber compounding. Vegetable oils, considered environmentally friendly extender oils, belong to these liquids, where they show surface tension below 36 mN/m. Extender oils used in this study refer to vegetable oils that have not been modified by epoxidation or similar processes. The physical and chemical properties of vegetable oils were experimentally determined or calculated. The surface tension of examined vegetable extender oils was determined in a wide temperature range by the standard Du Noüy ring method. In this study, the effect of relative density, fatty acid composition, and refractive index of vegetable oils on the surface tension was examined. Calculations of surface tension required reliable predictive models, hence statistical methods like multivariate and linear regression were applied. Following those, the dependence of surface tension on temperature was compared to calculated values of surface tension based on the fatty acid composition. It can be assumed that vegetable extender oils will effectively distribute among the rubber components and form droplets more easily. It can be concluded that the surface tension of extender oil can be estimated by the proposed linear regression equation based on the refractive index (Adj. R^2=0.9478).

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Keywords: rubber, vegetable oil, surface tension

The oldest glacial environmental archive in Serbia – from gastropod perspective

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Terrestrial archives in general, but especially loess-palaeosol sequences (LPSs) formed before and at the time of the termination X, are very rare in Europe. Therefore, the results of malacological sampling of Stari Slankamen LPS in Serbia can be compared with the results of proxies from deep-sea sediments or speleothems, such as from the Iberian margin to the Atlantic Ocean and the Corchia Cave in the Apennines (Bajo et al., 2020). The malacological assemblage found consists of 23 species and unidentified slug taxa. Based on magnetic susceptibility, the fixed points of absolute ages of Lisiecki and Raymo (2005) are applied to our results. The Malaco- thermometer in July was estimated for Marine Isotope Stage (MIS) 22-24 and varied between 17.9°C and 20.1°C, with three colder periods. These fluctuations can also be seen in the aforementioned archives. The reconstructed sea surface temperatures show an additional colder phase caused by the strong input of melted ice water, while in the Carpathian Basin the temperature increases steadily toward the termination X. On the other side of Eurasia, on the Chinese loess plateau, three cold phases are suggested by the malacofauna of the loess at Luochuan and Xifeng. Moreover, both sequences have the initial soil horizon as Stari Slankamen (Wu et al., 2011). The malacological results of the aforementioned LPSs suggest the opposite of the very cold glacial conditions proposed in previous studies on Chinese LPSs (Guo et al., 1998). Interestingly, the genera *Vallonia* and *Pupilla* are dominant at the Euroasiatic level. Based on all this, we propose here a "warm" steppe environment in the Carpathian Basin for the period MIS 22-24.

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Keywords: loess-palaeosol sequences, Malaco- thermometer, environmental archive, MIS 22-24, Stari Slankamen, North Serbia

Downstream change of quartz luminescence sensitivity and the rearrangement of OSL components along large rivers, a case study from the Pannonian Basin

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Nowadays, the possibility of determining the source and origin of quartz grains within sediments using luminescence methods is widely accepted. However, the sensitivity of a quartz grain cannot be considered constant, as numerous factors beyond its origin can influence it, such as the number of sediment cycles. A more detailed understanding of the factors influencing sensitivity is essential in order to expand and specify the applicability of the parameter in sediment sourcing. In our study, we examined the spatial changes of coarse grain quartz sensitivity in modern sediments of the largest rivers of the Carpathian Basin: the Danube and the Tisza. In order to do this, we measured and compared several different sensitivity parameters, such as CW-OSL, Total LM-OSL, TL110 °C, and the fast, medium, and slow components of the LM-OSL signal. In addition, we stimulated the samples through artificial laboratory-induced irradiation and bleaching cycles, thereby examining the effect of sedimentary cycles occurring in nature on sensitivity. Comparing the average sensitivity values of the samples, the Tisza sediments exhibit higher values than the Danube sediments for all the sensitivity parameters studied, except for the LM-OSL medium component. In the evolution of sensitivity in Tisza sediments, the tributaries play a dominant role, while in the case of Danube samples, the erosion of presu-

mably less sensitive Pleistocene sediments and their mixing with recent fluvial sediments are likely determining factors. In both the Tisza and Danube cases, the LM-OSL fast component shows an increase downstream. Beyond changes in sensitivity parameters, we also observed transformations in the proportions of certain components of the LM-OSL signal. Additionally, there were differences in the sensitization of Danube and Tisza sediments.

Keywords: luminescence sensitivity, fluvial sediments, LM-OSL components, coarse grain quartz

Corridors of interaction in the Balkans

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The Balkan Peninsula, at the crossroads of the main migratory corridors into and out of Europe, represented an ideal setting for hominin migration, refuge and interaction throughout the Pleistocene. Its growing hominin fossil record, when reviewed in a regional context, shows chrono-spatial patterning that allows us to hypothesise possible repeated interactions among different resident and migrating populations. New Palaeolithic research in the Balkans demonstrates that the area played an important, albeit complex and yet- to- be understood, role in the interaction among archaic hominins. Purported interlocked presence of two different lineages in the Chibanian -- a possible *Homo bodoesnis* at Mala Balanica and Neanderthals in the adjoining Velika Balanica, early evidence of *Homo sapiens* in Apidima, admixed morphology of Petralona and morphological signal of admixture in Krapina as well as demonstrated contact between the Balkans and the southwest Asia -- all indicate much more dynamic population interactions in the Palaeolithic than previously envisaged. Late Pleistocene migrations of modern human and their demonstrated interactions and interbreeding with Neanderthals in the Balkans, thus represent the continuation of the pattern, rather than a unique event.

Keywords: *Homo bodoesnis, Homo sapiens*, Mala Balanica, Neanderthals

Meltwater Pulse1A Triggered an Extreme Cooling Event: Evidence From Southern China

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It is generally accepted that large quantities of meltwater injected into the ocean is reducing Atlantic Meridional Overturning Circulation and will cause a significant cooling event in the Northern Hemisphere. However, it was not a cooling event that coincided with Meltwater pulse1A, the largest freshwater injection of the Late Quaternary, but the abrupt Bølling warming event. This paradox is still debated because so far no cooling event coinciding with Meltwater Pulse 1A has been found in paleoclimatic records. This is mainly due to the lack of suitable proxy and high-resolution records in high northern latitude regions. Here we reconstruct winter temperature based on sedimentary diatoms from Huguangyan Maar Lake in tropical China. The results show that winter temperature dropped by at least 6°C within ~100 years at 14.8 ± 0.02 ka BP, coeval with the onset of Meltwater Pulse 1A, within dating uncertainty. We argue that Meltwater Pulse 1A weakened the Atlantic Meridional Overturning Circulation (AMOC), resulting in abrupt severe cooling in the Northern Hemisphere that caused a severe winter temperature drop in East Asia by strengthening the winter monsoon. We propose that extreme cooling in winter temperature triggered the Bølling warming by stopping the freshwater release from the ice-sheet, triggering the AMOC to recover quickly and causing the Bølling event as an overshoot under gradual forcing.

Keywords: Huguangyan Maar Lake, Atlantic Meridional Overturning Circulation, China

Integrating Geoethical Principles for Sustainable Management of Subterranean and Surface Karstic Geoheritage

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Karstic landscapes, distinguished by intricate geological formations and diverse ecosystems, introduce a distinctive challenge in harmonizing subterranean exploration with surface conservation within the context of geotourism. This abstract delves into the integration of geoethical values as an overarching framework for fostering responsible and sustainable management of subterranean and surface karstic geoheritage. This inquiry firstly encompasses a holistic geoethics framework, which includes a comprehensive model for integrating geoethical considerations, spanning both subterranean and surface dimensions of karstic landscapes, with the aim to facilitate a unified approach to ethical decision-making in geotourism management. Moreover, the ethical conundrum of balancing the promotion of subterranean exploration with the preservation of surface ecosystems is thoroughly examined, with geoethical principles explored as instrumental guides for reconciling these contrasting objectives. Educational and cultural initiatives, innovative educational initiatives and cultural engagement strategies are dissected for their role in nurturing geoethical awareness, playing a pivotal role in cultivating a conscientious and informed approach to preserving subterranean and surface karstic geoheritage. Thus, this paper will contribute to interdisciplinary discourse encompassing geoscientists, conservationists, tourism practitioners, ethicists, and cultural experts. By delving into the intrinsic interplay of subterranean and surface realms, encapsulated by the adage "as above, so below," this exploration advances comprehension of ethical imperatives that underpin the enduring vitality of karstic geoheritage. Ultimately, this inquiry underscores the paramount significance of fostering a geoethical consciousness to ensure the perpetuation of these extraordinary geological and ecological landscapes through responsible and sustainable practices.

Keywords: karst geoheritage, geoethics, geotourism.

Determination of changes in the total amount of precipitation using the Mann-Kendall trend test in Central Serbia for the period from 1949 to 2018

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This study presents the trend analysis for a specific category of variables, namely the average annual precipitation (YP). The geospatial distribution of the obtained results in Central Serbia is visualized using Geographic Information System (GIS) numerical analysis. The primary objective of this study is to identify potential changes in the trends of average annual precipitation within the observed area. Methodologically, the Mann-Kendall (M-K) trend test, trend equation, and trend magnitude were employed for trend analysis. The data used for the analysis were sourced from the Meteorological Yearbooks of the Republic Hydrometeorological Service of Serbia, encompassing a total of 24 meteorological stations and spanning the period from 1949 to 2018. Each of the analyzed time series was identified with a corresponding acronym, consisting of the station's abbreviation, the year, and the variable type. Based on the obtained results, statistically significant positive trends were observed in 17 time series, favoring the alternative hypothesis (Ha). Conversely, a decline in precipitation was noted in the remaining 7 time series. Among the time series, the largest increase in the total amount of precipitation over the past 69 years was recorded in the Zl-P series, with a value of 233.3 mm, followed by the SJ-P series (167.6 mm) and the SP-YTn series (107.0 mm). Conversely, the lowest increase in average precipitation, at 10.7 mm, was observed in the BG-P series, followed by the KZ-P series (28.2 mm) and the KS-P series (30.4 mm). Furthermore, the time series with the greatest decrease in average annual precipitation was NG-P, with a decrease of 43.9 mm, followed by the BU-P series (-43.6 mm) and the VR-P series (-14.7 mm). In order to effectively address water-related challenges associated with precipitation fluctuations, it is essential to gain a comprehensive understanding of the shifting trends in precipitation over the region of Central Serbia.

Keywords: climate change, precipitation variability, Central Serbia, average annual precipitation trends, Mann-Kendall trend test, GIS

Wrong investment? Climate prediction of snow free ski resort on Stara planina, Serbia

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Stara planina is the highest mountain in Eastern Serbia, which is why it was heavily degraded for the development of the ski center "Babin zub". Although the highest point of the mountain is Midžor at 2169 m above sea level, the highest point of the ski center is at 1757 m above sea level. The consequences of the ski center on Stara planina were already visible after its opening in 2006. The deterioration of the soil and vegetation in the area of the ski center was noted in the last decade (Ristić et al., 2012). The ski center consists of slopes at the locations "Konjarnik", "Sunačana dolina" and "Markova livada". It has a four-person cable car "Konjarnik" with a conveyor belt for transporting skiers, with a capacity of 1400 skiers per hour, and a ski lift "Sidro" and "Sunčana dolina" with a capacity of 1200 skiers per hour. More than 13 km of groomed trails are available to skiers of all categories. A system of artificial snowmaking was built so that visitors can enjoy winter sports in the absence of natural snow. Even if the tracks are shifting location due to severe surface erosion, the question of the appropriate winter climate in the future remains. How often will artificial snow be used and is it effective? Regional climate models could provide the answer. In this study, we present daily maximum temperatures from 2024 to 2100 based on three representative concentration paths (RCPs): 2.6 (one regional climate model (RCM)), 4.5 (three RCMs), and 8.5 (three RCMs). These were obtained for 3 coordinates which correspond to the current hypsometry of the ski center at Stara planina. All models are bias corrected. Here we emphasize that temperatures above 0°C are a threat to the ski season, which was analysed from November to March. In a 2.6 "world", only one RCM exists for the studied area, and it shows the best conditions for the ski center, as there is the highest probability of negative temperatures in January by the end of this century. In a 4.5 "world" there is hardly any probability for snow accumulation during the ski season, with January being the coldest month. However, in the 8.5 "world", snow accumulation is probable only in the next ten years in January, and it is not existing towards the end of the century. All RCMs agree that November and March will have positive maximal daily temperatures by 2100, eliminating the opportunity for skiing. Current regional climate models indicate that investing in a ski center on this mountain may not have been the best idea.

Keywords: Stara planina, Regional climate model, Serbia, Skiing, Daily maximum temperature

References:

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Dust mass accumulation rates calculated for the Surduk loess profile, Serbia

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Normally, the measurement limit for luminescence analysis of quartz is 50-70 ka with the most widely used single aliquot regeneration (SAR) protocol, consequently, the dating of MIS 3 and MIS 4 samples or older is problematic using quartz. However, recent studies propose that the sensitivity-corrected multiple aliquot regenerative dose (SMAR) measurement technique has the potential to extend the dating limit as far back as 130 ka, making quartz luminescence applicable even for MIS 5 sediments. In our study the dust mass accumulation rate (MAR) of the L1 loess layer in the Surduk loess profile was investigated with the SMAR luminescence measurement technique. In the ~14 metres thick L1 layer samples were collected at every 20 cm. This high-resolution sampling can provide a good basis to build up a more reliable age-depth model for MAR calculation. To validate the quartz SMAR ages, the polymineral fraction of samples was subjected to post-infrared-infrared ($pIR_{50}IR_{290}$) measurements at ~1 meter intervals. Based on our results we propose, therefore the application of the quartz SMAR protocol when establishing age models for the LGP in the Surduk loess profile. Later, the MAR values combined with the grain size analyses and other proxies can provide valuable information for detailed paleoenvinromental reconstructions in the region.

Keywords: quartz luminescence, Surduk, SMAR protocol, loess

Risk Evaluation by Using High-Resolution Geophysical Techniques along the Artificial Levee of Tisza River (Hungary)

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Artificial levees along alluvial rivers are major components of flood-risk mitigation. This is especially true in the case of Hungary, where more than one-third of the country is threatened by floods and protected by an over 4200-km-long levee system. Most of such levees were built in the 19th century. Since then, several natural and anthropogenic processes, such as compaction and erosion, might have contributed to these earth structures' slow but steady deformation. Meanwhile, as relevant construction works were scarcely documented, the structure and composition of artificial levees are not well known. Therefore, the present analysis mapped structural differences, possible compositional deficiencies, sections where elevation decrease is significant along a 40-km section of the Lower Tisza River and evaluating the related risk. Investigations were conducted using real-time kinematic GPS, ground-penetrating radar (GPR), Electrical Resistivity Tomography (ERT) and drillings. Information obtained by the different techniques was cross-checked and combined. Onsite data acquisition was complemented with an analysis using a Persistent Scatterer Synthetic Aperture Radar to assess general surface deformation. GPR profiles showed several anomalies, including structural and compositional discontinuities and local features. The GPR penetration depth varied between 3 and 4 m. According to height measurements, the mean elevation of the levee crown decreased by 8 cm in 40 years. However, the elevation decrease reached up to 30 cm at some locations. It was possible to capture structural changes and resolving the thin layers by 1 m electrode spacing ERT profile. In turn, at a larger spacing it was possible to get information on the sedimentary base below the levee body. The selected levee section could be assessed in terms of its structure and composition and the major units within the levee body and their composition could be resolved by the applied methods. Sections affected by structural anomalies, compositional changes, and increased surface subsidence are especially sensitive to floods when measurement results are compared with flood phenomena archives.

Keywords: Tisza River, levee health, GPR, ERT, Drillings, surface deformation, flood-risk.

The model of resistance of the local community of Bar municipality to earthquake hazards

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The subject of the research work refers to the examination of the influence of certain physical-geographical and social-geographical characteristics on the resistance of the local community in the municipality of Bar to disasters caused by earthquakes. Through research, we can find out which factors affect the resilience of the local community, as well as the implementation of certain strategies in order to influence the improvement of the situation in that area. The goal of the research is to recognize the elements that affect the level of danger of local communities in the event of a disaster caused by earthquakes, as well as creating prerequisites for the development and implementation of various platforms that will have an impact on improving the situation in that area. Based on the results of preparedness for disasters in the event of danger, which we will receive through survey research from citizens, we can contribute to improving the resistance to natural disasters of the local community in the municipality of Bar, which is one of the most seismically vulnerable municipalities in the territory of Montenegro. Also, the results can be used for further research, as well as by municipal and state authorities, local communities, as well as citizens themselves for the purpose of improving response in case of natural hazards and disasters caused by earthquakes.

Keywords: geotectonics, earthquake, local community, geohazards, resilience

Determinants influencing tourists' willingness to visit Türkiye – influence of earthquake hazards on Serbian tourists

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Earthquakes are a complex natural phenomenon that cannot be prevented, and their effects can be catastrophic and have profound implications on various economic sectors (including tourism). This study investigates the relationships between subjective factors (gender, age, education, income, previous experience, and disaster anxiety), the perceived travel risk, and the travel intention of tourists from Serbia to destinations in Türkiye. The pilot study was done in March 2023 with 110 students from the Faculty of Science, Department of Geography, Tourism, and Hotel Management, Novi Sad. After the validation of the instruments, the main survey was conducted in the period from March to June 2023. The subjects of interest were residents of Serbia over the age of 18. The data from this study will be analyzed using the CFA and Path analyses. This study will expand knowledge on perceived risk and travel intention, with a focus on Türkiye. Since hazards from earthquakes can be multi-dimensional, geographical modeling and analysis via GIS environment will be employed for deriving a risk map of perceived travel risk vulnerability exposure to seismic hazard in a given case study area. Thus, this study may provide a conceptual foundation for both theoretical and practical implications for the improvement of risk management techniques at a specific travel destination in areas prone to earthquake hazards.

Keywords: subjective risk factors; perceived travel risk; earthquake hazards; Türkiye; Serbian tourists; risk management

Analysis of land sensitivity and degradation by applying MEDALUS model in two Mediterranean catchments (Middle Atlas of Morocco)

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Land degradation is a pervasive phenomenon on a global scale that ultimately results in a decline of soil fertility. Across expansive regions of the globe, soils face the threat of diminished biological productivity and resilience, driven by a combination of natural forces and human activities. The aim of this paper is to analyse and assess the sensitivity of land degradation using the MEditerranean Desertification and Land Use model (MEDALUS) within two different catchments from the Atlas mountainous of Morocco. Situated within the Middle Atlas of Morocco, the chosen catchments located in the Ouaoumana basin, The Tiguert and the Wanmroud catchments (i.e < 10 km^2) are a small mountainous area characterized by Mediterranean climate with mountainous influence. The annual rainfall average ranged between 300 to 500 mm at Dcher El Oued gauging station. The climatic data and field investigations were analysed to characterize four indexes of soil quality, climate, vegetation, and land management. The obtained findings reveal a significant degradation of land in both studied catchments. In both catchments land classified as fragile and very sensible to degradation due to dynamic of land uses and lithology types.

Keywords: Land degradation, sensitivity, MEDALUS model, GIS, Tiguert and Wanmroud catchments; Middle Atlas of Morocco

Variability of Holocene dust dynamics in the Carpathian and Wallachian Basin

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Fine-grained windblown deposits (loess) in which fossil soils (palaeosols) are preserved are excellent records of past climate. However, so far paleoclimate reconstruction studies conducted on such loess-palaeosol sequences (LPS) in SE Europe were focused on the climate changes of the last one or two glacial-interglacial cycles, while almost no attention has been directed to the climate of the current interglacial, the Holocene. This is probably since, according to ice core and marine isotope records, the Holocene is considered a climatically stable period and because LPS with well-preserved Holocene loess have been lacking, until now. Three newly discovered loess-palaeosol sequences in the Eastern Carpathian and Wallachian Basin display fully preserved Holocene loess and thus have the potential to reveal new and detailed information about the Holocene climate. Here, we present initial results of two of these LPS: Kisiljevo (44°44'0" N and 21°25'0" E) in north-eastern Serbia (Carpathian Basin) and Velika Vrbica (44°35'1.70"N, 22°43'15.97"E) in eastern Serbia (Wallachian Basin). For both sequences, detailed OSL chronologies using 63-90 μm quartz have been constructed. The calculated OSL ages were modelled using the r.bacon software (Blaauw & Christen, 2011) after which dust accumulation rates (MAR) for the last ~30 ka were calculated. The initial results at Kisiljevo reveal a considerable loess accumulation during the Holocene (~120 cm). The highest MARs were observed between 10 and 12 ka (~10 000-8 000 BC) with a mean value of 148 g m2 a-1. At the Velika Vrbica LPS, a similar trend is evident. The average calculated MARs during the early Holocene (8 – 11.7 ka) were 189 g m^2 a^{-1}, showing a decreasing trend towards the later part of this period (8 – 3.1 ka) with average values reaching 132.1 g m^{-2} a^{-1}. Interestingly, at this site, the mean MARs during marine isotope stage 1 (MIS) were higher than during the cold, stadial MIS 2, where the recorded values averaged 177 g m^{-2} a^{-1}. These initial results indicate that the Holocene climate in this region was more variable than what the generally accepted models suggest.

References: Blaauw & Christen (2011). Flexible paleoclimate age-depth models using an autoregressive gamma process.

Keywords: Holocene loess, Kisiljevo, Velika Vrbica, Serbia

Geotouristic approach to the elements of geocultural heritage: UNESCO site Felix Romuliana (Zaječar, Serbia)

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This paper aims to emphasise the geotourism potential of the geocultural site Felix Romuliana. Geoheritage elements of the UNESCO cultural site Felix Romuliana, near Zaječar, were evaluated by using the newly proposed Urban Geoheritage Assessment Model (UGAM). This study also applied macroscopical mineralogical-petrological analysis to determine rock types used at Felix Romuliana in order to support UGAM. The obtained results indicate a significant petrographic diversity, such as igneous (hornblende andesite, red porphyry), sedimentary (lumachella, sandstone), volcaniclastic (volcaniclastic sandstone) and metamorphic (marbles) rocks. This is of great importance for the interpretation of urban geoheritage. In addition, subindicators for the accessibility and promotion are rated with highest grade. However, some shortcomings are also revealed, especially related to the interpretation of geoheritage of the site. Moreover, geoscientific content on information boards is missing. Also, low level of geoscientific knowledge of tour guides is a big drawback. In total, Felix Romuliana has a notable geoeducational potential which is still not utilised. The future tourism strategy of the site should consider the inclusion of geoheritage values into new tourism offers. The results of this study can help policy makers, local government and all other interested stakeholders to develop urban geotourism in Zaječar, and to attract a larger number of tourists in upcoming times.

Keywords: Felix Romuliana, Urban Geoheritage Assessment Model, Serbia

Agronomical, Environmental and Societal Value of Chernozem in Vojvodina Region, Northern Serbia

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Soil is the basis and essence of all terrestrial life. Chernozem is steppe soil developed in conditions of dry continental climate, steppe vegetation and calcareous parent material. Recent analysis presented wide range of period for chernozem formation in Europe, from Late Glacial to the Early Holocene. Favorable physical, chemical and microbiological properties bring to chernozem high agronomic potential. With dark brown to black color humic horizon mostly 60 to 80 cm depth, high-quality humus, loamy texture, high base saturation, stabile aggregates and certain $CaCO_3$ content chernozem looks like ideal soil. Although, chernozem is considered as one of the most fertile soils its resilience to degradation is not on the highest level. Thus, chernozemic zone is partially limited as a foundation for sustainable intensification of agriculture. Exposed to the long-term intensive conventional agriculture in Vojvodina Region in the last decades, chernozem showed signs of degradation. Leaching of carbonates, compaction, soil organic matter decrease and structure deterioration lead to unfavorable air-water regime. In order to stop unwanted processes and desertification in chernozemic zone, human activities should concentrate to good practice in water, nitrogen and phosphorous management, organic fertilizers and reduced tillage.

Keywords: Chernozem, Soil, Agriculture, Vojvodina

Topological considerations in sandstone diagenesis and loess deposit formation: Arbitrary curve and mathematical models

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At the moment of deposition an ideal particulate sediment has certain topological properties. In the case of sandstones the diagenetic process is driven by the reduction of surface area and this process can be considered in relation to the topological properties, with a view to identifying key moments in the process. The connectivity and genus increase as cementation occurs and in some systems may decrease again. Relations between genus, density, depth of burial and time are considered for a sand-sandstone-quartzite system. The Rhines-Smalley process model is applied and modified.The situation for a loess deposit is more complicated. In the ideal deposit quartz particles fall to form a characteristic packing structure. A form of diagenesis may occur, sometimes called loessification, which modifies the particle contact environments, and may be describable in topological terms. In the sandstone system the silica material is redistributed to change the genus; in the loess system materials are added to change the nature of the particle contacts and possibly change the topological nature. The change in the nature of the particle contacts is absolutely critical in determining the properties of loess and the application of topological ideas may be useful in clarifying the nature of the stages in the loessification process. Also this may allow the study of the process whereby 'old' loess is formed; an unrecognized and underdeveloped frontier in loess research concerns the nature and formation of pre-Quaternary loesses, possibly of great age; almost certainly classified as siltstones, it would be useful to detect their loessic characteristics and determine the ultimate stages in their formation processes. For the description of the process of loess diagenesis, several models have been proposed. In the basic model is presented as a graph of arbitrary curve for changes non-dimensional fractal density in the time. Other models were mathematically; analytically and numerically. The best result is obtained using the approximation by 51st degree polynomial.

Keywords: sandstone diagenesis, loess, loessification, topological concepts, genus, connectivity, old loess, arbitrary curve, analytical model, numerical model