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(Editors)

Current status and new challenges in geomorphological research

The 35th Romanian Symposium on Geomorphology

May 23-26, 2019, Timişoara, Romania

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Content

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Conference programme

Thursday **May 23rd, 2019** ***Young Geomorphologists Workshop***	
08.00 – 12.00	Registration and oral presentations
12.00 – 13.00	Lunch
13.00 – 18.00	Field application
18.30	Dinner
Friday **May 24th 2019**	
08.30 – 09.30	Registration
09.30 – 10.00	Conference opening, welcome speeches
10.00 – 16.30	Scientific sessions - oral presentations
16.30 – 18.30	General Assembly of Romanian Association of Geomorphologists; discussions, elections
16.30 – 18.30	Geo-walk tour through the historical center of Timi□oara
18.30	Dinner
Saturday **May 25th 2019**	
08.30 – 09.30	Registration
09.30 – 15.30	Scientific sessions – oral presentations
16.00 – 17.30	Poster session
17.30 – 18.00	Closing of conference, concluding remarks
18.30	Festive Dinner
Sunday **May 26th 2019**	
08.00 – 19.00	Field trip to Muntele Mic

Conference detailed programme

Thursday, May 23rd, 2019

Young Geomorphologists Workshop

Room 137, 1st Floor, WUT main building

08:00 – 09:00	Registration
09.00 – 09.30	Object-oriented analysis for landform mapping *Lucian Drăguț (West University of Timişoara)*
09:30 – 10:00	Ultra mobile 3D scanning solutions for generating a digital terrain model *Claudiu Toma (Blacklight)*
10:00 – 10:30	IAG opportunities and events for young geomorphologists *Mihai Micu (Institute of Geography, Romanian Academy of Science)*
10.30 – 10.45	Coffee break
10.45 – 11.15	To date or not to date? Practical guidelines for the application of Optically Stimulated Luminescence (OSL) in geomorphological studies *György Sipos (University of Szeged)*
11.15 – 11.45	Geoscience methods for archaeological research *Alexandru Hegyi (West University of Timişoara)*
11.45 – 13.00	Lunch
13.00 – 18.00	Field trip application in Maşloc "Șanțul Turcilor" site *Petru Urdea, Alexandru Onaca, Alexandru Hegyi (West University of Timişoara)*
18.30	Dinner

Friday, May 24th, 2019

Amphitheater A01, Ground Floor, WUT main building

08:30 – 09:30	Registration
09.30 – 10.00	Opening ceremony; welcome speeches
	Session 1 – oral presentations Chairmans: Lucian Drăguț, Mihai Niculiță
10.00 – 10:30 **Keynote speech**	The erosion of glaciated mountains ***Ian S. Evans***
10:30 – 10:45	The reservoir bottom gullies from Jijia-Bahlui Depression *Mihai Niculiță, Mihai Ciprian Mărgărint, Nicuşor Necula, Paolo Tarolli, Valeriu Stoilov-Linu, Silviu Costel Doru, Georgiana Văculişteanu*
10.45 – 11.00	The morphogenetic and typological complexity of landslides in Vrancea seismic region and its implications in hazard assessment *Mihai Micu, Dănuț Călin*
11.00 – 11.15	Integration of A-DInSAR techniques and slope stability analysis for investigation of landslides dynamics *Nicuşor Necula, Mihai Niculiță, Mario Floris, Rinaldo Genevois*
11.15 – 11.45	Coffee break
	Session 2 – oral presentations Chairmans: Petru Urdea, Dan Dumitriu
11.45 – 12.15 **Keynote speech**	Late Pleistocene linkages between glacial, fluvial and aeolian processes in the SE Carpathian Basin ***György Sipos,*** *Petru Urdea, Tímea Kiss, Slobodan Markovic, Zsófia Ruszkiczay-Rüdiger*
12.15 – 12.30	A deterministic-based approach on landslide susceptibility. Case study: The Subcarpathian Prahova Valley *Iuliana Armaş, Mihaela Gheorghe, George Cătălin Silvas*
12.30 – 12.45	Channel forming discharge in rivers: a case study of Trotuş River (Romania) *Dan Dumitriu*
12.45 – 13.00	Fluvial adjustments to Late Quaternary climatic changes in Someşul Mic drainage basin, NW Romania *Ioana Perşoiu, Aurel Perşoiu, Florin Borbei*
13.00 – 14.45	Lunch
	Session 3 – oral presentations Chairmans: Iuliana Armaş, Ioana Perşoiu
14.45 – 15.15 **Keynote speech**	Semi-automated mapping of landslides ***Lucian Drăguț***

15.15 – 15.30	Multiscalarity in landslide susceptibility, hazard and risk assessment *Mihai Ciprian Mărgărint, Mihai Niculiță*
15.30 – 15.45	New insights on fluvio-marine interactions at wave-influenced river mouths *Florin Zăinescu, Alfred Vespremeanu-Stroe, Edward Anthony, Florin Tătui, Luminița Preoteasa*
15.45 – 16.00	Putting in regional context the dynamic status of rock glaciers from Southern Carpathians *Răzvan Popescu, Alfred Vespremeanu-Stroe, Nicolae Cruceru, Mirela Vasile*
16.00 – 16.30	Coffee break
16.30 – 18.30	General Assembly of Romanian Association of Geomorphologists; discussions, elections
16.30 – 18.30	Geo-walk tour through the historical center of Timişoara (with Ludovic Satmari from Timişoara City Tours)
18.30	Dinner

Saturday, May 25th, 2019

Amphitheater A01, Ground Floor, WUT main building

08:30 – 09:30	Registration
	Session 1 – oral presentations Chairmans: Mircea Voiculescu, Olimpiu Pop
09.30 – 10.00 **Keynote speech**	Improving climate change adaptation and disaster risk reduction through geomorphology ***Daniel Germain***
10:00 – 10:15	Natural hazards and disappeared settlements in NE Romania *Văculişteanu Georgiana, Mihai Niculiță, Mihai Ciprian Mărgărint*
10.15 – 10.30	Linking snow-avalanche activity and snowpack persistence in low-elevation areas of Maramureş Mountains (Eastern Carpathians, Romania) *Olimpiu Pop, Mihai Hotea, Vasile Timur Chiş*
10.30 – 10.45	Coastal Sensitivity of the Black Sea Coasts to Erosion and Flooding Hazards *Florin Tătui, Marius Pîrvan, Mădălina Popa, Burak Aydoğan, Berna Ayat Aydoğan, Tahsin Görmüş, Dmitry Korzinin, Florin Zăinescu, Alfred Vespremeanu-Stroe, Sergey Kuznetsov, Nataşa Văidianu, Luminița Preoteasa, Margarita Shtremel, Yana Saprykina*
10.45 – 11.15	Coffee break

	Session 2 – oral presentations Chairmans: Mihai Micu, Alexandru Onaca
11.15 – 11.45 **Keynote speech**	Crumbling Alps? Permafrost and periglacial dynamics in Austria under the influence of climate change ***Andreas Kellerer-Pirklbauer***
11.45 – 12.00	Aspects of internal structure and characteristics of the earth hummocks of Muntele Mic *Petru Urdea*
12.00 – 12.15	Permafrost characteristics in marginal periglacial environment of Rila and Pirin Mountains *Alexandru Onaca, Mircea Voiculescu, Florina Ardelean, Petru Urdea, Emil Gachev, Brigitte Magori Alexandru Hegyi, Flavius Sîrbu, Mihai Băbănaş*
12.15 – 12.30	Geomorphological restitutions: Moldavian Plain and Transilvanian Plain *Mihai Niculiţă*
12.30 – 14.15	Lunch
	Session 3 – oral presentations Chairmans: Sandu Boengiu, Mihai Ciprian Mărgărint
14.15 – 14.30	The complex Upper Pleistocene landslide from Coste□ti (Iaşi County) – dating and characterization *Mihai Niculiţă, Mihai Ciprian Mărgărint, Chiriloaiei Francisca, Nicuşor Necula, Valeriu Stoilov-Linu, Silviu Costel Doru*
14.30 – 14.45	The sediment fluxes from Bistricioara catchment (Eastern Carpathians) *Valeriu Stoilov-Linu, Mihai Niculiţă, Dan Dumitriu*
14.45 – 15.00	Examining thermal conditions of low-altitude cold scree slopes at Detunata Flocoasă (Apuseni Mountains) *Mihai Băbănaş, Petru Urdea, Patrick Chiroiu, Fabian Timofte, Alexandru Hegyi, Alexandru Onaca*
15.00 – 15.15	Toward a snow avalanche inventory based on satellite images, historical data and field observations in Southern Carpathians *Marcel Török-Oance, Mircea Voiculescu, Florina Ardelean, Anişoara Irimescu, Narcisa Milian*
15.15 – 15.45	Coffee break
15.45 – 17.30	Session 4 – posters Chairmans: Nicolae Cruceru, Florina Ardelean
	What can tree rings tell us about the headcut retreat of Groapa Ruginoasa gully system? *Ramona Chelaru, Olimpiu Pop, Andrea Gál, Zsuzsa Borbándi, Judit Ilona, Hunor Lengyel, Péter Kacsó, Szilárd Kanyó, Ákos Szabó*

	Assessment of damages caused by landslides. Case study: Seciurile village (Gorj) *Gilda Ciorecan, Sandu Boengiu* The reconstruction of the climate and the avalanches in the Southern Carpathians, based on the isotopic composition of δ 18O and δ2H in precipitations and rivers and the isotopic composition of δ 18O in tree rings *Renata Feher, Mircea Voiculescu, Aurel Perşoiu, Patrick Chiroiu* Tree-ring dating of snow avalanches in Rodna Mountains National Park *Ionela Georgiana Gavrilă, Flaviu Meseşan, Cosmin Timofte, Cristina Trifan, Olimpiu Pop* Short-term changes in evolution of the Pâclele Mari mud volcano *Andrea Gál, Judit Ilona, Zoltán Imecs, Péter Kacsó, Szilárd Kanyó, Ákos Szabó* Landforms and landscape variety in the Romanian Plain.Identification and typology *Florina Grecu, Gabriela Ioana-Toroimac, Iulian Săndulache, Mihaela Verga, Sorin Carablaisă, Robert Dobre, Cristina Ghiță-Petre, Mădălina Teodor* Assessment of hiking trails and associated risks in Bucegi Mountains *Mihai Jula, Mircea Voiculescu* Evaluating geomorphosites and geomorphological processes that impact them. Case study: Cozia Massif *Adriana-Bianca Ovreiu, Iulian-Andrei Bărsoianu, Laura Comănescu, Alexandru Nedelea* The morphological role of the Timiş Valley on the pattern of inhabiting in prehistory *Sorin Hadrian Petrescu, Maria Hosu* Effects of aridization on land use in the west of Oltenia plain *Cristian Răducă, Lavinia Crişu, Sandu Boengiu* Landslide susceptibility assessment using the AHP method in the Central Development Region of Romania *Sanda Roşca, Dănuț Petrea, Ştefan Bilaşco, Iuliu Vescan, Ioan Fodorean, Sorin Filip*

	Morphometrical analysis on the glacial cirques of the Făgăraş Mountains. Case studies *Andreea Andra-Topârceanu, Mihaela Verga* Soil erosion exerted by water within Băileşti Plain *Andreea-Gabriela Zamfir, Lavinia Crişu, Sandu Boengiu*
17.30 – 18.00	Closing of conference, concluding remarks
18.30	Festive Dinner

Sunday, May 26th, 2019

Field trip Muntele Mic

08.00 – 19.00	Field trip to Muntele Mic

Book of abstracts

The erosion of glaciated mountains

Ian S. Evans

Durham University, U.K.

There are many differences between glaciated and unglaciated mountains, but how are these differences best expressed quantitatively? One way is to define and measure the specific landforms – cirques, arêtes, troughs and closed rock depressions – that characterize glacial erosion. Another is to take a whole mountain range and measure its distributions of altitude, slope and curvature. Frequency distributions of altitude (hypsometry) and gradient (clinometry) alone do not seem adequate. Taking these two variables together – hypsoclinometry, plotting slope gradient against altitude – is more promising. Mean or median slope is not sufficient, as glaciation produces gentle and reversed slopes as well as extra steep slopes. It is necessary to plot frequency distributions of slope gradient at different altitudes: this is exemplified for mountain ranges in Romania, England and British Columbia. Variation in slope, and frequencies of extremely high or low slope gradients, are the most promising indications of glacial modification. Thus it is possible to rank mountain ranges by degree of glacial modification.

The definition of specific landforms is progressing but remains subjective. In some areas it is difficult to distinguish shallow glacial cirques from deep-seated rock slope failure scars, whose deposits may have been removed by glaciation. Glacial troughs are more difficult to define: an inverted parabola (U-) shape is characteristic but alluvial valley-floors muddy the distinction from fluvial valleys and make fitting a model to the bedrock surface problematic. Deposits in cirques are less of a problem, and size and shape variables can now be calculated objectively given a cirque outline. Cirques in Romania are larger than those in the English Lake District, but smaller than those in Wales, Ireland, Scotland and certain British Columbian ranges. Duration of glaciation can be estimated from cirque location and size combined with reconstructions of palaeoclimate.

Improving climate change adaptation and disaster risk reduction through geomorphology

Daniel Germain

Department of Geography, Université du Québec à Montréal, Canada,
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Ensuring science is useful, usable and used in global Disaster Risk Reduction and Climate Change Agreements, as well as for the Sustainable

Development Goals. For example, the recently adopted United Nations' Sendai framework on Disaster Risk Reduction 2015-2030 has a much greater emphasis on science compared with other global policy frameworks. Indeed, it is built and based on the idea that science is more than a key factor, it is even essential for effective policy-making to improve lives, livelihoods, health, and for a sustainable and safe development of territories. In that regards, geosciences and particularly geomorphology appear as a corner stone of environmental approaches that can be used to greatly improve the well being of our societies. Defined as the science of landforms with an emphasis on their origin, evolution, form, and distribution across the physical landscape, the potential of geomorphology remains underestimated to deal with all the ongoing and upcoming global challenges that humanity as to face off. Therefore, through this presentation I propose to demonstrate the usefulness of geomorphology and its scientific contribution to the identification, management and prevention of natural hazards and risks from many theoretical and practical examples at various spatiotemporal scales.

Crumbling Alps? Permafrost and periglacial dynamics in Austria under the influence of climate change

Andreas Kellerer-Pirklbauer

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The global cryosphere is massively changing at present related to the effects of present climate change. Glaciers, as one major element of the cryosphere, are rather easy to recognize, to delineate and to monitor by mapping the spatial extent using remote sensing data indicating rapid glacier recession as for instance revealed for Austria. Subsequent nation-wide glacier inventories and the glacial monitoring program of the Austrian Alpine Club show extreme recent changes. Glaciers, but also permafrost are, however, still typical landscape elements in alpine Austria. Whereas the former of the two is in most cases clearly visible in the landscape the latter is certainly not. Permafrost can only get quantified using spatial numerical models which are normally based on rather few field data within a modelling domain. Based on a recent Alpine wide permafrost model, some 1600 km² of Austria's mountain environment (or 1.9% of the entire country) is presumably underlain by permafrost. In contrast to glaciers, knowledge regarding permafrost changes in terms of spatial extent and temperature during the recent past in Austria is nevertheless very limited related to missing multi-decadal permafrost temperature data. Document changes in the mean annual ground surface and

near surface temperature at alpine sites in Austria act, however, as valuable proxy data for permafrost changes. Such ground temperature data series (starting in 2006 and initiated by the author) indicate a clear trend suggesting a general and Austrian-wide, high-altitude ground surface warming and hence permafrost warming and degradation. This significant change in alpine permafrost has a severe influence on the periglacial dynamics in different substrates as in solid bedrock, in fine-grained material or in coarse-grained blocky deposits. Changes in the thermal regime in bedrock influence freeze-thaw cycles, the time within the frost cracking window and consequently weathering processes. This might lead even to massive rock fall events potentially threating mountaineers (e.g. a large rock fall event in 2007 at Mittlerer Burgstall, near Pasterze glacier) and help to shape the reputation that the Alps are in a crumbling mode. Changes in thermal conditions in fine-grained substrate influence solifluction rates and landforms as shown for several sites in the Hohe Tauern National Park in central Austria. Changes in the ground climate of coarse-grained sediments such as rock glaciers influence its velocities, its mode of movement and even its stability conditions potentially causing thread to humans and environment. Observations and measurements regarding all these changes form the essence of this contribution.

Progress in reconstruction of Holocene fluvial activity of the Romanian Carpathian rivers

Maria Rădoane

Ştefan cel Mare University, Suceava, Romania

This study marks the first instance when a database comprising numerical ages of fluvial deposits of rivers draining the Romanian Carpathians has been collected, classified and analysed in order to reconstruct the phases of geomorphic activity of rivers during major flood events and periods of low hydroclimatic intensity throughout the Holocene. The main purpose of this work was to link the results determined in our study area (the Carpathians, SE Europe) to data from other European regions and to assess the role of local controls in the magnitude and timing of hydrogeomorphological phases. Based on the analysis of probability fequency for 142 selected age datings (of a total 196 age datings), 17 major flooding episodes were identified, of which 12 (mostly from the last 4500 years) coincide with wet phases determined for lacustrine sedimentary units from the study area.

At regional scale, of the 17 centennial intervals with flood events recorded in fluvial archives from Romania in the last 10 ka, 15 intervals are synchronous with at least one area from Central or Eastern Europe, leading to the conclusion that the climatic factor manifested dominantly in SE Europe, as well.

At local scale, the orographic barrier of the Carpathians interfering with the dominant circulation of western air masses has modified the magnitude and timing of flood event phases as follows: the average relative probability for datings of western fluvial units is nearly three times higher than the parameter for eastern units; the intervals with relative probability above average are longer in datings for western rivers compared to eastern rivers; overall, the number of intervals surpassing average probability is 17, of which only 8 time intervals coincide with peaks exceeding the relative probability averages of the two curves.

Other controls with local influence in terms of the local dynamics of hydroclimatic processes, such as vegetation dynamics and human impact, have indicated that the areas located between 700 and 1000 m asl exhibited the highest susceptibility to the stress of Holocene vegetation changes, whereas the rate at which human interventions occurred increased since the Bronze Age (post ca. 4500 YBP). Both factors (i.e. vegetation dynamics and human impact, in particular) overlapped with the action of the dominant climatic factor, and their response was visible in the manifestation of fluvial processes of incision and/or aggradation and avulsion.

The process of channel incision was prevalent in the Early and Mid-Holocene (4700 YBP was a turning point), while sedimentation, avulsion as well as incision occurred at a much faster rate during the Late Holocene. Sediment reworking was much more pronounced along western rivers almost continuously throughout the Holocene, as fluvial processes were controlled by water flows as high as 3 times larger compared to eastern rivers and fewer, finer-grained sediments, and further complicated by the diapir tectonics of the Transylvanian Depression. By contrast, eastern rivers had to adjust their activity to comparatively lower streamflow discharge values, whereas the sediment input was larger and coarser-grained.

By comparing event chronologies, we concluded that during the Holocene, if we overlook the pre-10 ka BP period (due to insufficient datings), we documented the following periods with the amplest fluvial processes manifesting on the rivers draining the Romanian Carpathians: 9500-9200, 8200 (particularly on western rivers), 6300; 4800-4700, 3600-3300, 2300-2200, 1300 (Migration Period), 950-700 (Medieval Climatic Anomaly) and 600-350 BP (Little Ice Age).

Late Pleistocene linkages between glacial, fluvial and aeolian processes in the SE Carpathian Basin

György Sipos[1], Petru Urdea[2], Tímea Kiss[1],
Slobodan Markovic[3], Zsófia Ruszkiczay-Rüdiger[4]

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[2] *West University of Timişoara*
[3] *University of Novi Sad*
[4] *Hungarian Academy of Sciences (MTA), Research Centre for Astronomy and Earth Sciences, Institute for Geological and Geochemical Research*

The development of spatially adjacent geomorphological systems, let they be formed primarily either by glacial, fluvial, eolian processes or mass movements are naturally interlinked. This is especially true in a basin type environment, where general slope conditions will usually preform the main directions and trajectories of sediment and energy transfer. The strength of linkages can vary however over time as a matter of climatic, tectonic and incident geomorphological changes. The presentation attempts to identify the possible traces of Late Pleistocene geomorphological linkages within the SE part of the Carpathian Basin through two main trajectories. One includes the Danube Tisza Interfluve, the Danube Floodplain and the downwind Bácska Loess Field. The other includes the Southern Carpathian Retezat Mountains, the downstream Maros/Mures Alluvial Fan and the Tisza/Tisa Floodplain. In each case surface and close to surface morphological units and forms were investigated in order to test the existence and intensity of past linkage related to two potential triggering events: west to east channel shift of the Danube at around 40-50 ka and glacial retreat in the upland catchment of River Maros between the LGM and the Holocene.

A deterministic-based approach on landslide susceptibility. Case study: The Subcarpathian Prahova Valley

Iuliana Armaş[1], Mihaela Gheorghe[1], George Cătălin Silvas[2]

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In this research, we propose using the one-dimension infinite slope stability model for shallow landslide susceptibility mapping, validated and refined based on interferometric synthetic aperture radar (InSAR). We implemented the infinite slope model across a hilly area of Romania prone to translational landslides, the Subcarpathian Prahova Valley.

The deterministic approach required a large amount of data such as Digital Elevation Model (DEM)-based geomorphological characteristics (slope angles, sine and cosine), existing thematic maps, detailed field surveys, geomorphological analyses and mapping, laboratory tests. The geotechnical input parameters such as cohesion and friction angle of slope materials were obtained with the aid of several private companies, based on written agreements. The data used are part of the 2014 geotechnical study for the Comarnic-Braşov motorway and consists in geotechnical drillings, vertical electrical surveys, geological mapping and geotechnical laboratory results. A geological mapping was also accomplished in the autumn of 2017.

Multi-temporal InSAR techniques were applied to detect unknown developing landslides and validate the ones already identified. The main difference between susceptibility maps obtained through classic techniques and the InSAR deformation maps is the kinematic characterization of the landslides which can be used for confirming and updating pre-existing landslides inventories. There is little available literature on validating susceptibility maps using InSAR.

For processing imagery from the European Space Agency Sentinel-1A and B satellites we applied the Small BAseline Subset (SBAS) algorithm. The data was selected due to its enhanced temporal resolution and free availability over the last 4 year, as well as its potential for continuity. A number of 62 Sentinel-1A and B images acquired on ascending and 61 images acquired on descending orbit, were processed for landslide mapping between October 2014 and October 2018 having a temporal resolution of 1 month. The initial dates correspond to the first image acquisition over Prahova Valley by the Sentinel-1A satellite after launch, on each orbit.

A quantitative comparison between the susceptibility map derived with the one-dimension infinite slope stability model and the deformation maps revealed a good performing in reproducing the observed landslides in areas predicted as unstable and critical by the infinite slope model.

Examining thermal conditions of low-altitude cold scree slopes at Detunata Flocoasă (Apuseni Mountains)

Mihai Băbănaş[1], Petru Urdea[1], Patrick Chiroiu[1],
Fabian Timofte[1], Alexandru Hegyi[1], Alexandru Onaca[1]

[1] *Department of Geography, West University of Timisoara, Timişoara, Romania*

Despite that the altitudinal permafrost limit in the Romanian Carpathians lays at 2000-2100 m, non-alpine scree slopes at altitudes around 1000 m revealed near-ground microclimatic conditions suitable for hosting

permafrost (Popescu *et al.,* 2017). These slopes are covered by a thick layer of blocks with an open void system enhancing ground cooling due to intense air ventilation. The `chimney effect` is in most of the cases responsible for ground overcooling and exceptionally cold microclimates in case of low-altitude cold slopes. This air circulation mechanism and constant cold conditions at the surface of low altitude scree slopes were highlighted by the thermal measurements conducted at Detunata Goală scree slopes, at 1020-1100 m (Popescu *et al*., 2017). In this paper we present the preliminary thermal regimes of three scree slopes located below the Detunata Flocoasă (1258 m) in order to examine the likely/unlikely sporadic permafrost conditions at this unexplored site. During late springs we observed ice close to the surface between the boulders, whereas a cold current of air was perceptible at several places. In addition the growth of the trees in the cold areas appeared to be also inhibited, according to the distribution of the dwarf trees. Based on the preliminary findings we assume that the scree slope with a western orientation have similar thermal conditions with the ones described at Detunata Goală, whereas the presence of permafrost at the southern exposed scree slopes is unlikely. In case of the northern exposed scree slope the preliminary thermal results are not consistent to formulate any hyphothesis regarding permafrost occurrence. Geophysical measurements will be performed in the future to get more information about permafrost occurrence and internal structure of the scree slopes.

Reference:

Popescu, R., Vespremeanu-Stroe, A., Onaca, A., Vasile, M., Cruceru, N., Pop, O., 2017. Low-altitude permafrost research in an overcooled talus slope-rock glacier system in the Romanian Carpathians (Detunata Goală, Apuseni Mountains), *Geomorphology,* **295**, 840-854.

What can tree rings tell us about the headcut retreat of Groapa Ruginoasă gully system?

Ramona Chelaru[1], Olimpiu Pop[1], Andrea Gál[1], Zsuzsa Borbándi[1], Judit Ilona[1], Hunor Lengyel[1], Péter Kacsó[1], Szilárd Kanyó[1], Ákos Szabó[1]

[1]*Babe□-Bolyai University, Faculty of Geography, Cluj-Napoca, Romania*

Groapa Ruginoasă gully system situated in Bihor Mountains has been studied by our team starting from 2014 by classical methods and photogrammetric surveys targeting the headcut retreat rate and the changes in the drainage system. The ongoing gully headcut retreat affects the coniferous forest present in the area. Disturbed trees located on the scarp margins record in their rings evidence of geomorphic disturbance, offering the possibility to obtain detailed information about the headcut retreat events at medium time

scales. The objective of this study was to explore the possibility to reconstruct the frequency and spatial distribution of gully headcut recession events. In this sense, 52 Norway spruce (*Picea abies* (L.) Karst.) trees disturbed by stem destabilization and root exposure were sampled during a field campaign conducted in summer 2018. Other 13 undisturbed *P. abies* trees growing outside the area affected by gullying were sampled, so as to obtain a local reference chronology. In the laboratory, all samples (44 cores and 8 discs) were first prepared for analysis (air-dried, sanded) and then analyzed for age determination. Ring-width measurements were performed using the LINTAB 5 measurement table and TSAP-Win Scientific software (RINNTECH). Growth anomalies identified in rings of disturbed trees, but absent in the rings of reference trees (e.g. the onset sequences of compression wood and abrupt growth suppression) were considered to be the result of stem destabilization and root exposure to subaerial conditions events. Taking into account the tree position and the temporal occurrence of growth reactions, the spatial distribution and event history was obtained in different gully scarp sectors. Further dendrogeomorphic investigations based on the analysis of both stem and root samples are expected to provide a better understanding of gully headcut retreat rate in the study area.

Assessment of damages caused by landslides. Case study: Seciurile village (Gorj)

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Seciurile village is part of Rosia de Amaradia commune, located with the coil quarry within the upper basin of the Amaradia river. In the western, norther and eastern part of the villages, there are two lignite quarries – Seciuri Vest and Seciuri-Ruget, where soil uncovering and stockpiling occurred on very large areas. During the spring of 2006 (08.05.2006), the village experienced a severe landslide, which affected the entire area of the village, both the built-up area and the surrounding agricultural fields. It damaged completely the buildings, roads and infrastructure of the quarry. As a result of the risks, the authorities decided to evacuate the village and dislocate the population within Campu Mare despression, where a new village is built.

The present paper aims to analyse the characteristics and causes that lead to the landslide, based on the observations carried on in May 2006, the subsequent evolution of the landslide mass and the present situation, as well as to assess the damages and the problems related to the relocation.

Channel forming discharge in rivers: a case study of Trotuş River (Romania)

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Effective discharge at bankfull stage has been considered to be the key control upon channel formation and/or maintenance. In geomorphic terms, multiple effective discharges include channel-maintaining and channel-changing discharges. The former category comprises higher frequency flows which carry sufficient sediments to maintain channel shape and prevent either aggradation, degradation or vegetative invasion, whereas the latter includes rare floods which exceed a geomorphic threshold, thus prompting significant channel changes. The relation between flow frequency and magnitude, in terms of outlining effective discharge, is a hot spot in fluvial geomorphology. To reduce the degree of subjectivity generated by the choice of certain flow-class intervals as much as possible, we opted to employ several class-based approaches and analytical methods for the assessment of effective discharge or personal adaptations to such approaches. At all four gauging stations along the Trotu River, we observed that the transport efficacy of suspended sediments was generally characterized as highly multimodal, and we were able to distinguish between two types of effective discharges: (1) the main effective discharge (Q_{effT}), which corresponded with rare flows (RI<20 years in more than 95% of cases) with a magnitude 7 to 82 times greater than that for Q_{mad}; and (2) the sub-bankfull effective discharge ($Q_{eff<bf}$), which occurs relatively frequently (RI ~ 1.0-1.6 years), with a magnitude 1.5 to 3 times greater than that for Q_{mad}. In regard to the temporal evolution of effective discharges, we documented decreasing factors from 1.2 to 1.7 at Goioasa, Târgu Ocna and Vrânceni, while at Lunca de Sus, the value nearly doubled between 2005 and 2014 compared to the previous time frame (1994-2005). The differences were caused by the channel changes generated by the flood events of 2005 and 2010. By plotting hydraulic thresholds with the geomorphic significance on the effectiveness curve of suspended sediment transport, effective discharges corresponding to sub-bankfull flows ($Q_{eff<bf}$) were ranked as channel-maintaining discharges, whereas the main effective discharges (Q_{effT}) were ranked as channel-changing discharges. On the one hand, this study reconfirmed that large flood events play a major role in the evolution of stream channels from mountainous regions; on the other hand, this study showed that each flow able to carry sediments had its own significance. A comparison between the results yielded by our study and the

data published by Rădoane and Ichim (1986) (i.e., the first and only study to date regarding the effective discharge of a Romanian river-namely, the Trotuş- between 1960 and 1980) reveals that the values are relatively close upstream (at Lunca de Sus and Goioasa), indicating that the channel bed has undergone few changes; however, the effective discharge values determined in our study have nearly double values at the stations located mid- and downstream (Târgu Ocna and Vrânceni), which results from changes occurring in the channel bed.

The reconstruction of the climate and the avalanches in the Southern Carpathians, based on the isotopic composition of $\delta^{18}O$ and $\delta^{2}H$ in precipitations and rivers and the isotopic composition of $\delta^{18}O$ in tree rings

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Climatic evolution is characterized by a series of changes in the specific parameters which persists for a long time (decades or even more) and can greatly affect the environment. In recent decades, as a result of the increase in the number of human victims and material damage caused by extreme natural phenomena, as in the case of avalanches, it has become necessary to know the evolution in time and space of these parameters. One of the main sources of information on past dynamics of avalanches is given by the footprints left by them in tree rings growth. In addition, variations in annual ring width, density and isotopic composition reflect the influence of climatic factors on the biological processes that form these rings. In particular, the reports of heavy (^{18}O) and light (^{16}O) oxygen and hydrogen isotopes (^{2}H şi ^{1}H) printed in tree rings growth are powerful indicators of past climate change.

The aim of this study seeks the climate reconstruction of the Southern Carpathians over the past 100 years and the dynamics of avalanches by: 1) the analysis of the impact trace frequency in trees, 2) reconstruction of the climatic conditions based on the $\delta^{18}O$ analysis in the tree rings growth. A first step in the latter study is to understand the relationship between the climate, the isotopic composition of precipitation water and the surface and the isotopic composition of tree rings growth.

In this study case we present preliminary data on the study methodology and the relationships between the climate and $\delta^{18}O$ şi $\delta^{2}H$ in rainwater and rivers near the study area. In order to carry out this study, we used monthly climatic temperature and precipitation data from Bâlea, Ţarcu,

Craiova, Drobeta-Turnu Severin stations and data on variations of $\delta^{18}O$ şi $\delta^{2}H$ from rainwater and rivers in the proximity of the Meridionali Carpathians (Bega, Jiu, Olt, Danube, Turia For the analysis of the isotopic composition of the tree rings growth and for the reconstruction of the avalanches, there will be taken wood samples from trees from the Ţarcu Mountains, Făgăraş Mountains and Bucegi Mountains.

As a result of this research, we expect to find a correlation between the average monthly temperatures and the temporal variations of the isotopic composition of δ18O in water and in the tree rings growth, the differential spatial distribution of isotopes in rivers and precipitation depending on the season, and how the seasonal growth of tree rings growth reflect the very close link between avalanches and the winter heat regime.

Short-term changes in evolution of the Pâclele Mari mud volcano

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Although Pâclele Mari and Pâclele Mici mud volcanoes are one of the most impressive mud volcanoes in Europe, they have been poorly studied from geomorphic point of view. They are located near Berca village, in the Buzău Subcarpathians, along the same hydrocarbon-bearing anticlinal structure fragmented by a system of faults. The aim of this study is to describe the patterns of changes at Pâclele Mari mud volcano during one year. For this, we used photogrammetric surveys of the area from two consecutive years (2017 and 2018) made by UAV technology. The images were processed with Agisoft PhotoScan Professional software. The generated orthophotos and digital terrain models were analyzed in ArcGIS 10.6 software. The most significant recorded change was the expansion of the mud flow at the expense of the vegetation. Our main goal was to reveal a possible relation between the difference in the number of active vents and the change in elevation of the mud volcano area, taking into account that more active vents would mean higher amounts of discharged mud. At the same time, we studied the transformations in the drainage system according to changes in mud flow patterns, as there is a correlation between the activity of the different vents and the surface runoff on the mud volcano.

Tree-ring dating of snow avalanches in Rodna Mountains National Park

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Tree-rings can provide valuable data about past geomorphic activity, but up to now little research has been carried out with this purpose in Eastern Carpathians. The ACTIVNEIGE project aims to reconstruct the frequency of snow avalanche events in the natural protected areas from Romanian and Ukrainian Eastern Carpathians using tree-ring methods, remote sensing and GIS techniques. The records of avalanche occurrence will be further explored for hazard assessment and risk mitigation measures for a proper management of protected areas. In this study a tree-ring reconstruction of snow avalanches was initiated along two paths in the north-western part of Rodna Mountains National Park (Romania). A total of 201 Norway spruce trees (*Picea abies* (L.) Karst.) with visible signs of mechanical impact caused by snow avalanches (scars, tilting, stem decapitation, broken branches) were sampled along two south-facing paths below Piatra Arsă Peak (2.034 m a.s.l). Growth anomalies (scars, traumatic resin ducts, compression wood, growth suppression) provided a chronology of snow avalanche events back to the middle of the 20th century. A minimum frequency was calculated based on the number of trees with growth disturbances in each of the reconstructed years. Then, the spatial extend was mapped for every reconstructed high-magnitude avalanche events. Results obtained in this study will help the Administration of the National Park in their effort to implement appropriate management decisions for tourism activities in the study area.

This work is a contribution to the project ACTIVNEIGE «*Activité des avalanches des neige dans les Carpates Orientales Roumaines et Ukrainiennes*» (*Snow avalanche activity in Romanian and Ukrainian Easthern Carpathians*), funded by AUF-IFA RO.

Landforms and landscape variety in the Romanian Plain. Identification and typology

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The plain units, seemingly insignificant as landscaping, require a variety of landscapes due to synergy between environmental elements. This conception is applied in the study of the Romanian Plain, a lacustro-fluvial plain situated in the Carpathian-Balkan Depression where it owns over 90% of the plain on one side of the Danube River. The paper brings into discussion the genesis of landscapes in geographic units with major plain relief. Geological and paleoevolutive quaternary features imply landscapes specific to the genetic types of the plains, which distinguish the landscapes of the plain interfluves - the fields - and the valley / river landscapes. Referred to Romania's relief, Romanian Plain has a landscape of the 1st level – the plain landscape. Sinergism of the environmental elements implies the identification and hierarchy of landscapes according to the genetic criterion, establishing landscapes of orders 2 and 3.

Anthropic intervention has altered the natural landscape creating anthropized landscapes that exist in all types of landscapes. The quality of synergism is given such a function and dynamic character of natural landscapes that determine specific, anthropic functions: the rural landscape, the urban landscape. The continuous and sustained anthropic interventions in the Romanian Plain, over time, highlights the multifunctional quality of this space, the current landscape complex being the result of more or less rational exploitation of its ecological and biological potential.

Assessment of hiking trails and associated risks in Bucegi Mountains

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Hiking in mountain areas is an increasingly used form of physical activity, due to the vertical drop and different lengths of the hiking trails. These are marked routes, which are constantly maintained and developed as a network, with a key role in preventing uncontrolled tourists' dispersion. In

this study we aim to assess and classify some of the hiking trails in the Bucegi Mountains, using topographic parameters (the slope, especially), but also the associated risks (Environmental events, Equipment and Medical events). We analyzed the 5 most important trails in the area, taking into consideration the landscape, difficulty and associated hiking risks: Buşteni - Babele (Jepii Mici) (T1), Buşteni - Jepii Mari (T2), Babele - Peştera (T3), Babele - Omu Peak (T4) and Buşteni - Cerbului Valley - Omu Peak (T5). For each hiking trail, we assessed the following: altitude and alignment, by using the "*contour*" function in ArcMap, followed by slope and aspect functions. In this way, we highlighted the places where the trails' slope is radically changing, or has excessive values, according with Romanian law HG 77/2003, which classifies hiking trails and states the places with high risk of sliding or falling out.

In order to calculate the hiking trails' Accessibility Index (AI), we took into consideration the location of the trail in relation to the transportation network (national/county roads at less than 5 km, access to railroads, cable car over the trail), the type and number of pathways and the average time to cover the route on foot. Accidents (fatalities and injuries) along the trails were recorded from 2008 to 2018 and from May till November, when the weather is warmer and tourist activity intensifies. The length of the studied hiking trails varies between 4.61 and 8.68 km, in the case of the hiking trails with starting points in the Bu□teni resort and between 3.81 and 4.97 km, in the case of the hiking trails with starting points on the Bucegi plateau area. The segments with slopes between 20% - 40%, represent between 19.1 and 30.4% of the trails' length and segments with slopes over 40%, between 8.1 and 38.5% of the trails' length. The aspect of the hiking trails is according to the overall topography. The segments with slopes less than 20%, between 20 – 40%, and over 40% are differentiated within the trails, but also within the Carpathian environmental zones (forestry, subalpine, alpine). The majority of the segments with slopes between 20 to 40% and over 40% are located in the steepest part of the Bucegi Mountains, called "abruptul prahovean", for the trails T1, T2 and T3, and in the subalpine zone for trails T4 and T5. According to Sinaia and Buşteni MRPS, 173 people were involved in 57 accidents, which means an average of 5.7 accidents per year and 17.3 people per year involved in accidents (mean ± SD 3.03±3.45, median=2, min=1, max=20, CV=1.13). Thus, we can state that topographical conditions and morphometric characteristics imposed associated hiking risks. Most accidents were recorded on T1, with 5 fatalities and 86 other rescue situations. On T2 only one fatality was recorded, and 44 other rescue situations. On both T5 and T3 also just one fatality and 20 other rescue situations were recorded and on T4 two people were injured after they slipped. The AI is: T1=16, T2=30, T3=53, T4=52 and T5=17 and the Degree of accessibility is: T1=low, T2=low, T3=high, T4=medium and T5=low in the middle and upper part.

Multiscalarity in landslide susceptibility, hazard and risk assessment

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According to the scopes of landslide susceptibility, hazard and risk assessments, these studies are made at different scales using different qualitative and quantitative methods. In Romania officially, these studies are made as a legislative necessity, according to a unique geotechnical input factors method (a local scale approach). These studies cover especially the administrative units that were hit by landslides in the past and for those that is likely to produce in the future. On another side, the academic network provided a wide methodological types of studies by taking into consideration the international backgroud concerning the selection and the number of input factors at different scales for various spatial extensions: from local to regional and national scales. In this paper are discuss a wide range of issues related to the characteristics and scale of input factors: acquisition, mapping, weights etc., in relationship with the method used. Also the paper highlights the role of landslide inventories (a factor which is neglected at present in the official methodology used for hazard assessment) in evaluation of the robustness of the modeling outputs. The paper contains certain examples carried out in the Moldavian Plateau emphasizing the advantages offered by using different input factors and methods, according to a multiscalar approach of landslide susceptibility, hazard and risk assessment.

The morphogenetic and typological complexity of landslides in Vrancea seismic region and its implications in hazard assessment

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While Romania might be considered one of Europe's landslide hotspots, the Curvature region of the Romanian Carpathians could be definitely approached as its landslides paradigm. An extremely wide range of predisposing (complex and heterogeneous associations of intensely folded and faulted morphostructural units built on landslide-prone flysch and molasse deposits, affected by intense neotectonics and seismicity), preparing and triggering (precipitation and earthquakes) factors leads to the occurrence of a large landslide typology. Under these circumstances, there is an obvious and

increasing interest towards building good-to-better, improved-to-optimal hazard assessments, meant to support risk management strategies as important parts of the risk culture development. In the meantime, the development of such a risk culture, based on rigorous scientific substantiation, stakeholders' active involvement and common language is still tributary to the progresses which should be directed towards the typological harmonization (in space and time) of landslide databases, on which the future predictions (in terms of susceptibility and hazard) entirely depends. However, both aleatory and epistemic uncertainties constantly derive from the extreme morphogenetic complexity of landslides, which imprints a wide variety in terms of morphodynamic typologies. Elements such as the different stages in evolution, frequency-magnitude relationship, a proper identification of a certain triggering threshold and its recurrence interval, as well as the slope-channel system sensitivity and connectivity are making the proper evaluation of hazard extremely difficult and subjected to a consistent number of uncertainties. It is the purpose of this presentation to outline, through several local and regional evaluations conducted in Buzau and Vrancea Carpathians and Subcarpathians, this entire context of complexity-induced uncertainties, and in the meantime to pinpoint the priorities within an approach which should strengthen the prevention-preparedness framework for authorities in support of their effective answer. The proposal of a complex landslide observational perimeter along Buzau Valley will be presented at the end, as the framework for detailed (local and regional) and modern hazard evaluations development for consequences mitigation and risk reduction.

Integration of A-DInSAR techniques and slope stability analysis for investigation of landslides dynamics

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Investigation of landslides behaviour became a very important procedure in the stabilization process of displaced material or prevention of such hazardous phenomena. Hence, various sensing techniques and instruments are used to monitor, analyse and explain the displacements of sliding mass. Their outcome represents an essential support for the implementation of effective procedures and policies to mitigate these hazards. In our study we aim to understand the contributing factors and driving forces to the rock geomechanics of the very slow-moving landslide that affects Țicău neighbourhood of Iaşi Municipality. In fact, the history of this area is marked

by multiple landslides reactivations. One important event that occurred in 1942 was reported in the literature of the time during which over 350 houses were damaged and the road network was destroyed. That reactivation has been the result of the heavy rainfall that took place before triggering coupled with the high volume of precipitations of the previous winter. The back-analysis of the event using limit equilibrium of slope stability suggests that the landslide triggered due to the increase of water table close to the topographic surface, confirming the idea from the literature. At the moment, the velocity of moving landslide body records values of 15-20 mm/year (in satellite's Line of Sight). These results are based on Advanced Differential SAR Interferometry (A-DInSAR) outputs that also outline the most active sector represented by the middle part of landslide body. To understand the mechanism of sliding we simulated the behaviour of material by performing a two-dimensional Finite Element numerical modelling (FEM) along the landslide body. The results point out that increasing the volume of water in the remolded material leads to the displacement of unstable mass. Also, by comparing the DInSAR measurements with rainfall we have noticed that a monthly precipitation amount more than 60 mm leads to small accelerations in the displacement rates of landslide body, supporting the results of the numerical simulations.

Geomorphological restitutions: Moldavian Plain and Transilvanian Plain

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In Romanian geomorphology there are a series of inadvertencies induced socio-politically by the oppressive regime before 1990. Among these, we exemplify in this paper the use of the notion of plain for a number of areas in Romania, although these are clear hills, both geomorphologically and geomorphometrically: Moldavian Plain and Transylvanian Plain. To support these positions were calculated a series of geomorphometric indices based on MNT SRTM and an argumentation of the geology and geomorphological evolution of the studied areas was made. We support the elimination of the plains term to designate the relief of these two regions and the reintroduction of the terms used before 1945.

The reservoir bottom gullies from Jijia-Bahlui Depression

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Jijia-Bahlui Depression represents an area where reservoirs were built and silted starting from the Medieval period. After the decommissioning of these reservoirs, mainly through dam breaching, the water flow concentration around the breach at floods generated the development of gullies on the flat sediment reservoir bottom. In the Jijia-Bahlui Depression we identified and delineated 484 gullies on high resolution DEMs (0.5 m the pixel size). Using the interpolated surface of the initial bottom we applied the Dem of Difference method to compute the eroded gully volume. The total volume eroded between 1920 and 2012 was of 700 000 m^3, without being possible to periodize better the timing of gully erosion. In order to better characterize the timing of error during the year and to establish a long term monitoring we have surveyed with an UAV four gullies which showed evolution from 2012 to 2019. Using Structure from Motion methodology we have obtained high resolution DEMs (0.01 m pixel size) which were integrated with the LiDAR DEM from 2012 in Geomorphic Change Detection analysis. The results showed changed especially and the head of the gully (erosion) and on the main channel (deposition). These erosional hotspots need to be monitored and studied because it represents source of sediments that were not included in the sediment budgets.

The complex Upper Pleistocene landslide from Costeşti (Iaşi County) – dating and characterization

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Relict landslides represent a characteristic of the geomorphologic landscape of the Moldavian Plateau. The isotopic methods of absolute dating allow the temporal framing of these landslides by dating the surficial deposits that appear over these landslided areas. In the Costeşti village perimeter (Iaşi

County), the Bahluieț Valley is wider because some complex landslides, that covered the floodplain deposits. These landslide deposits were later covered by floodplain deposits that were dated by C^{14} method to 20-45 ky cal BP. After, the channel of Bahluieț deepened in its own sediments and in the landslide deposits, forming a channel 5 to 11 deep and up to 30 m wide. The former floodplain became a fluvial terrace, and it is appearing all over the Bahluieț channel bank, while the landslide deposits appear only on some parts. The geomorphologic context of this area allow us to consider the landslide to be pre 45 ky cal BP so Upper Pleistocene in age. In order to characterize this landslide field reconnaissance was performed on geomorphometric elements recognized semi-automatically from a LiDAR DEM at 0.5 m pixel resolution. In order to depict the internal structure of the complex landslide and of terrace deposit, several 2D ERT section were performed. These geophysical informations were interpreted based on the geology of the study area, recognized in the field from literature description. As a final result we obtained a geomorphologic map which show the landslide typology and its extension, and a geomorphological profile, which show the internal structure of the landslide.

Permafrost characteristics in marginal periglacial environment of Rila and Pirin Mountains

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In marginal periglacial environments isolated patches of permafrost occur regularly at lower elevations compared with the regional limit of mountain permafrost. The occurrence of permafrost is highly controlled by local topo-climatic and geologic conditions. Rila and Pirin Mountains are located in the southwestern part of Bulgaria and their highest summits exceed 2900 m (Musala Peak, 2925 m; Vihren Peak, 2914 m). The existence of permafrost in the Rila and Pirin Mountains is strongly related to rock glaciers and is limited to sites characterized by coarse openwork debris, reduced income of solar radiation and high altitudes (above 2450 m). The high porosity of coarse debris enhances an intense cooling of the ground due to efficient ventilation effects. These outstanding landforms indicating permafrost creeping occurs between 2100 and 2700 m in the investigated mountain ranges. The mean elevation of rock glaciers is around 2400 m,

whereas the 0°C isotherm of mean annual air temperature lies at 2450 m. 28 rock glaciers are developed entirely above 2450 m, whereas almost half of the rock glaciers have the mean elevation above 2450 m. Permafrost conditions in case of 10 rock glaciers and 2 scree slopes in the Rila and Pirin Mountains were investigated using thermal and geophysical investigations. Based on preliminary results permafrost occurs above 2400 m at sites where the coarse debris allow an efficient cooling mechanism and where the reduced solar radiation allow the preservation of snow until July-August. The active layer is thick (between 5-10 m), whereas the permanently frozen layers are very thin, indicating that the existing permafrost is in imbalance with the current climate.

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Evaluating geomorphosites and geomorphological processes that impact them. Case study: Cozia Massif

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Forms of relief that acquire in time by human perception scientific, ecological, aesthetic, cultural and economic value are geomorphological sites of interest called geomorphosites.

This paper aims to evaluate the most important geomorphosites in the Cozia Massif area that can affect and damage them. The evaluation method proposed is based on the one created by Reynard at al. (2016) but also considers other (Pralong 2005, Serrano and González Trueba 2005; Bruschi and Cendrero 2005; Reynard et al. 2007; Pereira et al. 2007; Pereira and Pereira 2010; Comănescu et al. 2012; Grangier 2013; Bussard 2014) which it modifies and complements. The new methodology aims to emphasise geomorphosites as multifunctional entities with both scientific and additional (aesthetic, cultural, ecological) values, as well as tourism and educational utilisation. The primary purpose of the new methodology is to increase the evaluation' accuracy by quantifying all the features of the selected geomorphosites from their intrinsic value to aspects related to their legal protection status and their tourism promotion policies.

The most crucial geomorphological hazard in the area is disintegration. Its impact was assessed in the field with the help of a working chart that gathered information on the fracture degree, type of rocks, and their

resistance, the geomorphological context and the type of material that was transported and deposited at the base of the slopes.

Thirteen geomorphosites were included in this study, and all of them achieved scores between 0.51 (Pietrele Roşiei, Fruntea Oii Edge) and 0.79 (Cozia Gorges). The study ended with identifying the most important geomorphosites for scientific research (e.g. Cozia Gorges) and their tourism development (ex. Cascada Gardului). Also, another objective of the research is the establishment of vulnerable geomorphosites that require protection and conservation solutions (Stone Gate).

Fluvial adjustments to Late Quaternary climatic changes in Someşul Mic drainage basin, NW Romania

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Recent synthesis on climate variability and vegetation adjustments throughout Central and Eastern Europe during the last 60 ka years indicate differences between Western and Central Europe, in terms of the amplitude of climate changes, and the nature and type of vegetation adjustments. The increased continentalism in the Central and Eastern Europe is reflected in lower amplitudes of climate changes compared to western Europe, resulting in the maintenance of open boreal forests at mid-low elevations (e.g., in the Carpathian Mountains).

Investigations on Late Quaternary fluvial behavior in Eastern Carpathian Basin highlight the distinct imprint of climate conditions (including their effect on vegetation and soil frost) on fluvial behavior, but also the localized importance of other controls (e.g., local/regional tectonics, general slope of the valleys, distance from the catchment areas). They offer a complex overview on fluvial history in the area, but still with many gaps, which make difficult any attempt to compare it with the more complete image from Western Europe.

On this background, we present here the dynamics of rivers in Somesul Mic drainage basin (3774 km^2), in relation with climatic changes during the past 60.000 years. Our investigation is based on study sites located along Someşul Mic River and three of its tributaries - Someşul Cald, Bonț and Bandău Rivers. Morphological, sedimentological and absolute chronology (OSL, 14C) investigations on the floodplains and lower terraces lead to reconstructed local fluvial histories, emphasizing the channel patterns active at different moments, timing of vertical and/or spatial fluvial response to

climatic changes, and the role of other local controls in amplifying/delaying or inhibiting fluvial reactions to these disturbances. Based on these findings, we propose a first basin scale perspective on spatial and temporal variability of fluvial reactions in Eastern Carpathian Basin to Late Quaternary climate changes.

The morphological role of the Timş Valley on the pattern of inhabiting in prehistory

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The river valleys represent landforms with support function and resources for the placement and development of human communities. The research carried out along the Timis Valley, the section Lugoj-Caransebes, highlighted important aspects regarding the relationship between the occupancy pattern and the morphological elements of the valley (river beds, meadows, terraces and outfalls) in prehistorical times. This study focuses on the mapping of the morphological elements of the Timis Valley (Lugoj-Caransebes) and the relationship established between these elements and the pattern of human occupation. The morphological features of the study area were initially mapped in the field using topographical maps (1:25.000), geological maps (1:200.000), and orthophotographs (50 cm resolution). Several methods were used to measure terraces heights. For the relative altitude of terraces, we calculated the difference between the absolute altitude of the Timi□ River bed and the absolute altitude of the terraces level on the same alignment. The altitude of few terraces was directly measured on the topographical map (1:25,000) and the following terraces were identified: the 10 m terrace; the 18 m terrace; the 30 m terrace; the 50 m terrace, is the most extensive terrace having an almost horizontal surface; the 90 m terrace; the 120 m terrace is restricted to a small area. Subsequently, using a number of specific instruments and complex methods, specific to GIS, a series of morphometric, morphographic, hydrologic and geologic variables were analyzed. These variables were subsequently brought to a common standpoint in terms of values, to the extent that the logical ensemble could be kept. The ultimate goal was to integrate these valuables into a mathematical model that explains an insufficiently adressed issue in both geomorphology and archeology: how did they influence the environmental factors (the forms specific to the river landforms, the hydric, morphometric and geological components), the placement of the existing prehistorical sites within the Timis

Valley. The importance of the study consists of two important aspects. First, in terms of being a starting point, regarding the multidisciplinary research of the interconditions between the prehistoric human communities and the river landforms in Romania, and the testing of some hypotheses linked to the sphere of archeology and environmental psychology. The second, in practical terms, refers to the contribution of this research in the process of diversification and refinement of much more familiar analogue models of archaeological prediction.

Linking snow-avalanche activity and snowpack persistence in low-elevation areas of Maramureş Mountains (Eastern Carpathians, Romania)

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In Maramureş Mountains, snow avalanches occur frequently on higher steep slopes, but reach the valley bottoms below 1000 m a.s.l. in their runout zones. The patterns of avalanche activity and the presence of particular topoclimatic conditions are supposed to influence the frequency and spatial distribution of the persistent snowpack accumulations along the valley bottom. During particular avalanche winters, avalanche deposits consisting on a mixture of snow, rock, soil and woody debris materials accumulate in various volumes in the runout zones. A firn-like structure of the avalanche deposits creates progressively and may persist in successive years. As the past snow-avalanche activity is not documented in the area, information about avalanche history is missing, excepting the scarce event years witnessed by tourists. In this study we explored the potential offered by tree rings as natural archives to reconstruct the avalanche activity responsible for the occurrence and persistence of snowpack accumulations. In order to date the snow-avalanche frequency within a path selected for investigations, living trees repeatedly disturbed by past avalanche activity were sampled using a Pressler borer and a handsaw. Samples (cores and discs) were analyzed and tree-growth reactions formed within rings as a result of mechanical impact produced by snow avalanches served to reconstruct past events with annual resolution. The results indicate that, apart from the known 2005 avalanche event and also confirmed by tree-ring dating, multiple other events can be reconstructed with tree-ring analyses. Despite some inherent limitations of tree-ring methods in reconstructing past avalanche events,

these preliminary investigations confirm their utility in deciphering the patterns of avalanche activity and related long-lasting snowpack accumulations at unusual lower altitudes. Further tree-ring studies planned to be extended to several paths in the study area will allow reconstructing the snow avalanche chronology at a regional scale and will provide a better understanding of factors influencing the spatio-temporal distribution of persistent snowpack accumulations.

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Putting in regional context the dynamic status of rock glaciers from Southern Carpathians

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Rock glaciers (RG) are permafrost landforms widely distributed across mountain ranges around the world. The active RG move with speeds of a few centimeters to meters per year some authors supporting the contribution of warming climate for the latter category which implies the so called „destabilization" and permafrost degradation respectively. Most RG from the Southern Carpathians are relict landforms with some of them, which are located in the most favorable conditions, containing probably low amounts of ice. Studies performed so far in Romania indicate very low dynamics on the order of a few centimeters per year for the granitic RG from Retezat Mountains which also do not seem to move differently from one year to another or to accelerate. The present study aims to discuss the Southern Carpathians RGs and their dynamic status in the wide context of RG typology from the other massifs which benefited by intensive research. Besides measured kinematics, thermal regime and internal structure, several other parameters like climate (temperatures, precipitations), topograpy (slope and direction), lithology (rock type) and rock glaciers morphogenesis were inventoried based on the international literature for several RG developed in different ranges: Swiss Alps (*Murtel* and *Muragl*), Austrian Alps (*Äußeres, Hochebenkar*), Italian Alps (*Cima, Uomo*), French Alps (*Laurichard*) and Pyrenees (*Argualas*). Results show that temperature is not a restrictive factor for the dynamics of the highest RG in Southern Carpathians, instead the

precipitation amount, and more exactly the seasonal and monthly distribution, do not support the increment of ground ice content that would decrease internal deformation and make possible „unequivocal" permafrost creep. For the referenced RG from Alps and Pyrenees, besides a higher ice content (derived from precipitations regime and RG morphogenesis), debris supply and slope angle also seem to favor dynamics in spite of comparable temperatures in some cases. We also present in this work an update to the rock glacier dynamics measurements at Judele RG (2012-2017) and the new measurements framework initiated in 2018 in Retezat Massif.

Effects of aridization on land use in the west of Oltenia plain

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The lands in southern Oltenia experienced during the last century different stages of evolution under the influence of the climatic factor and even more under the influence of the anthropic factor. From the extensive areas of ponds and marshes in the post-war period to draining, embankments, irrigation systems and protection forest plantings in the 50s and 60s (reflected in the 70s -80s agricultural highest development point) and to our days when we are witnessing aridization land and the extension of surfaces, predominantly sandy, unpractical to the current type of farming.

After 1990, agriculture in the southern Oltenia plain has suffered an accelerated decline due to the destruction of irrigation systems, the deforestation of the wind-breaks forests, the situation of land ownership and the lack of adaptation of crops to soil types. In 2012, the percentage of irrigated areas reached 0% utilized capacity from 76820 ha in the Blahniţa Plain and 1% capacity from 299621 ha in the Oltenia Plain. All this led to land degradation and amplification of geomorphological processes, especially on sandy lands, where the absence of the vegetation layer corroborated with wind processes lead to the destabilization and expansion of sand dunes.

This article proposes the spatio-temporal analysis of several types of land exposed to aridization, whose surface has increased considerably to nearly 50,000 ha and another 50,000 ha are prone to this phenomenon in the Oltenia Plain west of Jiu. The study identifies as an important element of environmental management for sustainable development the protection of the land by planting the rapidly growing species of woods (acacia, hybrid poplar, silvery pine, walnut), plantations set against the winds providing shelter and protecting soil from erosion.

The research methodology involved the processing of the average annual data on temperature, precipitation and wind direction from the metrological stations in SV Oltenia, data processing from Landsat maps, Corine maps as well as the analysis of the data provided by the expert reports on land occupancy offered by the Ministry of Regional Development and Public Administration. In the analysis of land degradation as a result of the aridization process, the situation of the current vegetal layer was taken into account using the Normalized Difference Vegetation Index (NDVI) and data taken from Corine Land Cover between 1990 and 2006 regarding the change of land use in Oltenia Plain.

Landslide susceptibility assessment using the AHP method in the Central Development Region of Romania

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Landslides are geomorphological processes that occur on large areas within the Transylvanian Depression causing economic damage at the territorial level so the studies to identify their occurrence probabilities as well as the reactivation of the old ones becomes very important in the process of spatial planning. The study was conducted for the Central Development Region of Romania, at the level of the Alba, Mureş, Harghita, Covasna, Brasov and Sibiu counties, so most of the studied territory is found in the Depression of Transylvania, a territory recognized by the cumulative causative and triggering factors of the landslides of geology, relief morphology, triggering rainfall as well as different degrees of anthropogenic intervention. Using AHP analytical hierarchy process (AHP) based heuristic approach was adopted to generate landslide susceptibility map for this preliminary regional level the landslide susceptibility study. The Analytical Hierarchy Process (AHP) was used as a tool for weighting and ranking the chosen parameters, which represent the main causes for landslide susceptibility of the study area: altitude, depth of fragmentation, density of plan curvature, profile curvature, aspect, slope, stream power index and wedness index. In order to validate the results obtained following the application of the proposed model, some case studies were chosen wirch represent territory affected by landslides that have a dynamic character depending on the variations in the amounts of precipitation considered to cause landslides. The analysis of precipitation in relation to the momentss of

landslide occurence from Transylvania Depression highlights a very good correlation and identifies the large amount of precipitation as the main landslide triggering factor.

The sediment fluxes from Bistricioara catchment (Eastern Carpathians)

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The Bistricioara Basin is located in the central part of the Eastern Carpathians, occupying 781 km^2 and spilling into Lake Izvorul Muntelui. In order to characterize the sediment flows in this hydrographic basin, data on liquid and solid flows from three hydrometric stations in the basin: Bilbor, Tulgheş and Bistricioara were analyzed. Periods with hydrometric data are between 1953 and 2017, but continuous data for the three hydrometer stations exist only since 1977. The Bilbor hydrometer station lacks liquid flow data, which is obtained by correlation with the other two stations. Liquid and solid flow data were expanded and normalized for the period 1961-2017, for which the precipitation data from ECA & D, ROCADA and WORDCLIM data was also extracted. An empirical model based on the correlation between precipitation, leakage and effluent sediment was developed to model the flow of water and sediment in the Bistricioarei sub-basins.

Coastal sensitivity of the Black Sea coasts to erosion and flooding hazards

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The Black Sea basin is affected by several environmental problems related to pollution, eutrophication, overfishing and loss of biodiversity,

among which erosion and flooding (as a result of storminess and sea level rise) hazards are of great importance for many coasts.

We evaluated these hazards along the Black Sea coasts using a Coastal Sensitivity Index (CSI) at 1-km spatial scale for more than 4000 sectors around the Black Sea, taking into consideration geological–geomorphological and physical characteristics of each sector through the following parameters: type of coast (coastal geomorphology and lithology), coastal slope (from shoreline to 20 m depth), shoreline changes in the last 30 years, wave incidence (the angle between the shoreline and the dominant storm waves), significant wave height during storm conditions and relative sea level rise. Results showed that 19% (800 km) of the Black Sea coasts are undergoing serious erosion, affecting mostly the coastlines of Romania (38%), Ukraine (29%) and Georgia (26%). The most sensitive sectors to erosion and flooding are superposed on the areas with gentle underwater slopes, soft lithology with high erodibility potential, high shoreline retreat rates and relatively high storm waves incidence angles: the deltaic coastlines of the main deltas (Danube, Kizilirmak, Yesilirmak, Sakarya, Rioni, Enguri, Kodori, Chorokhi), the low-lying areas along Kerch-Taman coastline and the lagoons, limans, coastal barriers and spits along Kalamitsky, Odessa and Karkinitsky Bays (Dniester, Dnieper, Tendrovskaya and Dzharlygachskiy areas). These highly sensitive sectors cover extensive areas along the coastlines of Romania (81%), Ukraine (57%), Russia (43%) and Georgia (38%). CSI assessment at basin scale may assist the Black Sea coastal managers, planners and policy makers to rapidly identify areas with high risk of erosion, providing a framework to prioritize efforts to enhance the resilience or consider adaptation measures in the coastal zone.

Morphometrical Analysis on the Glacial Cirques of the Făgăraş Mountains. Case studies

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Due to their latitudinal position, Southern Carpathians hold a maximum of evidences regarding Quaternary shaping done by the glaciers, related with the altitude above existent snow limit (1900 m) as a consequence of epeirogenic rhodano – valahe movements. These uplift movements were corroborated with change (cooling) of Quaternary paleoclimate. Through the process of replacing the fluvial – morphodynamical model system with periglacial system and then with the glacial system, glaciers set up has been possible holding in background pre-existing relief. The resulting forms at the

end of Pleistocene shaping are clearly developed in high Carpathians massifs and mountain complexes (including Făgăra Mountains) in respect with rock, alignment, longitudinal position, development and shape; these facts lead to the several specific types of glacial mountain units. The comparative morphometrical analysis between 132 glacial cirques reveal an asymmetry between the northern slopes and the southern slopes, because of the conditions set up by lithology, from the tectonics and the shapes of the pre-existent relief to the Quaternary freezing. The morphometry of the glacial cirques regarding to the size, shape, position, areal distribution and orientation measurements and also to the calculation and the correlation of the different morphological parameters, provide essential data for the process of understanding the overall evolution of the region. Morphometrical analysis consists in different measurement of glacial relief forms allow us to describe, compare and identify the cirque types and classes, as well as certain factors that can "isolate" some cirques by categories belonging to them; in the broad sense, it is useful to suggest hypotheses regarding the evolutionary stages and the factors that determined both their form and their development.

The inventory and mapping of the glacial cirques, highlighting of the context of their genesys and the types based on cirques morphometric parammeters are the main aims of our paper.

In order to analyze the glacial morphology, have been determined 34 quantitative and qualitative parameters for every glacial cirque. The results carry out to define the following characteristics: the glacial cirques have numerous common particularities, therefore can be considered like pertaining to a specific category of Făgăraş type that are classified in subcategories in connection with factors control like morphology, their localization regarding to the main ridge, lithology and tectonic features; the belongings to a specific typology of cirques express the characteristics of the last evolutionary phase of the Pleistocene glaciers.

Toward a snow avalanche inventory based on satellite imagery, historical data and field observations in Southern Carpathians

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Snow avalanches are considered among the most important natural hazards in mountain regions of the world with yearly records of fatalities, burial/injuries and infrastructural damage. With some exceptions, these events

often occur in remote and less accessible areas, thus the extent and frequency tend to be underestimated in some mountain regions of the world due to the fact that they are poorly documented and there is a lack of avalanche inventories, this being also the case of the Southern Carpathians, Romania. The detection and mapping of avalanche deposits resulted after avalanche events over extended areas is a time consuming process, but very important for validation of hazard mapping and avalanche forecasting. The existing records related to snow avalanche events in the Southern Carpathians is not continuous and does not cover all mountain areas susceptible of being impacted by this hazard. Although a permanent service for monitoring the snow parameters and snow avalanches exist in Romania from 2004, the information is sparse and the observations and measurements were provided only by 4 meteorological stations located in Bucegi and Făgăraş Mountains, and only one year ago the network was extended with another 7 stations. In the same time volunteer initiatives related to snow avalanche events exist since 2005, but there is no standard database that can provide consistent information related to past and current snow avalanches in the Southern Carpathians. High resolution satellite images and semi-automated algorithms for mapping avalanche deposits represent a good solution to these drawbacks. We used several high resolution multispectral images such as GeoEye-1, UAV derived images and DEM derived parameters to map the avalanche deposits on two test sites in Făgăraş Mountains. The results showed that most of the avalanches detected in the test sites were small to medium size events, mostly constrained by topography and concentrated on northern slopes, steeper than the south side of the mountains. Along with the historical events recorded for the same areas and other field observations, the results were integrated into an extended spatial database that can be used to improve the avalanche hazard mapping and forecasting for the Southern Carpathians. Moreover, using semi-automated algorithms based on remotely sensed data we can map large areas in short time after the image acquisition, as compared to point observation events delivered by the meteorological stations.

Aspects of internal structure and characteristics of the earth hummocks of Muntele Mic

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Earth hummocks are miniature cryogenic mounds forms, included in the small geometric patterned-ground category, widespread in the alpine domain of the highest area of Carpathians. In the Southern Carpathians these

periglacial landforms are very common in the alpine meadows, spread over the relatively flat surface of the peneplains. These landforms result from the combined, but variable interaction of differential frost heave, hydrostatic and cryostatic pressure and cellular circulation cryoexpulsion of clasts, connected to the ice segregation processes. The aim of our study was to examine the internal characteristics of these small dome-shaped hummocks of the Muntele Mic site, for a better understanding of the genesis, evolution and morphology of earth hummocks. The main of our interest is focused on the information provided by micromorphological analysis of thin sections of earth hummocks soil/sediment. This method makes it possible to study the interrelationships between the various individual components, particles, and pores that make up sediments and soils, identifying the types of features and then interpreting them in context with the environmental setting, providing information about the genesis of the soil and sediments, and, in our case, micromorphological modifications in their sequence of formation due by frost action. The impact of this process depends on various soil characteristics, and on the temperature regime and the segregation process of ice lenses results in the development of distinctive soil features, the most typical being platy and lenticular structures at various scales. In conditions of alternating freeze and thaw, the characteristic lenticular and platy microstructures occur together with more or less developed silt and coarse clay capping on lenticular aggregates and sorting of coarse grains, giving rise to different types of banded fabrics. The analysis of these microstructures was performed in correlation with the specific density revealed by computed tomography (CT) scanning, monitoring of the thermal regime inside of the earth hummock, the specific physicochemical characteristics, such as granulometry, vertical and horizontal variation of thermal conductivity, moisture and metal ions content, magnetic susceptibility and internal structure and its seasonal evolution were proved through electrical tomography investigations (ERT).

Natural hazards and disappeared settlements in NE Romania

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Natural hazards affect people, their assets and settlements. Unfortunately, sometimes the magnitude of the hazards can growth so much that they can reach certain thresholds that exceed the resilience level of the local communities. The study of the past events constitute a milestone in risk

analysis and management, due to their capacity to offer a better phenomenological understanding, in order to evaluate the aftermaths, and to offer a background for the future scenario-based vulnerability and risk assessments. These can really increase the capacity of local communities to rise up the level of resilience, to increase the level of preparedness and to find any available solution to mitigate the impact of natural hazards at least at a local scale. Natural hazards are the one of the most significant threats in rural areas of Romania and among them landslides, floods and bank river erosion are the geomorphological processes that impose the highest risk associated to rural areas in the Moldavian Plateau. Using old maps as primary tool (Moldavian Topographic Map 1894-1986 - 1:50000; Army Plans 1915-1940 - 1:20000, Romanian Topographic Map at 1:25 000 scale, Ist and IInd editions – 1960 and 1980) and overlaid with 2003-2012 ortophotos imagery we have identified 189 villages affected by natural hazards. These settlements were classified by the main natural hazard process (landslides, floods, bank erosion) and by the level of damages that natural hazards created (disappeared, displaced and partial affected). The main natural hazards that affected the inventoried settlements were landslides (63%), floods (26%) and river bank erosion processes (11%); a percentage of 19% of cases represent the settlements which completely disappeared. In the Moldavian Plateau the mentioned natural hazards played an important role in the dynamics of the settlement network, with variations induced mainly by the socio-political characteristics and not necessarily by the frequency variation of the natural hazard events.

New insights on fluvio-marine interactions at wave-influenced river mouths

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Floods and storms are recurrent high-energy phenomena that act on river mouths and have a considerable influence on their hydrodynamics and morphological change, although studies documenting their relationship and interactions are rare.

The present work discusses, using a database of annual bathymetric changes at the mouth of the Sfântu Gheorghe branch of the Danube River delta, the relationship of bed changes with Danube discharge (liquid and solid) and storm climate (wave height), which can be estimated by a

Flood/Storm index based on river water or sediment discharge and wave height proxies (R2=0.84). Furthermore, a selection of discharge and wave thresholds representative for this particular river mouth were simulated with Mike 21/3 by DHI (Danish Hydraulic Institute). The coupled hydrodynamic and wave model is used to characterize the current-topography interactions and applied bed shear stresses at this complex river-mouth sedimentary system. The model simulates 3D jet and plume hydrodynamics during floods, and the longshore current and wave dissipation during storms. The field data are presented alongside the Mike 21/3 model results in a conceptual morpho-hydrodynamic model of an asymmetric wave-influenced river mouth bar during the two antagonistic phases of river floods and coastal storms.

Furthermore, we extend the analysis using exploratory modelling to a full range of conditions on five idealized bathymetries which resulted in ~1000 different hydro-sedimentary snapshot conditions as a function of discharge, wave height and direction. The effects of the mouth bar configuration on the hydrodynamics are examined, as well as highlighting the differences between mouth bars with different volumes and symmetric or asymmetric morphologies. Finally, predictive relationships are proposed for emergent morpho-hydrodynamic interactions such as the "hydrodynamic groin effect".

Soil erosion exerted by water within Băileşti Plain

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The Băileşti Plain is the most complex plain within Oltenia Plain, being located on all the eight Danube terraces and covering an area of approximately 2170 km^2. The plain is crossed by the short courses of Bălăsan and Desnăţui and it has on its surface many gullies through which water flows during the rainy days. The annual amount of rainfalls oscillates between 500 and 600 mm. In this study we focus our attention on soil erosion exerted by water. This form of erosion has a strong impact on soil productivity, drinking water, the carbon stocks, or even the entire ecosystem can be affected (Panagos, P., 2015).

Thus, in order to quantify the soil loss rate we used RUSLE equation, which initially was created by Weischmeir and Smith (USLE, 1978) and later was improved by Renard K.G. et al. (RUSLE, 1996). Panos Panagos used RUSLE equation to estimate at an European level the soil loss rate exerted by water (2015). The RUSLE equation takes into account five factors to estimate the amount of soil eroded by the action of water, namely: rainfall erosivity

factor (R), soil erodibility factor (K-factor), cover-management factor (C-factor), slope length and slope steepness factor (LS), support practices factor (P). The mathematical formula is the product of all these factors: E = R x K x C x LS x P, where E is the annual average soil loss (t ha^{-1} yr^{-1}) (Panagos, P., 2015).

Some of these factors have been calculated and others have been taken from the literature. For example, to estimate the aggressiveness of the rain within the Băileşti Plain we used the monthly average rainfall quantities between 1966 and 2015. Then we apply a form of Fournier's equation in order to identify pluvial aggressiveness. The obtained values range between 6.2 in the Ciupercenii Noi area and 8.2 East of Măceşu de Sus. The coefficient of soil erodibility was taken after Moțoc (1975), respecting the texture criterion, the values ranging between 0.7 for the varied soil texture and 1.2 for the sandy texture. For the sloping factor, we used a 25-meter ASTER GDEM digital elevation model obtained through the Copernicus program of the European Commission and DG Enterprise and Industry. Dominant values range from 0 to 20. Factor C values were taken from Panos Panagos's work, which calculated at European level the impact of land cover and land use on soil erosion, using the LANDUM method (Panagos, P., 2015).

What we have obtained by multiplication of the above factors shows that the area under analysis has predominantly soil erosion rates ranging from 0 to 2.85 t $ha^{-1}yr^{-1}$, similar to those obtained by Panagos in its study (2.46 t $ha^{-1}yr^{-1}$in 2010 as an European average). Isolated, as it happens North of Piscu Vechi and Lipovu, soil loss rate has values exceeding 2.86 t $ha^{-1}yr^{-1}$. Overall, the values are small compared to other areas of the country, which can have an eroded soil quantity of over 5 t $ha^{-1}yr^{-1}$ (Bârlad Plateau, Carpathian Areas).

Field trip Muntele Mic

Muntele Mic – brief geomorphological monography

Location and geological setting of the Muntele Mic area

Muntele Mic Massif (1801.5 m) is located in the western extremity of Southern Carpathians, in the Retezat-Godeanu mountain unit (Fig. 1). The Massif dominates the Caransebeş Depression in the west and the Bistra Couloir in the north and is connected with Țarcu Massif through the low altitude interfluve Jigoria (1463 m) - Şeroni (1399 m). The south-eastern, eastern and northeastern limits are given by the valleys Vâlsanul-Olteana (Şucu) - Bistra Mărului and its tributary Brătonia, and to the south-west, west and northwest the Craiul-Sebeş and Borlovița-Borlova valleys. Muntele Mic has the lowest altitude among the four high masiffs that constitute Țarcu Mountains. Excepting Muntele Mic the other three masiffs exceed 2100 m, as follows: Țarcu – 2190 m, Baicu – 2150 m, Bloju – 2192 m.

Muntele Mic Massif belongs to the European system of the Alpine Orogene system, originating from the Mesozoic-Cenozoic Alpine orogeny. The structural setting of this typical mountainous area comprises the metamorphic rocks associated with magmatic bodies of granites and granodiorites belonging to the Danubian nappes. The entire area corresponds to the Upper Danubian Domain, with a thrusting sheet status, where the *Unit of Muntele Mic* occupies mostly the homonymous mountain range (Fig. 2). There is a great variety of rocks within the Muntele Mic granitoid body, consisting of granodiorites with biotite and hornblende, biotitic granites, and quartzitic diorites with melanocratic segregations, sometimes crossed by quartz and lamprophyre aplitic lodes, but they also contain magmatic zones with contact of schists enclaves (Gherasi and Savu, 1969, Savu *et al.,* 1981). The granitoids have a gneissic texture and contain quartz, biotite, plagioclase feldspar and potash feldspar.

To the south-east lies the Măgura Marga series, defined as an epimetamorphic series, - the green schists facies, metamorphosed in the assynthian cycle (Cambrian) - , consisting of schists with muscovite, chlorite and biotite, quartzitic schists, and intercalations of amphibolites, amphibolic gneisses and lenticular gneisses (Savu *et al.,* 1981).

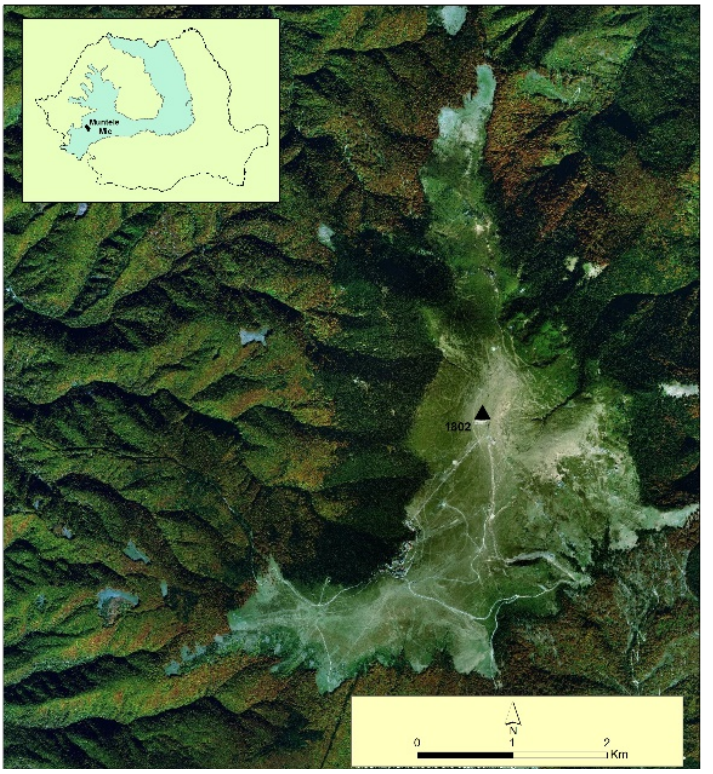

Fig. 1. Location map of the Muntele Mic Massif.

To the north-northeast another geologic unit occurs (*Poiana Mărului Unit)* and consist mainly on crystalline schists, represented by the Barnița series (Gherasi *et al.,* 1968). This is mainly made of chlorite-sericituous epimetamorphic schists with biotite, chlorite-epidotic schists with albit and chlorito-actinolytic schists. Intercalations of chloritizated amphibolites, quartz-feldspar gneisses and rarely gray quartz were also noticed.

The Măru Unit occurs to the west and it consists by crystalline schists of Zeicani series like orthoamphibolites, amphibolic gneisses, micaschists with muscovite and granats, fine quartzitic gneisses and quartzo-feldspatic intercalations, component of the inferior member and micaceous paragneisses, micaschists, chloritous schists with albit, quartzitic-chloritous schists, and rare crystalline limestone intercalation (Savu *et al.,*1981).

The Olteana Unit appear in the upper basin of Vâlsanu Valley, and have a different lithology which consist in metamorphosed Jurasic (Liasic) deposits, siltic quartzitic sandstones with carbonatic cement, quartzitic metapsamites and feldspatic metapsamites (Savu *et al.,* 1981).

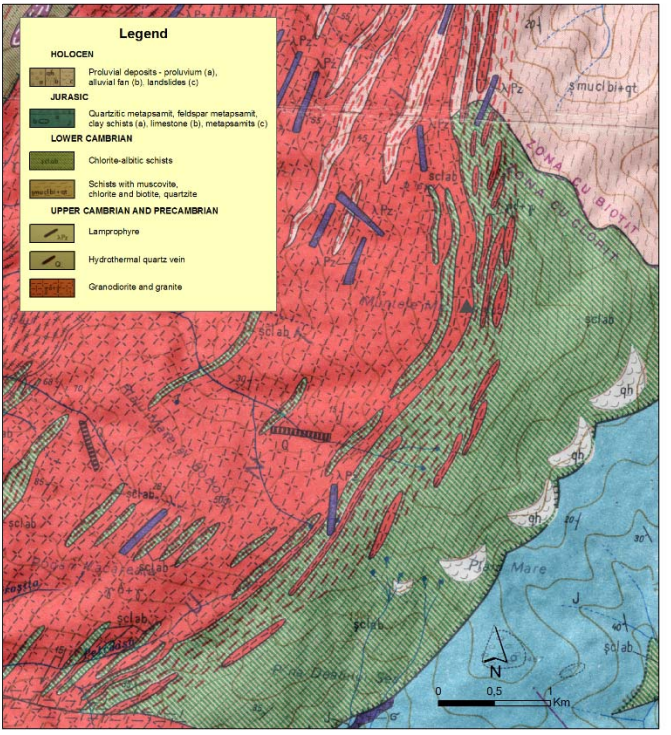

Fig. 2. Muntele Mic Massif - geological sketch (based on geologic map 1:50000).

The Şeloaca unit is present on the left slope of the Şucu Valley, downstream from the confluence with Vâlsanul, over Cleanţu Boborăţei, to Bistra Mărului, „bestride" the Olteana unit. There are rocks affected by retromorphism, such as gneissic granitoids, chloritous schists with albite and calcite, included in the Zeicani series, sporadically adding liasic rocks, similar to those in the Olteana Unit (Kräutner *et al.,* 1981).

Superficial deposits of quaternary ages represented by glacial and periglacial deposits, fluvial and biogenetic deposits, specific to wetland areas occur also within the study area.

Brief climato-hydro-biopedogeographical aspects

From the climatic point of view, the mean annual air temperature (MAAT) for the high zone of Muntele Mic Massif ranges between 2 and 3 °C. According to the climatic records in the Southern Carpathians, the calculated 0 °C isotherm of MAAT occurs around 2050 m. The closest meteorological stations are Ţarcu (2180 m) and Cuntu (1450 m), characterized by a MAAT of -0.5 °C and 4.4 °C respectively. The monthly

mean negative air temperatures are typical from November to April in Țarcu, with -8.6 °C, in February and from December to March at Cuntu station, with -4.3 °C in February. Average of maximum temperatures fluctuates between -1.1 °C in January and 17 °C in August at Cuntu station and between -5.8 °C in February and 10.8 °C in August at Țarcu station, while the average temperature is between -6.8 °C in February and 10.3 °C in July at Cuntu and between -11 °C in February and 5.5 °C in August at Țarcu station. The average number of frost days varies between 152 at Cuntu and 221 at Țarcu station at more than 2000 m.a.s.l.

Regarding the mean annual precipitations values, they are between 1072.2 mm at Cuntu and 959.4 mm at Țarcu, the maximum being reached in June with 158.6 mm at Cuntu and 139.9 mm at Țarcu. January and February are the driest months, followed by October and November. The number of days with snow cover may exceed 200 at the Țarcu station, while at Cuntu the value is between 100 and 160 days.

The hydrology of the high area of Muntele Mic is characterized by the presence of permanent springs occurring both at the base of the slope segment which separates the upper plateau from the secondary interfluves, and also, very frequently in the area of nivation niches and in glacial cirques, like on the middle step of the Vâlsanu, or Scorila cirque, where they flow into a small lake, all marked by a characteristic vegetation. The situation is explained by the thickening weathering mantle specific for the peneplains area and slightly slopes, storing large amounts of precipitation and water resulting from melting snow, snow accumulated abundantly through scattering on south-eastern slopes such as the one on which the archaeological site lies.

The Muntele Mic massif is almost entirely forested because of its low altitudes. The prevailing forest consist in beech, mixed and spruce forests. Moreover, due to long-lasting anthropic intervention, the beech and spruce occur up to 1400 m altitude, the spruce forest being represented only by a discontinuous fringe, isolated trees can be found up to 1500 m. Above, are the subalpine and alpine meadows with tufted fescue (*Festuca airoides*), alpine meadow-grass (*Poa alpina*), bent grass (*Agrostis rupestris*), highland rush (*Juncus trifidus*), crooked sedge (*Carex curvula*), green sorrel (*Rumex alpestris*), tufted hair-grass (*Deschampsiae caespitosa ssp. alpicola*), mountain avens (*Geum montanum*). Forest juniper (*Juniperus sibirica*) and shrubs such as *Rhododendron kotschyi, Vaccinium myrtillus* and *Vaccinium vitis-idaea* are widespread in this area. It is not excluded man's intervention over forests over the centuries, the meadows expanding because of the importance of the shepherd for the rural subsistence economy.

Muntele Mic Massif is dominated, in the plateau region and the rounded secondary interfluves, by podzolised acid brown soils and podzols, cryptospofdic, umbric and lithic, depending on the strictly local conditions of

the topographic surface and the geological substrate represented by acidic rocks (crystalline schists, granitoids). Acidic soils, poor in nitrogen, calcium and basic elements and often skeletal, are less fertile, being favorable only for coniferous and mixt forests, subalpine shrubs and alpine meadows.

The geomorphologic setting

The present-day geomorphologic landscape bears the signs of complex interactions of many factors and morphogenetic agents along several evolutionary cycles. The peneplanation by long-term erosion produced typical denudational surfaces in Muntele Mic Massif, whereas the tectono-structural and lithological elements are among the most conspicuous landscape features. Overall, the relief is typical for a mountainous massif, well individualized compared to the neighboring units. The meso- and microforms detailing the morphological aspect of this mountainous area, belong to the lithological, glacial, periglacial, fluvial and fluviol-denudational relief and, to a small extent, to the anthropic one.

A certain specificity of this mountainous area is highlighted by the analysis of the *morphometric characteristics.*

The hypsometry of this massif is typical for medium altitude Carpathian units, as well as the relatively concentric arrangement, disposed like in the Piedmont benchland model (*sensu* Piedmonttreppen, Penck, 1924) from the valley axis and/or tectonic couloirs to the center (Fig. 3).

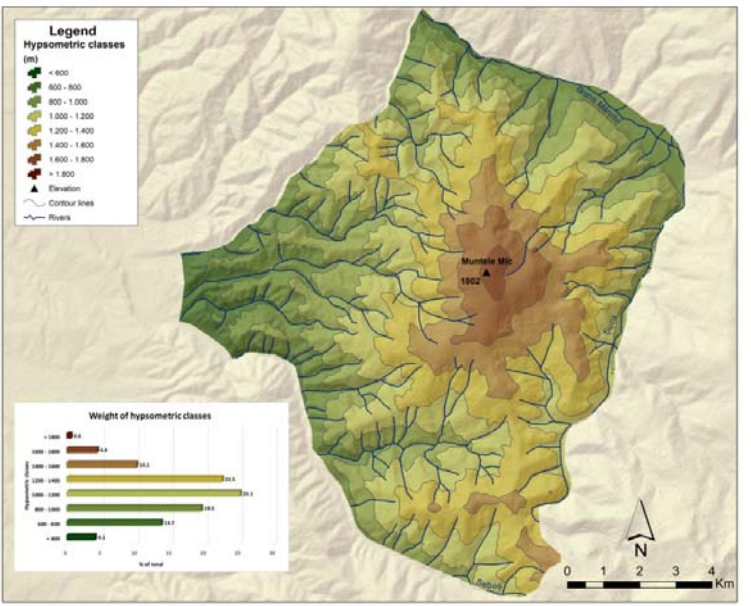

Fig. 3. Muntele Mic Massif – hypsometric map.

The relief with altitudes below 600 m has a minor weight, below 5%, similar to the step over 1600 m. The largest areas are occupied by the hypsometric classes of 1000-1200 m and 1200-1400 m, with 25.1% and 22.5% respectively, highlighting the interfluvial framing in the altimetric ceiling specific to the Gornoviţa and Râu Şes sculptural complexes; the latter developed at the expense of the old relief, that of the Borăscu sculptural complex.

Slope or geodeclivity, another important morphometric element, provides indications of the morphodynamic potential, the priming of processes and phenomena that are situated into the category of geomorphological hazard types and geographic risk phenomena. From this point of view, the map (Fig. 4) highlights the predominance of the slopes classes which, on the one hand, characterize the mature mountainous relief, - the slope classes of 2-5° with a weight of 23%, exemplarily exemplified through the broad dome of Muntele Mic-, and on the other hand, the slope classes over of 15°, with a cumulative weight of 35%, support and stimulate the triggering and unfolding of the gravitational processes, as well as, vertical erosion.

The mosaicated presence of surfaces with different, contrasting slopes, as at the source area of Vâlsan, Scorila, Balota and Uzina Brook, reflects the complexity of the relief in those areas, complexity of the relatively smooth surfaces of the peneplains on the contact with the glacial cirques, the nivation niches and the altiplanation/ cryoplanation terraces.

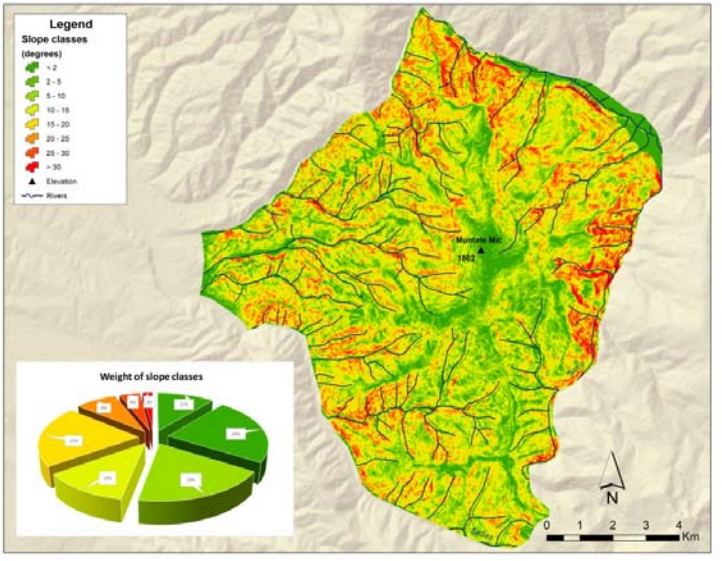

Fig. 4. Muntele Mic Massif – slopes map.

The relief energy expresses the efficiency with which the hydrographic network, the major agent of morphogenesis, has deepened in relation to the old and major interfluves, under specific lithological conditions and in spatial relations to the regional base levels, the Pannonian Basin and then the Timiş River and the local erosional base, caused by more resistant lithological complexes, such as Muntele Mic granitoides. As in the case of slopes, it is natural to differentiate the central area, corresponding to the broad extension of the Borăscu peneplain and on the upper level of the Râu Şes sculptural complex, with the lowest values of this morphometric parameter, with characteristic values below 100 m, and the marginal areas where, the relief energy values are 300-400 m, is representative for 39% of the area (Fig. 5). The values higher than 400 m have a cumulative weight of 22%, and are characteristic especially for river basins tributary of Bistra Mărului river, but also those belonging to Borlova Brook, grafted on crystalline schists.

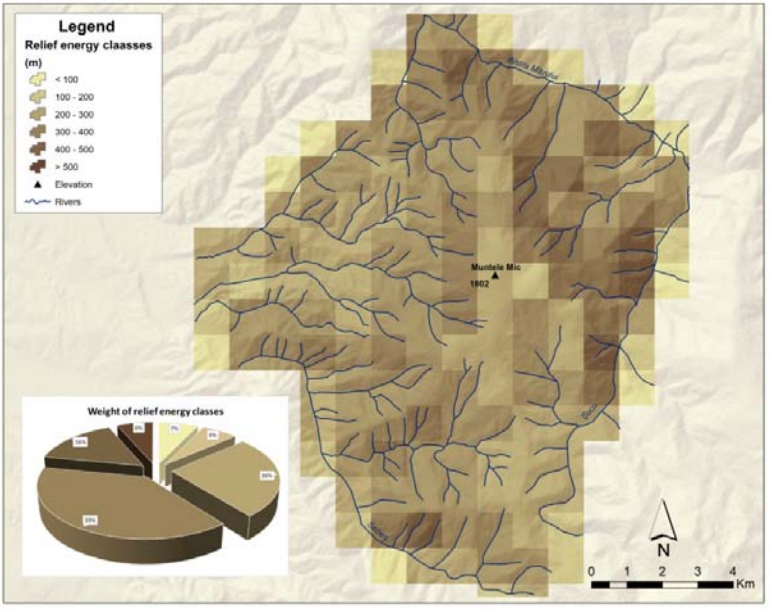

Fig. 5. Muntele Mic Massif – relief energy map.

Drainage density expresses how the permanent and temporary hydrographic network has managed to develop into the surface, developing a drainage network through the emergence of new tributaries - each with an elementary morphohydrographic basin - characterized by an efficient regressive erosion and in the detriment of interfluvial surfaces, a situation highlighted by the existence of some head saddle.

The density of relief fragmentation spatial model is very similar to that the depth of the relief fragmentation model, highlighting the central area, the highest and the main interfluves adjacent to it, the densities with a value of less than 1 km/km^2 and between 1 and 2 km/km^2 , with a share of 41% and 40%, respectively (Fig. 6). These are the ones that still bear the mark of the old denudational cycles, belonging to the Borascu and Râu Şes sculptural complexes.

The highest values of fragmentation densities, of over 3 km/km^2 have a weight of only 2% and are found in several morphohydrographic basins developed on epimetamorphic crystalline schists.

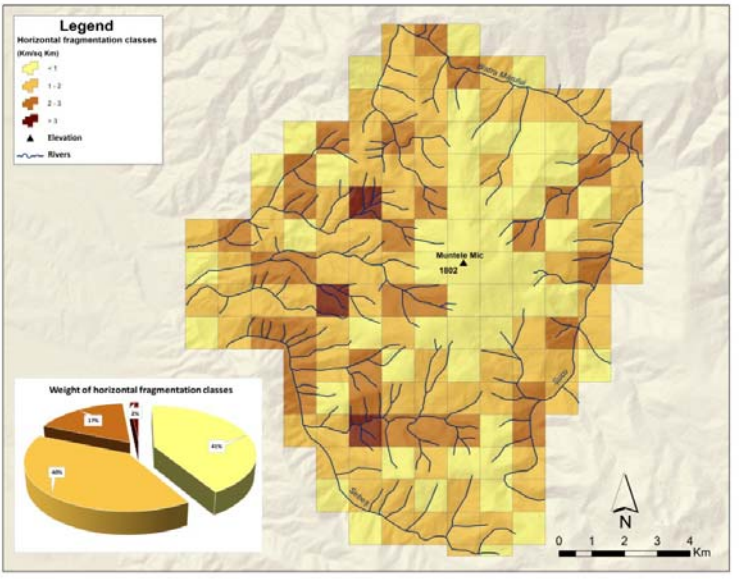

Fig. 6. Muntele Mic Massif – drainage density map.

With a quantitative and qualitative relevance, *aspect* is a characteristic that reflects the degree of sunshine, respectively the shading of the slopes, with topoclimatic consequences. Considering the general direction of the main hidrographic network, Timiş and Bistra Mărului, in function of which the valley network of their tributaries was established and has evolved, a network with a radial-divergent character, compared to the Muntele Mic hydrographic node, the aspect classes have relatively close weights, between 9 and 14% (Fig. 7). The morphological surfaces with north-western orientation, to the Caransebeş tectonic corridor, local base level, an apophysis of the Pannonan Basin, have the highest weight, 16%, the lowest part, only 1%, characterizing the southern orientation towards the Ţarcu Massif.

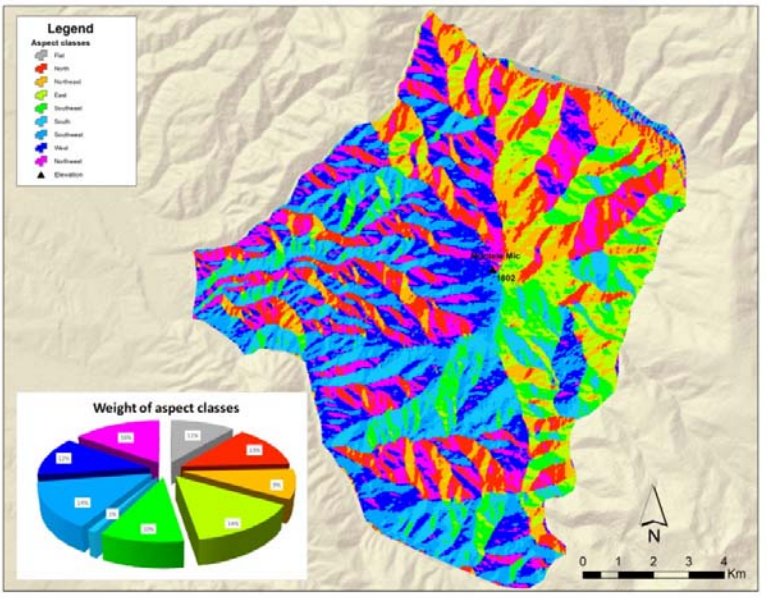

Fig. 7. Muntele Mic Massif – aspect map.

The general *geomorphologic aspect* is that of a dome, widely bulging, the somital part of this massif, a plateau (Photo 1) that corresponds to a planation surface (peneplain), a level of the Borăscu denudational complex (Fig. 8), that has a remarkable extension above 1775 m (Niculescu, 1971).

The plateau on the top of Muntele Mic is characterized by almost flat surfaces and slopes less incised by the hydrological network. The prolonged morpho-dyanimc evolution of this plateau is supported by the continuous and well-structured weathering mantle (Photo 2), with thicknesses exceeding even 2 m.

The analysis of the interfluves that radiate from this orographic node, points out that their morphology is marked by the presence of rounded or even flattened surfaces – *e.g.* Dealu Şes (Flat Hill), suggesting the existence of denudation surfaces belonging to the Râu Şes and Gornovița sculptural complexes (Fig. 8), all marking certain moments of paleo-morphologic evolution. The highest area of this radial interfluves reveals clear remnants of lower peneplain, which occurs at 1720-1760 m and might represent the lowest level of Borăscu denudational complex in the western part of the Southern Carpathians. Analysing the distribution of altitudes along the entire massif we noticed a certain asymmetry. On the eastern and northeastern slopes, adjacent to the Bistra Mărului, the morphological levels that are integrated into the Râu Şes denudational complex occur at 1620-1680 m, 1480-1550 m, 1330-1450

m, and those of the Gornovita denudational complex, with numerous valley shoulders, at 1200-1260 m, 1100-1160 m, 900-950 m and 800-860 m. On the other hand, on the western and north-western parts, within the Sebeş catchment, the altitudes of the denudational surfaces are about 30-50 m lower. This difference is due to the higher local erosional base level of the Poiana Mărului Depression, close to downstream by a gorge sector, crossing the northern end of the granite body of Muntele Mic (Urdea, 1984).

Photo 1. General aspect of the Muntele Mic Massif.

Photo 2. Weathering mantle on the Muntele Mic peneplain.

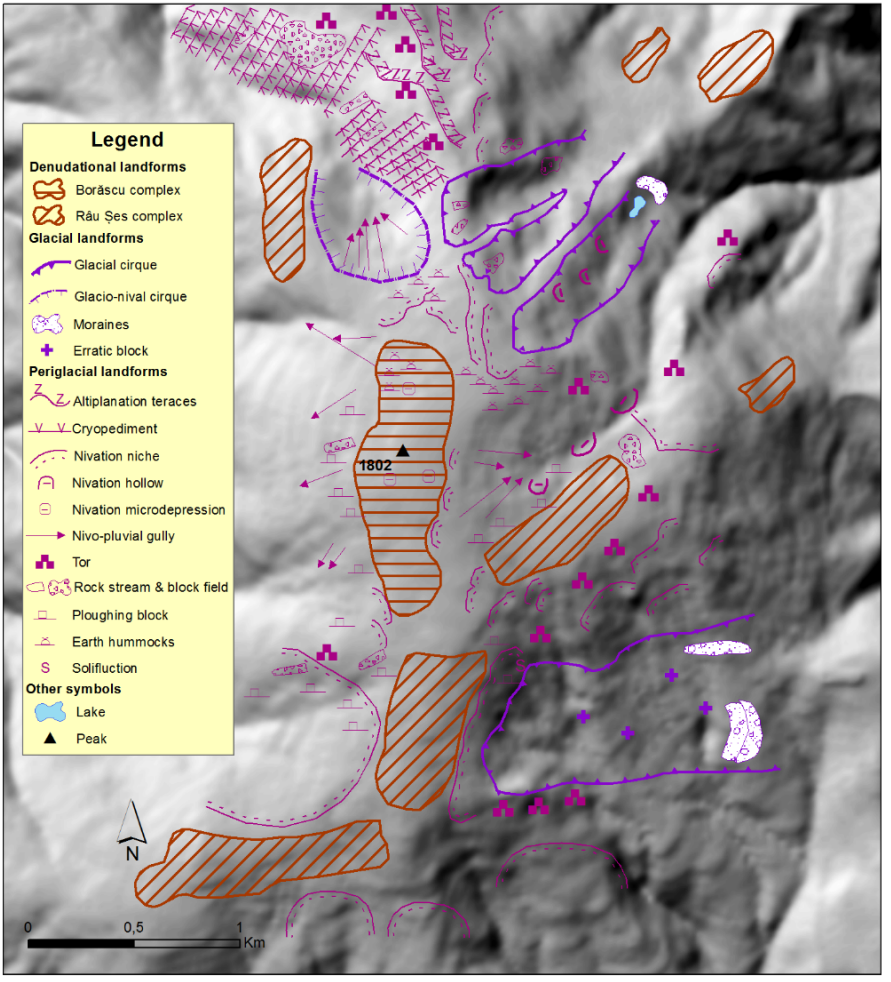

Fig. 8. Muntele Mic Massif – geomorphologic sketch.

The lower altitudes of the denudation levels in the Muntele Mic, compared with the corresponding within the neighbor mountainous units, can be explained both by the peripheral position of Muntele Mic Massif, in the vicinity of the Pannonian Basin, and by the presence of a fault crossing the southern extremity of the this area and which allowed a different vertical tectonic movement of the massif.

The lithological and structural landforms are correlated with the presence of the Muntele Mic syncinematic granitic body. The highest area correspond to the most resistant rocks to weathering. The presence of these

this lithology allowed a good preservation of the old cyclical relief, especially the Borascu sculptural complex, of post-laramian age.

The general aspect is that of the dome, widely bulging, dissected and rounded by radial valleys, what is included in a geomorphological landscape type *,,all-slope topography"* and *,,convex (dome-form) landscapes"* (Migon, 2006), forms of second order (Godard, 1977). An obvious aspect is that the surface of the peneplains are dominated by some rocky blocks, with ruinous look, called **tors**, very present in the landscape (fig. 8), isolated or grouped, with heights of 1 m, like stubs, to 8-10 m**.**

The shape of these individual residual landforms is controlled by joint and fracture patterns, specific for the granitic rocks and by schistosity planes, in the case of the crystalline schists. This microtectonic elements and pattern in horizontal and vertical plan controll the shape and general aspect of tors. When the tors are a rectangular outcrop whose margins defined by joints and/or bedding planes we have a castle koppie or castellated tor type, a good example for granitic landform (Photo 3).

Photo 3. ,,La Blid" tor, a castellated tor type.

Since several theories are conveyed on the genesis of the tors (Cunningham, 1968), considering that they occur only in the highest area of the massif, we consider that they have a Pleistocene periglacial origin. On the other hand, we cannot completely reject the hyphothesis supporting an older age for these erosion witnesses dominating the peneplain.

Where granitoids occur on the terrain surface granular weathering produces *granitic arena* or *grus* (Photo 4), and small weathering pits.

The influence of geology in the landscape is also evidenced by the thrusted strcuture. The thrust sheets unfolding from NW to SE, case in which the crystalline schists in all litostratigraphic units are arranged in a monoclin folds, with tilts from 20 to 45°. There are situations of asymmetry of the valleys, such as some sectors of the Borlova and Borlovița valleys, Brătonia, Vâlsanu, Boborața, or interfluves as in Culmea Cioaca, Cleanțu Boborății, Cracu Băloiu-Scorila, Cracu Maurului, Cracu Plaiul Orlei, Cracu Gorunului.

The lowered alignment of Pârâul Craiului Brook –Jigora Saddle-Vâlsanu Brook, is possible to overlap the fault, oriented W-E and crossing the southern extremity of the Muntele Mic granitoid body.

Photo 4. Muntele Mic granitoidic gruss.

Glacial landforms

The presence of Pleistocene glaciers in this Massif was not considered in the previous studies (*e.g*. Niculescu, 1971), although glacio-nival cirques have been described (Niculescu, 1990). In the recent decades, new findings (Urdea and Reuther, 2009), revealed a new perspective on the Pleistocene glaciation of this area.

It is true that the glacial landforms are not the most expressive, but the correlation between the erosional and accumulation landforms make it possible to prove the existence of glacial modeling in this mountainous area.

A first ascertainment is that glacial and glacio-nival cirques are present only on the eastern and northern slopes – as a function of the favorable conditions of snow accumulation and transformation into firn and glacier ice. These cirques have rather small sizes. The gradual transition from the relatively flat surface of the peneplain to the headwall of the cirques, with steep slopes (>45-50°) only in the lower half, proves that the glaciers in these cirques were also fed from the plateau glacier located in the high area.

The largest glaciar cirque, on the upper part of Vâlsan basin, oriented to SE, developed from 1695 to 1400 m a.s.l. , with a length of 1200 m and a maximum width of 530 m, is asymmetric, only the southern wall being steep and dominated by a a crest of about 400 m long on which several tors are present. The cirque floor ranges from 1585 m to 1400 m, it is in the form of three slightly inclined steps and a corrugated relief (Photo 5), with an alternation of marshy depression surfaces and hummocky surfaces of a morainic nature, with many erratics. In the lower northern part there is a beautifully shaped lateral moraine, of about 150 m long (Photo 6) and, a bit above, at 1460 m, an erratic huge block (Photo 7). A fragment of the terminal moraine is kept in the form of a double semicircular ridge at the south-eastern extremity of the cirque, at 1400-1410 m (Photo 8), which marks the maximum extension of the Pleistocene glacier.

Photo 5. General aspect of the Vâlsanu glacial cirque.

Photo 6. Lateral moraine of the Vâlsanu glacial cirque.

Photo 7. Vâlsanu glacial cirque: erratic block.

The Scorila cirque, present in the upper part of the homonym basin, is oriented to NE and developed between 1745 and 1535 m a.s.l. , with a length of 600 m and a maximum width of 330 m. The headwall have a broken arch

contour, with a more steep southern flank and poorly contoured to north. The floor is double-inclined, towards NE and S, with many dislevelments, with the exception of the lower part, which is flatter, swampy, with a small depression partially occupied by a lake at 1550 m a.s.l. Downslope the cirque is closed by a small morainic deposits.

Photo 8. Frontal moraine of the Vâlsanu glacial cirque.

At the springs of the Balota brook there are two small glacial cirques, Balota Sud and Balota Nord, which unite at an altitude of about 1520 m, in an incipient glacial valley.

The cirque Balota South is oriented to NE and developed between 1720 and 1535 m a.s.l., with a length of 610 m and a maximum width of 260 m and a headwall slightly lobate. At the bottom northern part of the walls of this cirque a block stream occurs. The cirque floor has a confused topography due to the post-glacial modeling of the morenaic deposits.

The cirque Balota North is oriented to E and developed between 1700 and 1535 m.a.s.l., with a length of 620 m and a maximum width of 270 m and a headwall slightly lobate on the south corner and then quasi-linear to the north. At the base of the headwall there are two block streams, and the northern side wall supports a scree deposits. The cirque floor has a gentle slope and a slightly expressive glacial topography, which continues with a small glacial valley.

The glacio-nival cirque *`La Blid`*, oriented to north, has a semicircular contour and centripetal slopes, slightly asimetric, dissected by some nivo-torrential creeks. Is developed between 1695 and 1400 m a.s.l. , with a length of 900 m and a maximum width of 530 m.

The reconstructed glaciers were of the following dimensions: Vâlsanul – 88.56 ha, Scorila - 15.33 ha, Balota North - 16.97 ha , Balota South 9,59 ha and La Blid firn field 32.19 ha; for Southern Carpathians ELA's average value being 1664 m (Urdea *et al.,* 2011).

Periglacial landforms

In the alpine area located above the timberline, the geomorphological landscape detail is dominated by mezzo and micro periglacial landforms.

After the Quaternary glaciation, in the deglaciated spaces, in so called paraglacial environment, the relief has been under the influence of periglacial modeling, cryogenic processes (frost weathering, frost creep, frost heaving and frost jacking, thermal sorting), solifluxions, cryoplanation and nivation, generating characteristic landforms, such as cryonivation niches, benches and depressions, altiplanation terraces, block streams, block fields, scree slopes, solifluxion lobes and terraces, periglacial tors, patterned grounds etc. Most of these landforms have a relict character, whereas few o them are typical features for marginal periglacial environments.

The spatial distribution of the periglacial landforms exhibit an asymmetry since the most extensive features, the cryonivation/ cryoplanation landforms are very representative for the northern and eastern slopes.

Altiplanation terraces, cryoplanation terraces, equiplanation terraces or *replats goletz* occur mainly on the northern part of the Muntele Mic alpine area. Here, on a distance of over 1 km, appear a terraces sequence, composed of four alternating relatively flat surfaces, wide up to 100-150 m, oriented to E and NE and small scarps, up to 7-10 m height (Photo 9). These scarps are linear or slightly ondulated by small nivation niches, being dominated by some tors, associated with small, more or less organized block streams.

The tors, dominating with a few meters (2-6 m) the terrace surface, are remnants from the former morphological surfaces.

The complex genesis mechanism of altiplanation terraces implies cryoplanation- cryopedimentation and/or nivation (Thorn and Hall, 2002) and „solifluctional peneplanation" (Boc hand Krasnov, 1943), the scarp retreat as the result of nivation and frost weathering, rocks and soils creep and mass-wasting/solifluction for the surficial debris remove. The presence of some blocks with a slab shape suggests the possibility of existence of a cryo-nival pavements, buried in the ground and covered with vegetation, thus relicts.

Photo 9. The altiplanation terraces sequences.

Because cryoplanation terraces occur close to the general altitude of snowline and are considered the periglacial analogs of glacial cirques (Nelson and Nyland, 2017) they are a good paleoindicators for permafrost environment (Reger and Péwé, 1976).

From the largest tor toward west, to Brătonia Brook, the slope is relatively evenly inclined (15-20°), with block streams and solifluction features, and the general aspect of a cryopediment.

On the quasi-horizontal surface of the upper plateau and altiplanation terraces, with a thicker weathering mantle, there are present uneven round or elliptical *nivation microdepressions* of 4-25 m in diameter, and 1-3 m deep, often with water (Photo 10).

There is a high variety of nivation landforms, from the *nivaton benches, to nivation hollows, nivation niches and nivation cirques,* the first especially on the eastern slope, even above the glacial cirques.

Nivation benches have a straight or slightly ondulating deployment, with a small scarp of 2-4 m and less than 10 m width, and may be present as a succession of steps (Photo 11).They are considered to be an early stage in the formation of alpine terraces (Wasburn, 1973).

Photo 10. Nivation microdepression on the altiplanation terrace.

Photo 11. Nivation benches „in stepped”.

The nivation hollows are distinguished by their semicircular or semi-elliptical shape of scarps and the concave profile, slightly inclined towards the slope, with a diameter not exceeding 50 m, as are the two on the left side of the Izvorul Scorila.

The nivation niches and nivation cirques are broader shapes with elliptical and semicircular contours, diameters that can exceed 500 m for cirques. The niches have a well contoured headwall, a slightly inclined profile and with a small reversal of slope on the endpoint (Photo 12).

Block streams are often associated with tors and their direction is pallel with slope inclination, direction similar also of the axes of the component blocks (Photo 13).

Block slopes and *block fields* are rare morphological elements and are associated with Balota cirques walls, or with some cliffs of lithological contact like the one at the altitude of 1390-1435 m on interfluve Cracu de la Stâna Bătrână.

Photo 12. Nivation niche.

Photo 13. Block stream.

Solifluxional and patterned ground

The presence of the solifluxional forms is very discreet, the landforms being inexpressive, - solifluxional sondulation curves; we consider that the intense grazing past over the centuries, influenced in a major manner the evolution of the detailed morphology of the topographic surface -, except for a solifluxion lobe above the Valsanu cirques and numerous *ploughing blocks.*

Earth hummocks are a form of nonsorted patterned ground develop in relatively rich in grained and organic soils/sediments, frost-susceptible. In explaining the genesis the basic ideas are those associated with the ,,cryostatic pressure" hypothesis (Williams and Smith, 1989). These landforms are miniature cryogenic mounds, a widespread phenomena in the Southern Carpathians alpine environment (Photo 14).

Stratified slope deposits or ,,éboulis ordonnées" (Francou and Hètu, 1989) were also identified at the base of several slopes (Photo 15) and have an important paleoclimatic significance.

Photo 14. Earth hummocks.

Thermal and geophysical measurements on earth hummocks

The periglacial hummocks on the north-eastern slopes of Muntele Mic Massif were first described by Niculescu and Nedelcu in 1961, whereas Urdea *et al*. (2003) initiated the measurements of frost heaving amplitude. Around 100 earth hummocks were measured recently by Onaca (2017), revealing that the mounds are not circular, but rather elongated to the north (Fig. 9). The

length of these mounds varies between 50 and 250 cm, whereas their widths range between 40 and 200 cm. The mean height of 100 earth hummocks is 31 cm and the spatial density of these landforms is 58/100 m^2 (Onaca, 2017).

Photo 15. Stratified slope deposits.

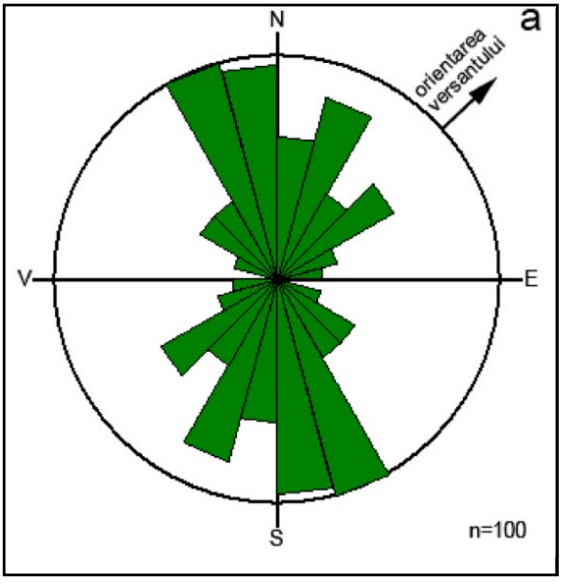

Fig. 9. Earth hummocks orientation in the Muntele Mic site.

In the 2010-2011 season, at 10 cm depth within one selected earth hummock (1759 m) the mean annual temperature was 5.1°C, whereas at 30 cm was 4.9°C. 152 days with subzero temperatures were recorded at 10 cm depth, whereas at 30 cm depth only 110 days with negative temperatures occurred. 17 freeze-thaw cycles were registered at 10 cm depth, whereas at 30 cm only 4 cycles. The first day with negative temperatures at 10 cm depth was 27th of November, whereas the last day with subzero temperatures occurred on 26th of April. At 30 cm depth the last day with negative temperatures occurred on 11th of May, which means 15 days later. This situation is nicely illustrated in Figure 11, revealing that the core of one earth hummock is still frozen at the beginning of May.

Between April 2013 and May 2013 we measured the aspect controlled temperature variations on the north and south parts of an earth hummock. We observed that on the northern flank the freezing is more persistent (with 5 days), compared with the south facing flank of the mound. This finding was used by Onaca (2017) to explain the elongation of the mounds to the north.

The temperatures recorded within the earth hummock at different depths indicated that the intensity of frost heave mainly depends on the soil moisture content, rather than the number of freeze-thaw cycles (Fig. 10).

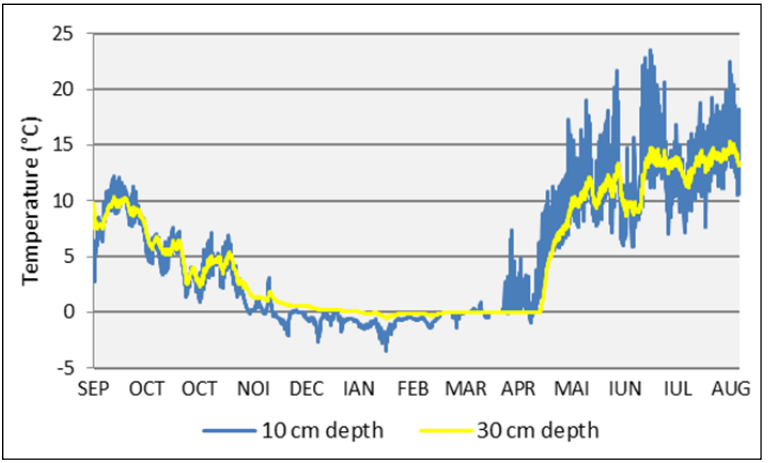

Fig. 10. Thermal regimes within an earth hummock in Muntele Mic (1759 m).

This finding was supported by thermal measurements and repeated Electrical Resistivity Tomography (ERT) measurements. In order to assess the changing physical properties of the subsurface we used ERT in three different seasons (Autumn, Spring and Summer).

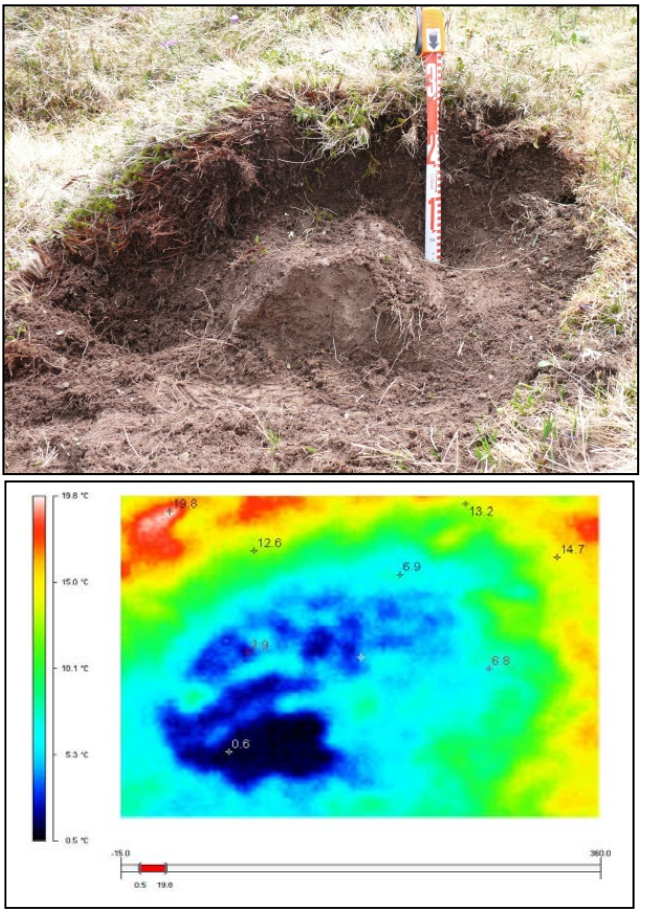

Fig. 11. Frozen core of an earth hummock at the beginning of March (a) and the thermal image, confirming the segregation ice (b) (Urdea, 2010).

In fig. 12 is clearly visible how the resistivity values suggest a completely unfrozen environment in autumn and summer, whereas in late spring the periglacial hummocks are still characterized by frozen sediments occurrence below 20 cm depth.

Seasonal frost heaving was also measured in different years (fig. 13). We observed that the inter-annual variations ranged between 27 and 68 mm and were strongly controlled by the formation of ice lenses in the substrate. The onset of insulating snow cover at the beginning of winter appeared to be very important for the efficiency of the freezing at different depths. The dimensions of the ice lenses depend also on the soil moisture content and the efficiency of freeze-thaw cycles.

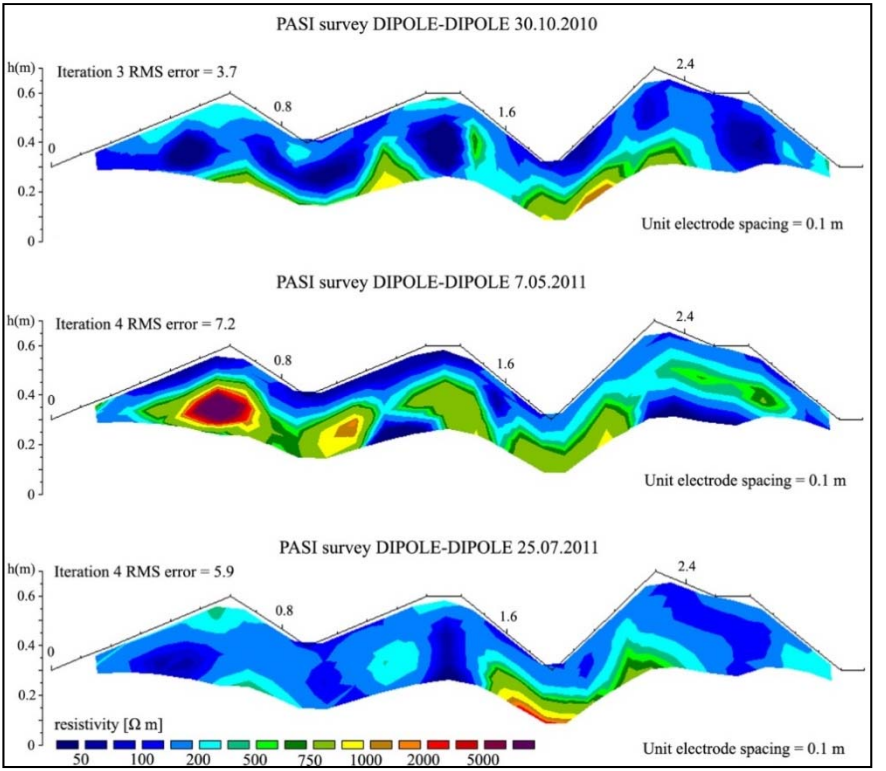

Fig. 12. ERT profiles across three periglacial hummocks at different dates in Muntele Mic Massif (Onaca *et al*., 2017).

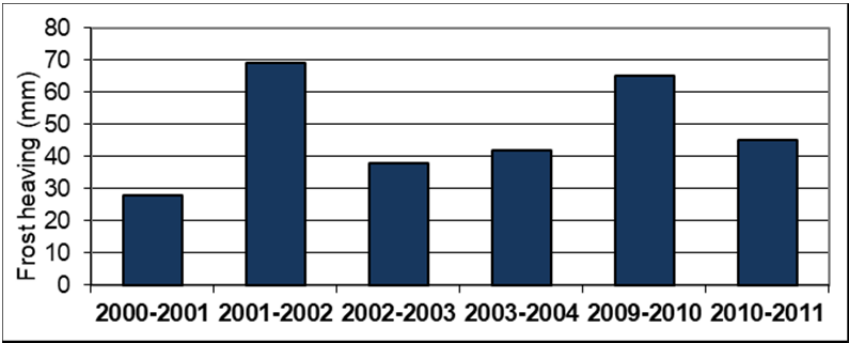

Fig. 13. The seasonal frost heaving at one site with earth hummocks for different years (Onaca, 2017).

Ploughing blocks: annual movement and controlling factors

These periglacial features are reliable indicators of the lower limit of the periglacial environment. In the Muntele Mic Massif we measured the horizontal movement of several ploughing blocks between 2000 and 2012 (Photo 16). The mean annual horizontal movement ranged between 2.3 and 25.8 mm/year. These findings are comparable with similar measurements performed in Tatra Mountains, Scandinavia, Great Britain or New Zeeland (Onaca *et al*., 2017). In 2012 we start to monitor 25 new ploughing blocks and after the first season we recorded horizontal movement between 2 and 44 mm/year (Onaca, 2017). Surprisingly, an enormous block, measuring 6.25 m in length revealed an annual horizontal displacement of 14 mm. However, 10 blocks revealed no horizontal movement in the 2013-2013 season.

105 blocks are currently being monitored in the Muntele Mic Massif. The mean elevation of these blocks is 1667 m, ranging from 1588 to 1751 m. The mean inclination of the slopes where these blocks occur is 17° (maximum: 38° and minimum: 4°). These blocks are moving with annual speeds between 2 and 36 mm (average: 7,7 mm) (□erban, 2016).

Our analysis revealed that the highest velocities were recorded in case of large blocks. Since the ploughing blocks are concentrated on very small altitudinal spacing, elevation does not control the horizontal movements of the blocks. The greatest horizontal movement occurred on slopes between 14 and 16°, but curiously above 18° the displacement rates of blocks was the lowest (□erban, 2016). The greatest mean displacement rates occurred on slopes facing west, north-west and north, whereas the smallest values occurred on eastern and south-western slopes (Şerban, 2016).

Thermal regimes and frost weathering of periglacial torrs

The thermal regime of one periglacial torr located in the northern part of the alpine slopes of Muntele Mic Massif, at 1664 m, was examined using two miniature thermistors. One data logger was installed on the northern facing flank of the torr, whereas a second one on the southern one, in order to examine the role of aspect on the variations of rock surface temperatures. Both thermistors were installed at 5 cm below the surface and covered with silicon. The mean annual temperature of the rock surface was 5.8°C at the northern face of the torr, respective 7.6°C at the southern one (fig. 14) (Onaca, 2017).

The first day with subzero temperatures at the northern rock face occurred on 9th of October, whereas at the southern facing location on 21th of October. More freeze-thaw cycles were recorded at the south facing location (46 vs 30 cycles) (Onaca, 2017). The highest number of freeze-thav cycles occurred in February at the south-facing location and in January on the northern face of the torr (fig. 14) (Onaca, 2017).

Photo 16 Ploughing blocks in Muntele Mic Massif (Şerban, 2016).

Table 1. Characteristics of the ploughing blocks in the Muntele Mic Massif (Onaca, 2017).

ID	A[1] (m)	P[2] (°)	Block dimensions				D[7](mm)	Azimut
			L[3](m)	l[4](m)	H[5](m)	V[6](m[3])	Annual rate (2012-2013)	(°)
1	1635	29	0.82	0.55	0.31	0.13	18	350
2	1635	18	0.94	1.13	0.61	0.64	3	295
3	1635	24	1.6	1.6	0.43	1.1	44	360
4	1750	9	2.1	0.54	0.55	0.62	2	360
5	1736	15	1.7	0.88	0.26	0.38	4	110
6	1722	22	1.9	0.65	0.44	0.54	2	125
7	1717	20	2.58	1.14	0.3	0.88	2	90
8	1718	20	1.6	1.63	0.71	1.85	16	180
9	1679	25	6.25	2.21	0.97	13.39	14	150
10	1664	23	2.6	1.7	0.7	3.09	14	140
11	1700	16	1.19	0.69	0.19	0.15	16	140
12	1665	17	1.14	0.86	0.61	0.59	5	110
13	1659	17	1.7	1.28	0.49	1.06	2	170
14	1657	15	2.17	1.13	0.32	0.78	2,5	130
15	1670	17	1.36	0.78	0.28	0.29	5	110

([1] – altitude; [2] – slope; [3] – length; [4] – width; [5] – height; [6] – volume; [7] – mean annual horizontal displacement rate).

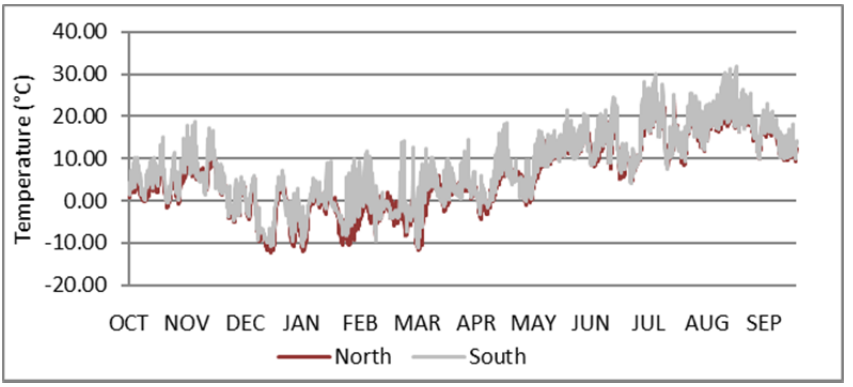

Fig. 14. Rock surface temperature variations during one season (2010-2011) at one torr in Muntele Mic Massif.

Using a Schmidt Hammer we tested the weathering degree of the northern and southern rock walls of five torrs. In all the cases the rebound values measured on the northern faces were greater, suggesting that the weathering was more efficient on southern faces. Our measurements revealed that the thermal stress is considerably greater on the southern faces, where the amplitude of short-term variations is higher (Onaca, 2017).

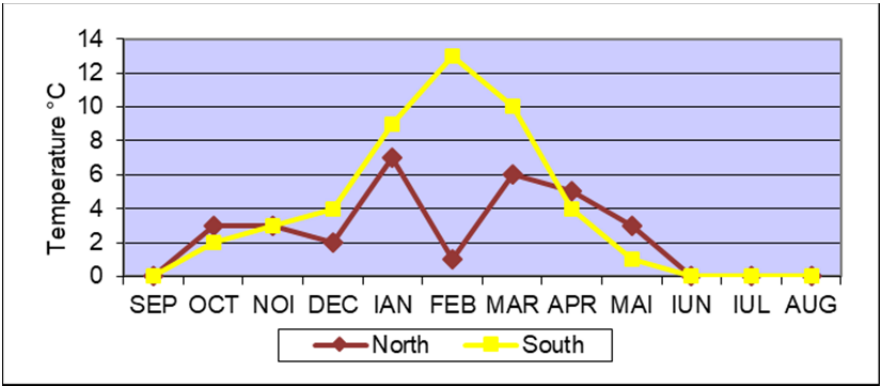

Fig. 15. Distribution of freeze-thaw cycles during 2010-2011 season on the northern and southern face of a periglacial torr (Onaca, 2017).

Based on the aforementioned findings it is possible to conclude that periglacial processes have a significant role in the present-day morphodynamics in the Romanian Carpathians. However, the contemporary climate support the manifestation of frost-induced processes, but in marginal conditions in the alpine environment of the Carpathians, including Muntele Mic Massif.

Field application for young geomorphologists

The archaeological site „Şanțul Turcilor" Maşloc - geoarchaeological approach

Archaeology has become a pure interdisciplinary science over the past decades, requirig complex research methods to highlight past human communities ' way of life.

Geoarchaeology thus appeared to be a necessity to understand many aspects of the connections between humans and the space they lived in during the millennia.

In the following rows we will present a case study in which we used geoscience methods to investigate a medieval archaeological site within southwestern Romania. A study was published (Hegyi et al., 2019) in last issue of Archeological Prospection Journal 2019/1 as a result of this investigation and following application description is therefore based on the paper found at the following link:
https://onlinelibrary.wiley.com/doi/full/10.1002/arp.1720.

The archaeological site „Şanțul Turcilor" is located in the contact area between the Vinga Plain, a high piedmontan plain, and the western extremity of Lipovei Hills. The geomorphologic landscape is dominated by piedmont plateaus, fragmented by some autochtonous valleys such as Beregsău, Magheruş, Apa Mare, Valea Caranilor. In terms of lithology, pliocene-pleistocene sands and pebbles appear together with interlayers of red clay with concretions, 26-30 m thick, covered with a thick loess layer of 8-12 m (Mihailă *et al*., 1987; Hegyi *et al.*, 2019).

The local landscape shows a sequence of rounded interfluves situated at the altitude of 150 -180 m, derived by piedmont interfluves, true riedel or doab type, connected to a local valleys network, with depths ranging from 25 to 30 m, such as Fibis valley, Maşloc valley, Strida Mare and Strida Mica or Turcului Valley, which borders the medieval settlement at WNW, all Beregsau river tributaries (Fig. 1). They have low slopes of longitudinal profile and often have a marshy bottom, just like the Beregsău valley, in the immediate vicinity (Hegyi *et al.*, 2019).

The hydrographic network is represented by Beregsău, a Bega tributary, with a multi-annual average discharge 0.46 m^3/s and tributaries connected to springs from the piedmont deposits, like the spring known as the "Turkish Fountain".

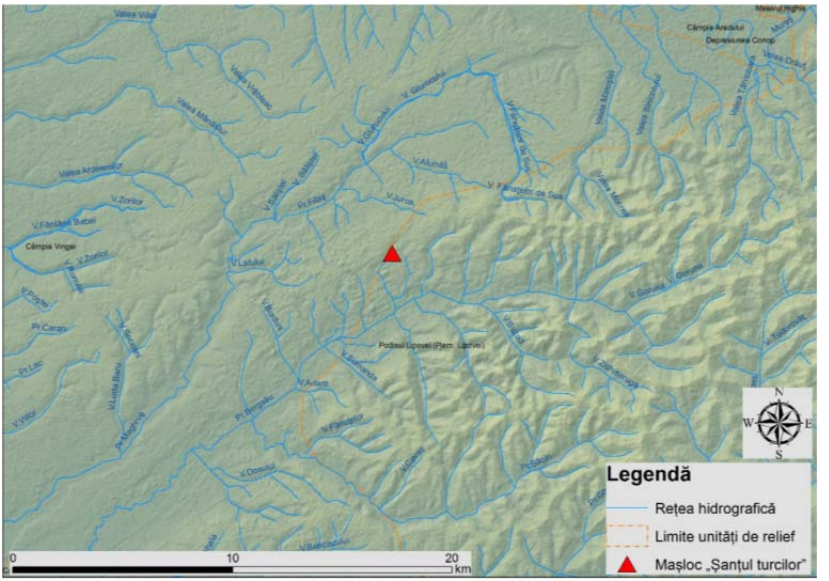

Fig. 1. General aspect of the Maşloc area (Hegyi, 2018)

By the hydrogeological point of view, piedmont deposits include groundwater horizons whose hydrostatic level is more than 5 m deep in the interfluvial area and at lower values in the area of the alluvial plain of the secondary valleys. Some of these waters have a slight mineralization, with a total content of 1000-1500 mg / l, with a chlorine content of 150-250 mg / l and 15 mg / l of sodium (Mihăilă, Giurgea, 1987).

From a biogeographical point of view, the studied area is part of the silvosteppe area, with the predominance of three species of quercineea: english oak (*Quercus robur*), turkey oak (*Q. cerris*) and hungarian oak (*Q. frainetto*). Soils are represented by luvosols - brown-reddish luvic-verto soils, brown-reddish vertic pseudogleyed soils, gleyed on the humid alluvial plain area (Ianoş, Puşcă, 1998; Hegyi *et al.*, 2019).

The archeological site of Ma□loc „□an□ulTurcilor" is a medieval fortification and settlement dated back in the Middle Ages, with a very well defined identity, especially through its radial -concentric topography (Fig. 2). From the documents, we learned that the site was named Machalaka and was first mentioned as an estate in 1322. Surviving documents allowed us to reconstruct the historical out layer of the site until 1561 when it appeared as an abandoned settlement, most likely because of Turkish occupation (Hegyi *et al.*, 2019)

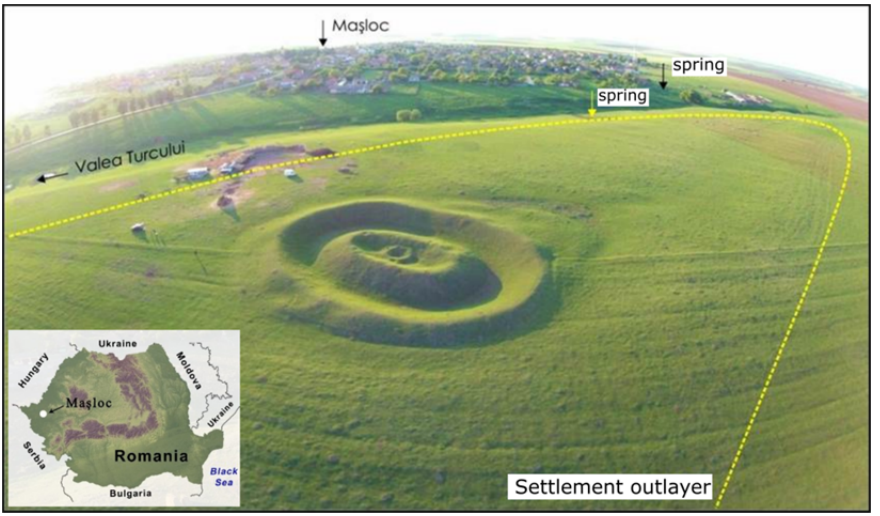

Fig. 2.The location of Maşloc „ŞanţulTurcilor" archaeological site and an aerial view of the fortification and settlement.

We conducted a geophysical survey using three different methods to look inside the site's structure. Therefore, magnetometry, ground-penetrating radar (GPR) and tomography of electrical resistivity (ERT) were used. In addition, through photogrammetry, we created a high digital elevation model. A G-858 total field magnetometer from Geometrics was used for magnetic measurements, a Geotomo system for ERT and Malla for GPR measurements. The high resolution digital elevation model was obtained from the photos acquired with a DJI Phantom 4 drone (Hegyi *et al.*, 2019).

The elevation model and the ortophoto mosaic highlighted the village's extent and provided valuable data related to the fortification's topography.

The geomagnetic survey was designed to overlap the central part of the site to see the fortification and nearby structures as the ERT and GPR profile crossed the ramparts and ditches of the fortification.

Based on the results several archaeological and historical conclusions emerged. A part of the village around the fortification was revealed by magnetic measurements (Fig. 3). Thus, the distribution of anomalies suggests that a certain pattern has followed the location of each house, dwelling or annex. This pattern is associated on both sides of the fortification with a clear internal organization of the village on two major (NNE–SSW) lines. The houses were built along the edges of the track on these axes. Linear / rectangular magnetic anomalies involve large rectangular households (Hegyi *et al.*, 2019) .

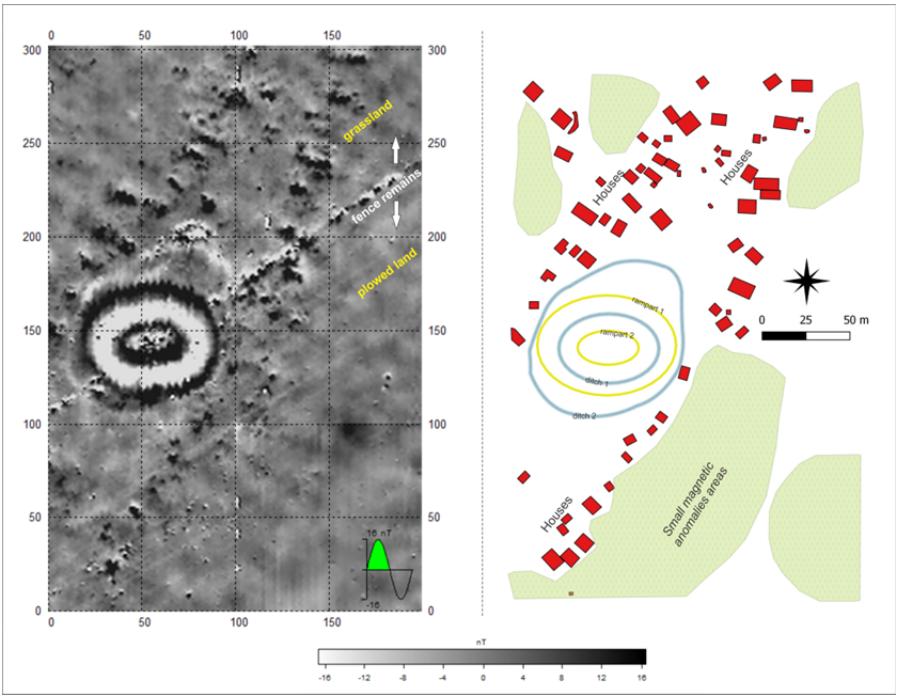

Fig. 3. Results of the displayed magnetic measurements and a digitized anomaly sketch representing the archeological structures (This is Fig. 4 in Hegyi *et al*., 2019).

Combined, the three geophysical methods used also revealed ramparts and ditches information.The existence of a second ditch around the fortification that is no longer visible on the field is considered to be a piece of important information brought by geophysics.We were also able to estimate each ditch's depth and point out the structure of the ramparts by using ERT and GPR measurements (Fig. 4) (Hegyi *et al.*, 2019).

Our measurements in the "SanulTurcilor" site enabled us to understand that the village's inhabitants had followed certain rules when they began building the settlement that involved most certainly a planned development. The measurements allowed us to formulate a significant historical conclusion concerning these villages' architectures. Thus, the medieval village of Ma□loc is the first in southwestern Romania where we can see a clear pattern in house location using geophysics and on that basis we are proving for the first time the attempt to systematize a village in this region during the 14th century and the coming centuries (Hegyi *et al.*, 2019).

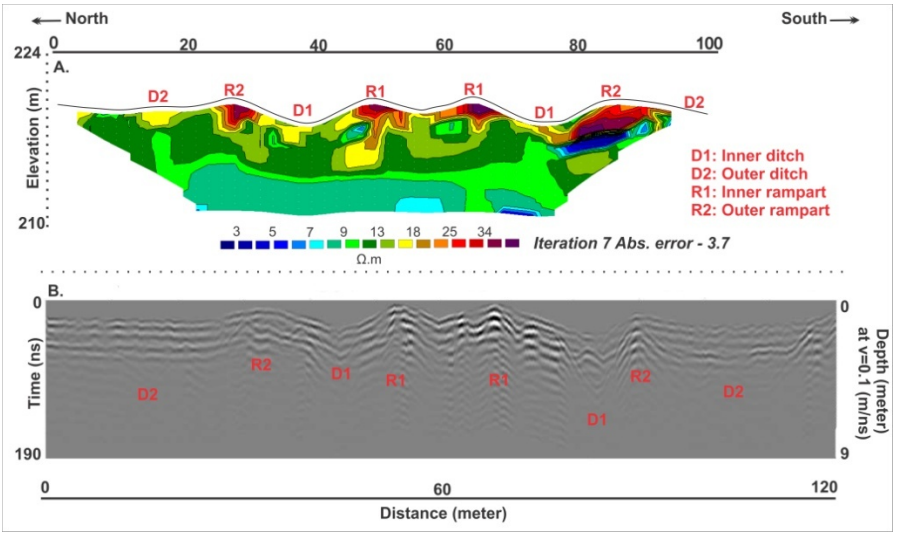

Fig. 4. Results of displayed ERT and GPR measurements crossing the fortification system form North to South (This is Fig. 6 in Hegyi *et al*., 2019).

Ultimately, we have to state that this application highlights the potential of geoscience approaches in archeological research and brings significant endorsement to archeological interdisciplinary.

References

Boch, S.G., Krasnov, I.I., 1943, O nagornykh terraskh I drevnik poverkhostyarkh vyravnivanya na Urale I svyazannykh s nimi problemakh, *Vsesoyuznogo Geograficheskogo obshchestva, Izvestya,* **75,** 14-25.

Cunningham, F.F., 1968, The significance of Caribbean evidence in the elucidation of tors, Caribbean Journal of Science, **8**, **3-4**, 187-198.

Demek, J., 2013, Pleistocene cryopediments and cryopediplains of the Moravian-Silesian Carpathians and the Vienna Basin (Czech Republic), *Studia Geomorphologica Carpatho-Balcanica,* **XLVII**, 5–17.

Francou, B., Hètu, B., 1989, Eboulis et autres formations de pente heterometriques. Contribution a une terminologie geomorphologique. Notes et Comptes-Rendus du groupe de travail "Regionalisation du Périglaciaire", **XIV**, 11–69.

French, H.M., 2007*, The Periglacial Environment,* Third Edition, John Wiley & Sons, Chichester, 458 p.

Gherasi, N., Savu, H., 1969, Structura masivului granitoid Muntele Mic, *D.S., Inst. Geol. Geofiz.,* Bucureşti, **54**, **3**, 55-82.

Godard, A. , 1977, *Pays et paysages du granite*, Presses Universitaires de France, Paris, 232 p.

Hegyi, A. 2018, Aplicarea metodelor specifice geoştiinţelor în cercetări arheologice din sud-vestul României, Unpublised PhD Thesis, Universitatea de Vest din Timişoara, 183 p.

Hegyi, A., Urdea, P., Floca, C., Ardelean, A., Onaca, A., 2019. Mapping the subsurface structures of a lost medieval village in South-Western Romania by combining conventional geophysical methods, *Archaeological Prospection*, **26**, **1**, 21-32.

Ianoş, G., Puşcă, I., 1998, *Solurile Banatului: Prezentare cartografică a solurilor agricole*, Edit. Mirton, Timişoara, 104 p.

Kräutner, H., Năstăseanu, S., Berza, T., Stănoiu, I., Iancu, V., 1981, *Metamorphosed Paleozoic in the South Carpathians and its relations with the pre-Paleozoic basement,* Carpatho-Balkan Geological Assoc. XII Congress, Guide to Excursion A1, Institutul Geologic, Bucureşti, 116 p.

Migon, P. 2006, *Granite landscapes of the world*, Oxford University Press, Oxford, 388 p.

Mihăilă N., Giurgea P., 1987, Harta hidrogeologică 1:50 000, Timişoara 24a, I.G.G., Bucureşti.

Mihailă, N., Popescu, N., Giurgea, P., 1987, Geologia şi morfogeneza Câmpiei de Vest (sectorul Arad-Vinga-Pecica) şi evoluţia Mureşului în cursul său inferior, *Stud. tehn.econ., I. G. G,* seria E, **15**, 79-131.

Nelson, F.E., 1989, Cryoplanation terraces: periglacial cirque analogs, *Geografiska Annaler. Series A, Physical Geography*, **71**, **1-2**, 31-41.

Niculescu, G.,1971, Munţii Ţarcu. Caracterizare geomorfologică, *Lucr. şt. Inst. Ped. Oradea, Geografie*, 45-54.

Niculescu, G., 1990, Relieful glaciar din Munţii Ţarcu, *Studii şi cercetări de geografie*, **XXXVII**, 43-52;

Onaca, A., 2017. *Procese şi forme periglaciare din Carpații Meridionali. Abordare geomorfologică şi geofizică,* Editura Universității de Vest din Timişoara, 264 p.

Onaca, A., Urdea, P., Ardelean, A.C., Şerban, R., Ardelean, F., 2017. *3.4. Present-day periglacial processes in the alpine zone.* In: Landform dynamics and evolution in Romania, Eds. Rădoane, M., Vespremeanu-Stroe, A., *Springer Verlag,* 147-176..

Reger, R.D., Péwé, T.L., 1976, Cryoplanation terraces: indicators of a permafrost environment, *Quaternary Research,* **6, 1**, 99-109.

Savu, H., Hann, H.P., Năstăseanu, S., Marinescu, F., Morariu, A., Rogge-Țăranu., E., 1981, Harta geologică 1:50000, Foaia 104 d Muntele Mic, Inst. de Geologie şi Geofizică, Bucureşti.

Şerban, R., 2016. *Studiu asupra solifluxiunii din zona alpină a Carpaților Meridionali*, Unpublised PhD Thesis, Universitatea de Vest din Timişoara, 240 p.

Thorn, C.E., Hall, K., 2002, Nivation and cryoplanation: the case for scrutiny and integration, *Progress in Physical Geography,* **26**, **4**, 533–550.

Urdea, P., 1984, Observații geomorfologice pe valea Bistrei Mărului, *Lucr. Sem. geogr. ,,D. Cantemir", Iaşi,* **4**, 37-46.

Urdea, P., Reuther, A.U., 2009, Some new data concerning the Quaternary glaciation in the Romanian Carpathians, *Geographica Pannonica*, **13**, **2**, 41-52.

Urdea, P., Onaca, A., Ardelean, F., Ardelean, M., 2011, New evidence on the quaternary glaciation in the Romanian Carpathians, J. Ehlers, P.L. Gibbard, P.D. Hughes (Eds.), *Quaternary Glaciations – Extent and Chronology*, Developments in Quaternary Science, **15,** Elsevier, Amsterdam, 305-322.

Washburn, A.L., 1973, *Periglacial Processes and Environments,* St Martin's Press, New York, 328 p.

Williams, P.J., Smith, M.W., 1989, *The Frozen Earth. Fundamentals of geocryology*, Cambridge University Press, Cambridge, 306 p.