Climate change during the Late Pleistocene and Holocene in the Carpathian region. Advancing research and cooperation

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GEOREVIEW

The Carpathian Mountains are considered to be one of Europe's last "wilderness" areas, but are nevertheless under heavy pressure from human activities. Examples range from large-scale activities (e.g. metal and coal mining) and ecological disasters (e.g. tailing dam failures in the Toroiaga and Baia Mare areas) to cross-border pollution (e.g. Chernobyl nuclear accident). The current political thrust for economic development is accelerating the pace of industrial activities, exploitation of natural resources and tourism. Romania has just recently been integrated into the European Union and many community-based projects were initiated to evaluate problems related to climatic and anthropogenic impacts.

The diversity of landforms that characterize the Carpathian region encompassing mountain ranges and large spans of adjacent lowlands and the dynamic interplay between North Atlantic, continental, and Mediterranean atmospheric circulation patterns in southeastern Europe, have resulted in extremely fragmented habitats and exceptional biodiversity (Veres and Mindrescu, 2013). However, the Carpathian Mountains remain the least studied mountain environment in Europe, as reflected for example by the low number of well-dated and high-resolution paleorecords (e.g. Buczkó et al. 2009). Rose et al. (2009) published a pollution history study from a lake in the Retezat Mountains at the western extremity of the Southern Carpathians, but no paleoenvironmental studies exist for the rest of the mountain range, despite the abundance of suitable sites (Akinyemi et al., 2013).

The first Carpathian-Balkan workshop

An interdisciplinary approach to geoscience is particularly important in this vast research field (geosciences), as innovative science is increasingly stimulated by studies that cross disciplinary

boundaries and thus benefit from multiple research methods and viewpoints. Grasping this concept has led us to encourage interdisciplinary cooperation by creating "meeting places" where geoscience researchers and scholars can find common grounds for discussion and collaboration (Hutchinson and Mindrescu, 2012).

In this regard an international meeting was organized at the Geography Department, University of Suceava, Romania, and was cosponsored by the University of Suceava, the Applied Geography Association (GEOCONCEPT), Past Global Changes (PAGES) and the Mountain Research Initiative (MRI). The purpose of the workshop was to bring together an international group of scientists interested in the Carpathian-Balkan region to discuss research results and promote opportunities for interdisciplinary and international collaboration. The entire workshop was webcast. The program centered on 36 oral and 15 poster presentations as well as open discussions on the climatic and environmental dynamics during the Pleistocene and Holocene. The 70 participants were from Romania, Hungary, Germany, United Kingdom, Bulgaria, Slovenia, Ukraine, Poland, Switzerland, Czech Republic, Greece and Belgium. For many young researchers and students the workshop offered an educational opportunity to present their results to an international audience and discuss their research in a multidisciplinary community.

To promote follow-up activities in the region, the "Suceava working group" was created under the lead of Marcel Mindrescu, Angelica Feurdean, Eniko Magyari and Daniel Veres. A group website is currently being set up (http://atlas.usv.ro/www/climatechange/) and grant proposals will be prepared. The group will also coordinate the organization of a second regional workshop in 2014 in Romania. Further activities, such as summer camps or meetings in the field are also considered.

Special issue on Carpathian-Balkan paleoclimate

The organizers of the workshop offered to lead publication of the more advanced workshop contributions in a special issue of the journal Quaternary International, volume 293/2013 (Fig. 1) and 23 author groups committed themselves to contribute papers which are summarized in the following:

The paper opening the special issue presents a detailed bulk rock-magnetic investigation of the loess-paleosol sequence at Mircea Vodă, Dobrogea Plateau, Romania (Fig. 2, pos. 25) that covers the last five glacial-interglacial cycles (Necula et al. 2013). A wide range of grain-size and concentration-dependent magnetic proxies were discussed that alongside outputs from an unmixing model of remanence properties added significant new data in understanding the origin and characteristics of magnetic carriers within glacial loess and interglacial paleosols.

Vasiliniuc et al. (2013) reported on new luminescence investigations of Romanian loess, focusing on the loess-palaeosol sequence at Mircea Vodă, SE Romania (Fig. 2, pos. 25, 32 and 33). The study showed that the application of the double-SAR protocol to polymineral fine grains offers a viable alternative for dating Romanian loess, avoiding the need to isolate pure quartz aliquots. However, results also show that until further developments, use of the double-SAR protocol should be restricted to samples from the last glacial period only.

Veres et al. (2013) analyzed the glass chemical compositions and general chronological relations for several volcanic ash layers embedded in Pleistocene loess and fluvial deposits of the lower Jiu and Olt valleys in southwestern Romania (Fig. 2, pos. 34). The tephrochronological correlations

proposed were fully supported by luminescence dating results that were shown to provide reliable composite ages. The presence of chemically and chronologically similar volcanic ash layers (i.e., the Campanian Ignimbrite) at all studied locations could allow in the future to consider the local stratigraphic relations in a wider context.

According to the findings of a complex sedimentological, geochemical, malacological and pollen study, several interstadials could be identified in a sediment core sequence of an alkaline lake (Fehér Lake: Fig. 2, pos. 31) from the SE Great Hungarian Plain. The interstadials were dated and correlate well with Dansgaard-Oeschger (DO) and deglacial warm intervals seen in the Greenland ice core oxygen isotope records. Also cold phases were found that correlate with Heinrich event 2 and the Last Glacial Maximum (LGM). These data overall confirm that millennial-scale climate variability during Marine Isotope Stage 2 had profound effects on the terrestrial ecosystems in the continental interior of SE Europe (Sümegi et al., 2013).

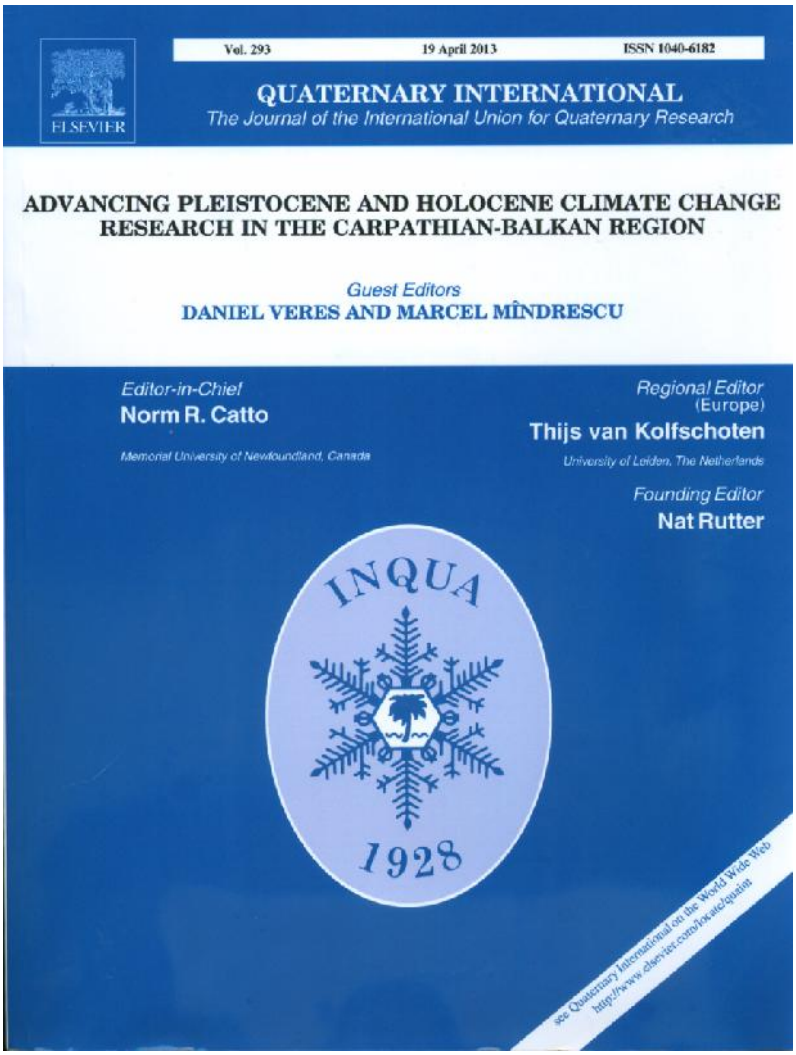

Figure 1. Quaternary International, volume 293, 2013 (cover).

Kuhlemann et al. (2013) performed a detailed study of the maximum glaciation in the Rila massif, Bulgaria (Fig. 2, pos. 23). The application of cosmogenic nuclide dating (10Be) on moraine

samples confirmed that the largest extent of former glaciers that left moraine deposits was around the time of the LGM. On the basis of the new chronological data, the maximum glaciation in the Rila massif occurred during the LGM, but likely not during the coldest interval of this glacial stage.

In a similar approach, Makos et al. (2013) propose a deglaciation scenario for the High Tatra range of the Polish Carpathians (Polish- Slovakia border, Roztoki valley: Fig. 2, pos. 27) based on cosmogenic 36Cl dating. Nineteen rock samples yielded ages between 21.5 and 9.5 ka. The spatial distribution of ages provides clear evidence of a progressive down wasting of glaciers. Dates of exposure indicate that the onset of ice volume decrease occurred no later than 21.5 ka. This provides evidence that the local maximum glaciation occurred in accordance with the global LGM. Glaciological modelling and paleoclimate proxies from the study area are used for climate reconstruction.

Next paper presented glacial geomorphological evidence from a glacial complex located in the western part of the Rodna Mountains, in the Eastern Carpathians, Romania (Fig. 2, pos. 24). GIS-based geomorphological mapping reveals five sets of moraines in glacial phases assigned to the Late Pleistocene. This reassessment is largely done for the cirque region (Mîndrescu, 2006; Mîndrescu et al., 2010) but should be continued for the glaciogenic accumulation forms. Sedimentological analyses of fluvioglacial deposits are required. Additional numerical dating techniques are required to confirm the relative chronology and to place the phases of the western Rodna Mts. glacial history into a chronostratigraphical framework (László et al., 2013).

A study of two peat bog sequences from the Maramureșului Mountains (Northern Romanian Carpathians), Tăul Mare Bardău and Cristina (Fig. 2, pos. 17), provides new records on the mid-Holocene forest dynamics and climate history in the Northern Romanian Carpathians (Fărcaș et al., 2013). Due to their location close to the northern border of Romania where glacial geomorphology is complex and the biodiversity rich, the Maramureș Mountains represent an interesting area for further studies.

Challenged by the relative paucity of sediment-based studies in the Carpathian Mountains in Romania, a British-Romanian team investigated both magnetically and geochemically short lake sediment cores from ten lakes in the Romanian Carpathians (Fig. 2, pos. 2 and 7-15). The results provide an assessment of the potential of these records as retrospective indicators of atmospheric pollution patterns and current dynamics (Akinyemi et al. 2013).

Braun et al. (2013) applied bulk sediment geochemical proxies to reconstruct lateglacial and early Holocene climatic changes from a glacially scoured basin (Lake Brazi, 1740 m a.s.l.) in the Retezat Mts., Transylvanian Alps, Romania (Fig. 2, pos. 4). The sediments deposited during cold and warm periods showed significantly different chemical compositions. Significant synchronicity was found between changes in both geochemical and biological (pollen, diatom, cladocera and chironomid) proxies and temperature variations over Greenland. Another study of the Lake Brazi (Fig. 2, pos. 4) sedimentary record provided the first continuous lateglacial and Holocene record of diatom silica oxygen isotopes for the Carpathians. It is concluded that the activity of North Atlantic circulation has likely been a major climate-governing factor in the region, clearly reflected in the oxygen isotope composition of the siliceous algae. During positive North Atlantic Oscillation (NAO) phases (warm periods), winters were mild and winter precipitation was likely low in the Retezat Mts. During negative NAO phases (colder periods), when winters were cold and wet, the lake likely received more isotopically lighter meltwater during the main diatom bloom period (Magyari et al., 2013). Also climatic and environmental changes were studied for lakes: Tăul dintre Brazi, Galeș and Sfânta Ana (Romania) and Sedmo Rilsko-Bulgaria (Fig. 2, pos. 4, 5, 6 and

22), using siliceous algae respectively, diatoms and chrysophycean cysts (Buczkó et al. 2013). According to the basal radiocarbon dating of the core, the lake was formed around 15,750 cal BP and sediment accumulation has been continuous ever since. The most remarkable changes in the aquatic ecosystem were observed at 6000 cal BP in the Holocene and 12,800 cal BP, at the onset of the Younger Dryas.

Stable hydrogen isotope compositions of inclusion-hosted H_2O, and carbon and oxygen isotope compositions of stalagmites of two caves from Central Hungary (Fig. 2, pos. 36) provide a speleothem-based paleoclimate record for the middle-early Holocene. The stalagmite hydrogen and d-excess series correlate positively with the alpine Spannagel cave record, interpreted as a signal of moisture source variations at regional scale (Demeny et al., 2013).

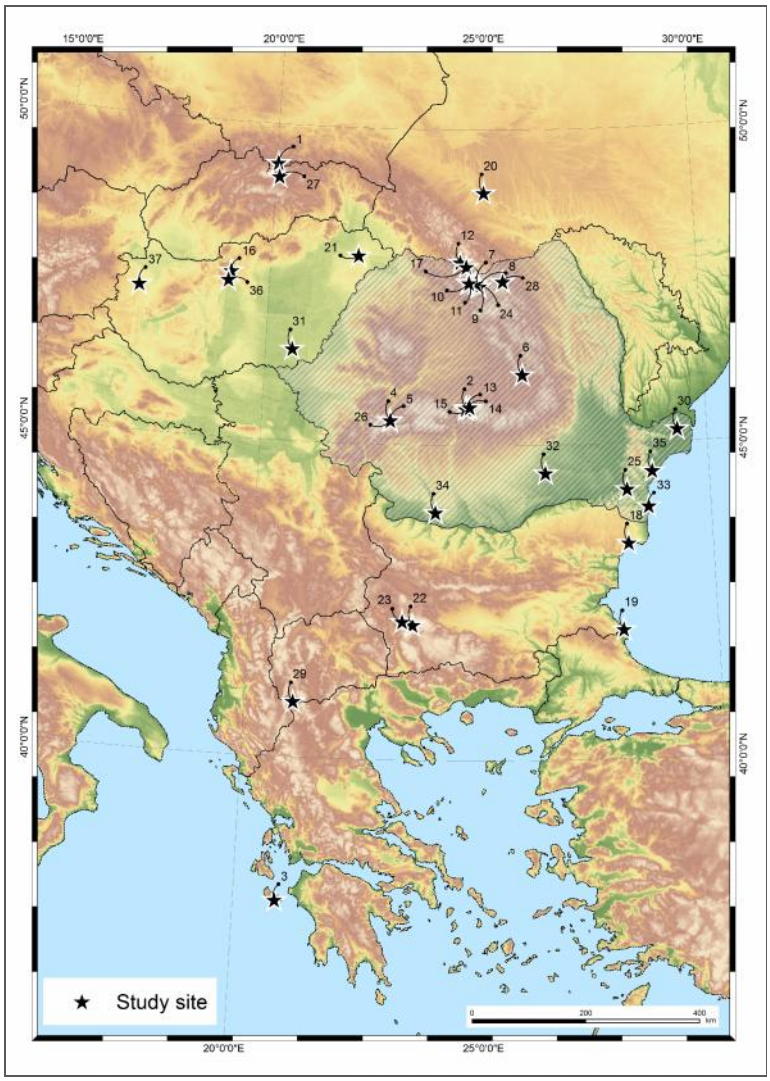

Figure 2. Location of study areas tackled in the special issue.

Pollen assemblages of a sediment sequence from Lake Prespa shared by Albania, Greece, and the Republic of Macedonia (Fig. 2, pos. 29) revealed substantial vegetational and environmental changes on a regional scale since 17ka BP. The age-depth model, based on radiocarbon dating and tephrochronology, indicates continuous sedimentation and relates centennial-scale

variability in vegetation and climatic during the Lateglacial and the Early Holocene (Panagiotopoulos et al., 2013).

A dated high-resolution marine record from the Black Sea continental slope (Fig. 2, pos. 18 and 19) is presented by Filipova-Marinova et al. (2013). Spores, pollen and dinoflagellate cysts of Late Pleistocene and Holocene sediments provide multi-proxy evidence of sea surface salinity and temperature changes. For example, an abrupt change in the composition of dinoflagellate cysts occurred at 7990 cal. BP and substantial freshening of Black Sea surface waters at 2570 cal. BP, both past climate events of regional significance.

Another marine study interprets the sedimentological, paleontological and palynological evidence from lagoonal sediments from Zakynthos Island, Greece (Fig. 2, pos. 3), in order to reconstruct the depositional environments and paleoclimatic evolution of the area, as well as to estimate the rate of sedimentation between 8540 and 3400 BP (Avramidis et al., 2013).

Analysis of the composition of malacological assemblages from the slope deposits and calcareous tufas at the Groń site, Podhale Basin, southern Poland (Fig. 2, pos. 1) revealed four types of faunal associations (Alexandrowicz, 2013). Their ages were established by radiocarbon dating and comparisons with other profiles. The malacofauna represented almost exclusively by terrestrial species, was used to reconstruct the changes in the environment during deposition.

Research in the valleys of Upper Dniester, in the Eastern Carpathian Foreland (Fig. 2, pos. 20), documents the occurrence of terraces and alluvial fills from the mid-Holocene. Flood phases distinguished in the Upper Dniester drainage basin correlate well with previously established phases of enhanced fluvial activity in the valleys of Upper Vistula. Fluvial accumulation processes along the Upper Dniester Valley were affected not only by human activity and more humid climate phases, but also by diverse neotectonic movements (Gębica et al., 2013).

An interdisciplinary study (cartographic and historical records, geomorphological, geological and bathymetric survey, water analysis, sediment coring and analyses) of two small and previously unreported lakes (Iezer and Bolătău) in the Obcina Feredeului Mountains, northeastern Romania (Fig. 2, pos. 28), provides new data into the environmental history and possible human impacts over the last millennium in this region (Mîndrescu et al., 2013). The two lakes hold significant potential for developing a quantitative, high-resolution climate reconstruction (decadal and multidecadal variability) over the past 1000 years for in the Northern Romanian Carpathians.

Romanescu (2013) presented a brief review of the main evolutionary stages of the Danube deltaic area (Fig. 2, pos. 30), according to the most recent discoveries in the field, as well as an emphasis on the new delimitating criteria for the hinterland in ancient and medieval times. A cartographic delimitation model for the studied settlements' hinterlands was created.

Vespremeanu-Stroe et al. (2013) proposed a new model for the coastal evolution of the Histria area, Dobrogea, Romania (Fig. 2, pos. 35) from the marine embayment dominated state that followed the post-glacial transgression to the present day low-lying coastal system composed of beach ridge plains, sandy barriers and shallow water lagoons. The results provide important evidence on the impact of coastal changes on the rise and fall of the ancient Greek colony of Histria at the Black Sea.

Kern et al. (2013) analyzed the effects of temperature and precipitation on radial growth (earlywood width, latewood width, and total ring width) and on latewood stable carbon isotope composition in a pedunculate oak (Quercus robur L.) stand in northeastern Hungary (Bakta forest: Fig. 2, pos. 21). Signal strength statistics of the tree-ring chronologies indicate that latewood width carries the strongest environmental signal among the three proxies.

Ignéczi and Nagy (2013) used data sets for 14 outlet glaciers worldwide for determining steady-state accumulation-area ratios (AAR0) from mass balance characteristics. They find an overall linear relationship, but also relatively strong non-linearity for some glaciers, presumably with special hypsometric profiles.

Finally, in the last paper the river ice regime was analyzed on Hungarian sections of two major Central European rivers (Fig. 2, pos. 16 and 37). Investigation focused on anthropogenic effects, eliminating the impact of climatic conditions. Anthropogenic effects such as river regulation, hydropower use and water pollution resulted in most cases in shorter length of ice-affected seasons and decreasing frequency of ice phenomena (Takács et al., 2013).

Retrospective view of the Mountain Research Initiative

To fully understand the Earth System and its responses to environmental change, we need to scroll back centuries or even millions of years to study the changes and interactions that have taken place over time. It that sense, the study of paleoenvironmental change is much like a detective story: researchers need to cross disciplinary boundaries to unearth clues and to make inferences about events in the past.

The mountain research community investigates paleoenvironmental changes using proxy data from glaciers, lake sediments, tree rings and other “silent witnesses” to discern the past. In turn, understanding the past is a helpful tool to interpret current environmental changes and to anticipate the future. The book “Global Change and Mountain Regions” (Huber et al. 2005), one of the first major products of the Mountain Research Initiative (MRI), devoted a whole section (one of five) to paleosciences. Moreover, identifying paleoecological signals of key climate parameters was highlighted as a priority action in the GLOCHAMORE Research Strategy (Björnsen 2006). Apart from this, however, the MRI community has not yet addressed paleoscience in mountains in an organized manner – except for the initiative led by Marcel Mindrescu and his peers. With the regional workshop on “Interdisciplinarity in Geoscience in the Carpathian Basin” in Suceava, Romania (18-21 October 2012), it was achieved several MRI objectives: to provide a comprehensive overview of the current knowledge on paleorecords in a poorly investigated mountain region, to foster knowledge exchange among researchers, and to cross disciplinary boundaries.

With the Suceava Workshop, we set the hare running! This initiative is exemplary for the fact that, if life has not offered the opportunities you want, you have to create the opportunity yourself.

Prospective view of the Past Global Changes project

Analysis of the “paleo-record” of scientific history reveals that flourishing research communities of any particular country or scientific field can often be traced back to a nucleus formed by a few visionary pioneers who pursue an idea and a key event that galvanizes a community. Only time will tell, but we might be witnessing The Big Bang of paleoenvironmental and paleoclimatic science in southeastern Europe. The first workshop, "Climate Change in the Balkan-Carpathian region during the Late Pleistocene and Holocene", in 2011 in Suceava, Romania, was successful in bringing together an international group of scientists and in producing a comprehensive and

internationally visible overview of the paleoscience carried out in the region. The 23 research papers in the special issue of *Quaternary International* bear witness to that. This was an excellent start to something potentially great, and I am delighted that PAGES was part of the endeavor as a supporter and co-sponsor.

The seed is planted – how to ensure that it will branch out into a strong tree and bear fruit? Follow-up activities such as the planned second Carpathian-Balkan meeting are obvious next steps to keep up the momentum and to further strengthen the developed community bonds. However, the impressive outcome of the first workshop suggests that this community has the scientific potential, leadership quality, and international positioning to set themselves more ambitious mid-term goals, which would provide the necessary stimulus for the positive development of paleoscience in the region.

This would entail that the community identifies joint scientific goals around very specific scientific questions, and develops strategies to target the research required to answer these priority questions. In addition, the group could join forces by developing collaborative research projects, by organizing the archiving and sharing of the paleoscientific data and metadata, and by coordinating a regional contribution to larger international efforts (such as the PAGES 2k network). Developing such tangible product-oriented projects would hopefully help the group to receive national or European funding for the underlying research in the form of fieldwork, sampling, measurements and data analysis.

This leads seamlessly into the next step to boost paleoscience in the region, which is, involvement at a larger international scale. Organizations like Past Global Changes (PAGES), the Mountain Research Initiative, and others offer activities in a wide range of disciplines that allow individuals to find tasks that suit their expertise and interest. What's more, such organizations usually aim for participation from currently underrepresented regions and might even offer financial support for suitable applicants, in particular those at early career stages. Researchers should therefore also step outside the comfort zone of the Carpathian-Balkan group and seek involvement with scientists all over the world. Subscribing to organisations' information distribution lists (such as through the PAGES website) or to social media feeds is a fist step into the international sphere.

There is a good chance that in the future we will all look back to the Suceava workshop as the event "where it all started".

Future plans

The 1st edition of this event was indeed considered a breakthrough for the scientific community of the region, as well as for the host country, as it succeeded in bringing together a critical mass of scientists interested in studying the Carpathian-Balkan region and creating new opportunities for interaction and collaboration, which were previously lacking, in the form of the newly created Working Group.

Thus, we believe it is consequential to preserve the momentum we gained with the 1st edition and we decided to organize the 2nd workshop in autumn 2014, such that we may continue the effort to support the working group focused on this area and explore new opportunities for scientific cooperation and growth and publishing in internationally recognized journals, as well as interesting young researchers in this rich field of study.

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References

Alexandrowicz W.P. 2013. Malacological sequence from profile of calcareous tufa in Groń (Podhale Basin, southern Poland) as an indicator of the Late Glacial/Holocene boundary. *Quaternary International* 293, 196-206.

Akinyemi F.O., Hutchinson S.M., Mîndrescu M., Rothwell J.J. 2013. Lake sediment records of atmospheric pollution in the Romanian Carpathians. Quaternary International, 293, 105-113.

Avramidis P., Geraga M., Lazarova M., Kontopoulos N. 2013. Holocene record of environmental changes and palaeoclimatic implications in Alykes Lagoon, Zakynthos Island, western Greece, Mediterranean Sea. *Quaternary International* 293, 184-195.

Björnsen Gurung, A. ed. (2006). *Global Change and Mountain Regions Research Strategy*. MRI/UNESCO Publication, ADAG Copy AG, Zürich, 47pp.

Braun M., Hubay K., Magyari E., Veres D., Papp I., Bálint M. 2013. Using linear discriminant analysis (LDA) of bulk lake sediment geochemical data to reconstruct lateglacial climate changes in the South Carpathian Mountains. *Quaternary International* 293, 114-122.

Buczkó K., Magyari E.K., Braun M., Bálint M. 2013. Diatom-inferred lateglacial and Holocene climatic variability in the South Carpathian Mountains (Romania). *Quaternary International* 293, 123-135.

Buczkó K., Magyari E.K., Bitusík P., Wacnik A. 2009. Review of dated late Quaternary palaeolimnological records in the Carpathian Region, east-central Europe. *Hydrobiologia* 208, 3-28.

Demény A., Czuppon G., Siklósy A., Leél-Őssy Sz., Lin K., Shen C.-C., Gulyás K. 2013. Mid-Holocene climate conditions and moisture source variations based on stable H, C and O isotope compositions of speleothems in Hungary. *Quaternary International* 293, 150-156.

Fărcaş S., Tanţău I., Mîndrescu M., Hurdu B. 2013. Holocene vegetation history in the Maramureş Mountains (Northern Romanian Carpathians). *Quaternary International* 293, 92-104.

Filipova-Marinova M., Pavlov D., Coolen M., Giosan L. 2013. First high-resolution marinopalynological stratigraphy of Late Quaternary sediments from the central part of the Bulgarian Black Sea area. *Quaternary International* 293, 170-183.

Gębica P., Starkel L., Jacyšyn A., Krąpiec M. 2013. Medieval accumulation in the Upper Dniester river valley: The role of human impact and climate change in the Carpathian Foreland. *Quaternary International* 293, 207-218.

Huber, U.M., Bugmann H.K.M., Reasoner M.A., 2005. *Global Change and Mountain Regions: An Overview of Current Knowledge*. Springer, New York, USA., 650 pp.

Ignéczi Á., Nagy B. 2013. Determining steady-state accumulation-area ratios of outlet glaciers for application of outlets in climate reconstructions. *Quaternary International* 293, 268-274.

Kern Z., Patkó M., Kázmér M., Fekete J., Kele S., Pályi Z. 2013. Multiple tree-ring proxies (earlywood width, latewood width and δ13C) from pedunculate oak (Quercus robur L.), Hungary. *Quaternary International* 293, 257-267.

Kuhlemann J., Gachev E., Gikov A., Nedkov S., Krumrei I., Kubik P. 2013. Glaciation in the Rila mountains (Bulgaria) during the Last Glacial Maximum. *Quaternary International* 293, 51-62.

László P., Kern Z., Nagy B. 2013. Late Pleistocene glaciers in the western Rodna Mountains, Romania. *Quaternary International* 293, 79-91.

Necula C., Panaiotu C., Heslop D., Dimofte D. 2013. Climatic control of magnetic granulometry in the Mircea Vodă loess/paleosol sequence (Dobrogea, Romania). *Quaternary International* 293, 5-14.

Magyari E.K., Demény A., Buczkó K., Kern Z., Vennemann T., Fórizs I., Vincze I., Braun M., Kovács J.I., Udvardi B., Veres D. 2013. A 13,600-year diatom oxygen isotope record from the South Carpathians (Romania): Reflection of winter conditions and possible links with North Atlantic circulation changes. *Quaternary International* 293, 136-149.

Makos M., Nitychoruk J., Zreda M. 2013. Deglaciation chronology and paleoclimate of the Pięciu Stawów Polskich/Roztoki Valley, high Tatra Mountains, Western Carpathians, since the Last Glacial Maximum, inferred from 36Cl exposure dating and glacier–climate modeling. *Quaternary International* 293, 63-78.

Mîndrescu M., Cristea A.I., Hutchinson S.M., Florescu G., Feurdean A. 2013. Interdisciplinary investigations of the first reported laminated lacustrine sediments in Romania. *Quaternary International* 293, 219-230.

Mîndrescu M., Hutchinson S.M. 2012. Interdisciplinary cooperation and studies in geoscience in the Carpathian Basin. *Georeview* 21, 1-7.

Mîndrescu M., Evans I.S., Cox N.J. 2010. Climatic implications of cirque distribution in the Romanian Carpathians: palaeowind directions during glacial periods. *Journal of Quaternary Science* 25 (6), 875-888.

Mîndrescu M. 2006. *The geomorphometry of glacial cirques in the Romanian Carpathians* (Geomorfometria circurilor glaciare din Carpatii Românești), PhD thesis, University of Iasi, Romania.

Panagiotopoulos K., Aufgebauer A., Schäbitz F., Wagner B. 2013. Vegetation and climate history of the Lake Prespa region since the Lateglacial. *Quaternary International* 293, 157-169.

Romanescu G. 2013. Geoarchaeology of the ancient and medieval Danube Delta: Modeling environmental and historical changes. A review. *Quaternary International* 293, 231-244.

Rose N.L., Cogalniceanu D., Appleby P.G., Bancelj A., Camarero L., Fernandez P. 2009. Atmospheric contamination and ecological changes inferred from the sediment record of Lacul Negru in the Retezat National Park. *Advances in Limnology* 62, 319-350.

Sümegi P., Magyari E., Dániel P., Molnár M., Törőcsik T. 2013. Responses of terrestrial ecosystems to Dansgaard–Oeshger cycles and Heinrich-events: A 28,000-year record of environmental changes from SE Hungary. *Quaternary International* 293, 34-50.

Takács K., Kern Z., Nagy B. 2013. Impacts of anthropogenic effects on river ice regime: Examples from Eastern Central Europe. *Quaternary International* 293, 275-282

Vasiliniuc Ş., Vandenberghe D.A.G., Timar-Gabor A., Cosma C., van den Haute P. 2013. Combined IRSL and post-IR OSL dating of Romanian loess using single aliquots of polymineral fine grains. *Quaternary International* 293, 15-21.

Veres D., Lane C.S., Timar-Gabor A., Hambach U., Constantin D., Szakács A., Fülling A., Onac B.P. 2013. The Campanian Ignimbrite/Y5 tephra layer – A regional stratigraphic marker for Isotope Stage 3 deposits in the Lower Danube region, Romania. *Quaternary International* 293, 22-33.

Veres D., Mîndrescu M. 2013. Advancing Pleistocene and Holocene climate change research in the Carpathian-Balkan region. *Quaternary International* 293, 1-4.

Vespremeanu-Stroe A., Preoteasa L., Hanganu D., Brown T., Bîrzescu I., Toms P., Timar-Gabor A. 2013. The impact of the Late Holocene coastal changes on the rise and decay of the ancient city of Histria (Southern Danube delta). *Quaternary International* 293, 245-256.