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Editorial Special issue

"Denudational processes and landscape responses to global environmental changes"

This Special Issue onDenudational processes and landscape responses toglobal environmental changes produced by the International Association ofGeomorphologists (IAG) Working Group DENUCHANGE (Denudationand Environmental Changes in Different Morphoclimatic Zones,http://www.geomorph.org/denuchange-working-group/) includes selectedpaper contributions from (i) the 2019 EGU General Assembly (7–12April 2019, Vienna, Austria) scientific session GM7.2 onDenudational hill-slope andfluvial processes, sedimentary budgets, and landscape responses toglobal environmental changes, from (ii) the Second IAG DENUCHANGE(Denudation and Environmental Changes in Different MorphoclimaticZones)WorkshopheldinCalpe,Spain,12–14 September 2019 (Beylichand Laute, 2019), as well as from (iii) the conference session S04 onDenudation in the Mediterranean Zoneat the International Association ofGeomorphologists (IAG) Regional Conference onGeomorphology ofClimatically and Tectonically Sensitive Areas,19–21 September 2019, Ath-ens, Greece.Denudation, including both chemical and mechanical processes, is ofhigh relevance for Earth surface systems and landscape development,and the transfer of solutes and sediments from headwater systemsthrough main stem of drainage basin systems to the world oceans.Denudational hillslope andfluvial processes and associated source-to-sinkfluxes and sedimentary budgets are controlled by a wide range of en-vironmental drivers and can be significantly affected by climate changeand various anthropogenic activities (Beylich and DENUCHANGE Team,2020).A systematic geomorphologic comparison of present-day denudationrates in different defined climatic zones combined with a coordinatedanalysis and compilation of the respective key controls of denudationthat is presently occurring in the different selected morphoclimatic set-tings is still largely missing and urgently needed. The IAG WorkingGroup on Denudation and Environmental Changes in DifferentMorphoclimatic Zones (DENUCHANGE, 2017–2021) is helping to closethis still existing key knowledge gap and shall contribute to a better un-derstanding of the possible effects of global environmental changes oncontemporary Earth surface systems. An overview of the scientific need,content and goals of the IAG DENUCHANGE Working Group is providedin the introductory and overview paper by Beylich and DENUCHANGETeam (2020) in this Special Issue.The elevenscientific papers that were selected for this SpecialIssue after the peer-review process collectively represent a cross-section of latest DENUCHANGE-related research activities ondenudational processes and landscape responses to global envi-ronmental changes in a range of undisturbed and anthropogenic-ally modified environmental settings and landscapes in Svalbard(Norway), Poland, Georgia, the European Alps (Austria, Italy),Spain, Israel, Nepal and the USA.The paper byCienciala et al. (2020)contributes to a better under-standing of various aspects of contemporary denudational processesin mountain basins and particularly highlights the importance of an-thropogenic legacies. Thebackboneof their investigation is a substantialdata set including reservoir surveys, geomorphic surveys, and remotesensing data. By evaluating a 20th-century sediment yield from a for-ested mountain basin in inland Pacific Northwest (USA) and estimatingthe partitioning of clastic sediment evacuated from the basin, the au-thors show that the specific sediment yield value in their study basinis intermediate between coastal and other inland basins. They also high-light that bedload constitutes nearly a third of the total sediment yieldduring their period of interest, which represents a value that is muchhigher than the often assumed share of 10–20%. Their gained insightsinto key sediment sources reveal that a considerable portion of the sed-iment yield is related to anthropogenic disturbances; forest operations,road construction, and large wood removal seem to be key anthropo-genic impacts whereas natural sediment sources such as lateralreworkingof thevalleyfloorand mass movementinputswere relativelylimited during the last century.Bell et al. (2020)investigate majorfloods and geomorphic eventswhich occurred during the monsoonal precipitation in 2018 in the KaliGandaki valley (Nepal, Himalaya) impacting both the monsoon-affected and the dry parts of the catchments. The authors analyze theevents and their triggers based onfield observations, multiple satelliteimage interpretations, climatological analyses using Global Precipita-tion Measurement and MODIS snow cover data, hydrological analysisand media analysis. The presented results show that the hydro-meteorological triggers are complex. Exceptional precipitation in Apriland May 2018 occurred in the entire study area, followed by a ratherdry period. Precipitation in August was exceptional in the northernpart whereas below average in the South. The authors argue that dy-namics of snow accumulation and delayed melting contributed signifi-cantly toflooding and increased geomorphic activity in the southernpart in August whereasflooding in the northern part was mainly trig-gered by rainfalls. Based on their results they define 2018 as an abnor-mal (pre-)monsoon year with less rainfall than

average but beingmore catastrophic. Given that the study area is subject to majorhuman impact, magnitude and frequency of such abnormal (pre-)mon-soon precipitation are highly relevant for sedimentfluxandnaturalhaz-ards studies.Geitner et al. (2020)present an extensive review on the currentknowledge on the main geomorphological processes for Alpine grass-land erosion within the European Alps, namely shallow landslides andabrasion by snow movements as well as combinations of both pro-cesses. They discuss the basic and variable controlling factors and pres-ent a comprehensive approach for identifying and classifying shallow erosion phenomena and processes. In addition, the potential and limitsof remote sensing methods are discussed in detail and the currentknowledge of re-stabilization by plants is summarized. In their conclu-sions, the authors outline the discussion on the impact of land-use andclimate change on these shallow erosion processes and identify themain research gaps that should align future scientific investigations onthese erosion types on Alpine slopes.The paper byShtober-Zisu et al. (2020)focuses on slope retreat ratesestimated from a chronology of tufa deposits sheltered by inlandnotches on Mt. Carmel in Israel. By taking advantage of tufa accumula-tions in the form of stalactites, drapes and crusts within the investigatedinland notches the authors applied U\\Th dating on 16 tufa samplesfrom 2 notches in order to determine the age of the latest stage ofnotch formation and calculate the relative rate of slope retreat. Theirfindings demonstrate that the oldest analyzed tufa deposits are fromthe Late Last Glacial (MIS-3, 39.0 ± 10.4 ky), while most of the tufagrew during the deglaciation (Late MIS-2/MIS-1, last ~20 ky) and theHolocene (MIS-1). The order of magnitude of slope retreat rangesfrom 101to 102mm/ky with one analysis yielding 20 to 35 mm/ky.Their obtained results correspond with the rates of tens of meters permillion years, similar to the magnitude of denudation found by previousstudies in the Mediterranean zone of Israel.Germain et al. (2020)use a multidisciplinary approach to study thesediment connectivity between a debris-flow channel network and theDolra River located in the Mazeri Valley in the Southern Caucasus inGeorgia. Dendrogeomorphology and the analysis of sedimentary char-acteristics are applied in order to establish a tree-ring-based chronologyof the debris-flow activity and to discriminate the different sedimentsources. The presented results from 161 sampled trees demonstratethe occurrence of 12 significant events over the last 65 years, with allof the events involving possible sediment input into the stream systemof the Dolra River. The authors argue that these successional events,with a return interval of 5.4 years, have partially destabilized thefluvialsystem and locally induced a switch in the channel style to a braidedchannel. Considering the current global warming scenario, sedimentconnectivity and potential downstream propagation are expected to be-come crucial with regard to the sustainable development of the moun-tain communities in the Southern Caucasus.Masseroli et al. (2020)assess the role of soils as a useful archive forretracing the geomorphological processes that are responsible for thelandscape evolution during the Late Holocene in a typical alpine catch-ment such as the hydrographic basin of the Buscagna stream located inthe Lepontine Alps, Italy. Seven soil profiles are selected along two val-ley slopes, in different morphological contexts, in order to address theinfluence of the different active geomorphic processes in the soil devel-opment. The soils are investigated by means offield and laboratoryanalyses, and geomorphological maps of the area surrounding the pro-files are made. Analyzed soil profiles reveal that bedrock and geomor-phic dynamics are controlling factors of soil development. Differentsoil units testify the succession of slope stability/instability phases. Theauthors demonstrate that exhaustive investigation of soils and paleosolscan provide detailed information in order to reconstruct past environ-mental conditions and spatio-temporal changes in denudation/deposi-tion processes.Gaspar et al. (2020)investigate the mobilization and redistributionof 15 major and trace elements in the soil along a karstic hillslope innorth-eastern Spain. The authors selected a representative soilcatenawith two distinctive sections based on the parent material in whichthe main soil properties and soil erosion patterns are very well charac-terized. Element contents were determined by ICP-OES and soil redistri-bution rates were obtained using137Cs for each of the 12 and 11 soilprofiles sampled in the upper and lower sections, respectively. The pre-sented results show that the different processes governed by infiltrationin the upper section versus runoff in the lower section affect elementalmobilizationalongthe soilcatenaand that soil erosion appears asanim-portantdriverof themovementof metal(loid)s inthe landscape. Resultsgained in this study contribute to understanding processes of elementaltransference in Mediterranean agroecosystems.The paper byGawrysiak and Kociuba (2020)presents afirst attemptto implement the geomorphons method on a small-valley spatial scaletogether with the more common DoD method for detecting and analyz-ing geomorphic changes in rapidly changing proglacial environments.The study was carried out over a 3.3 km distance of the non-glaciatedsection of the Scott River valley course in SW Svalbard, Norway. Acomparison of the obtained results (DoD and geomorphons maps;zonal statistics) as well as a compilation of both the quantitative assess-ment of the scale of changes and the qualitative assessment of thetransformation's direction allowed the reconstruction of the range andrate of morphological changes detected within the analyzed section ofthe

Scott River valleyfloor for a three-year period. Significant differ-ences in the dynamics of processes shaping the valley landforms alongthe longitudinal valley course are found. The authors demonstrate thatthe proposed combination of DoD and geomorphons methods enablesa spatio-temporal evaluation of the variability of complex geomorphicprocesses.Navas et al. (2020)explore if the geochemical signature of sedi-ments can be used to discriminate sediment provenance in proglacialenvironments during different stages of the melting season. Twenty-four composite surface samples of moraine materials and sediments atthe glacier surface and 12 sediment mixtures were collected in theAldegonda Glacier area located in western Spitsbergen Island, SvalbardArchipelago, Norway. Fingerprinting techniques were applied to deter-mine the sediment provenance and tracers were selected using a novelconservative index and consensus ranking method. By taking advantageof the FingerPro model bottom moraines are identified as the predomi-nant source in all cases (74%), followed by recent moraines (15%) andsediment on ice with a contribution of 11%. Theirfindings reveal thatvariations in source contributions depended on the location and typeof the sediment mixtures and that sediments on ice deliver radionu-clides and heavy metal(oid)s to arctic ecosystems.Mazurek et al. (2020)analyze hydrochemical water changes in achannel head located in the Parsęta drainage basin in NW Poland.Based on a high-resolution sampling and the performed hydrochemicalmeasurements, obtained results indicate for instance that (i) thehyporheic zone regulates the connectivity between groundwater andsurface water, (ii) the physical drivers affect water chemical transfor-mations in the channel head, and (iii) the downstream transport of sol-utes can be substantially affected by the hyporheic zone in the channelhead. The authors point out that the small areas of channel heads are ca-pable of improving water quality and that due to their important rolesin shaping the waters and solutefluxes, they must be conserved andtheir functions protected.The paper byPłaczkowska et al. (2020)focuses on disturbances incoarse bedload transport measured within the formerly glaciatedChochołowski catchment located in the Western Tatras in Poland. Thepresented long-term and substantial data set of bedload measurementsenables the authors to draw certain conclusions about general patternsof bedload transport dynamics as well as to observe various scenariosaltering these patterns. The results show thatfluvial bedload transportis activated along the entire length of the channel system every 2 to 5years, and that the distance of transport in afluvial valley is 2–7timeslonger than ina glacialtrough.Thefindings revealseasonaldisturbancesin bedload transport due to sudden snowmelt and locally occurringheavy rainfall events whereas the greatest effect onfluvial bedload dy-namics was caused by natural deforestation.The new scientificdataandfindings presented and discussed in theeleven papers selected for this Special Issue explore and collectively high-light the great variety, complexity and interconnections of denudationalprocesses and landscape responses to global environmental changes ina range of different morphoclimatic settings. The importance of both cli-matic changes and direct anthropogenic impacts for denudation andlandscape responses is evaluated and discussed in depth. The appointed Guest Editors Katja Laute and Ana Navas and theoverseeing Editor-in-Chief Achim A. Beylich were responsible for thepeer-review process for this Special Issue; and the preparation of thisSpecial Issue would not have been possible without the help of the nu-merous selected peer reviewers. The dedicated work and valuable con-tributions from the contributing paper authors and all peer reviewers,including a number of current members of the Editorial Board of Geo-morphology, are greatly acknowledged. We also wish to express oursincere thanks to the numerous international DENUCHANGE colleaguesfor their valuable discussions and comments provided during the scien-tific DENUCHANGE sessions and workshops that serve as important fo-rums for our DENUCHANGE activities.

Declaration of competing interest

The authors declare that they have no known competingfinancialinterests or personal relationships that could have appeared to influ-ence the work reported in this paper.

References

Bell, R., Fort, M., Götz, J., Bernsteiner, H., Andermann, C., Etzlstorfer, J., Posch, E., Gurung,N., Gurung, S., 2020. Major geomorphic events and natural hazards during monsoonalprecipitation 2018 in the Kali Gandaki Valley, Nepal Himalaya. Geomorphology (Vir-tual Special Issue

DENUCHANGE)https://doi.org/10.1016/j.geomorph.2020.107451.Beylich, A.A., DENUCHANGE Team, 2020.The International Association of Geomorpholo-gists (IAG) Working Group on Denudation and Environmental Changes in DifferentMorphoclimatic Zones (DENUCHANGE): scientific need, research objective, key activ-ities and products. Geomorphology (Virtual Special Issue DENUCHANGE).Beylich, A.A., Laute, K., 2019.Second Workshop of the IAG Working Group on Denudationand Environmental Changes in different Morphoclimatic Zones (DENUCHANGE), 12–14 September 2019, Calpe, Spain. Volume of Abstracts. GFL Geomorphological FieldLaboratory Publication Series Number 1, September 2019 (56 pp).Cienciala, P., Melendez Bernardo, M., Nelson, A.D., Haas, A.D., 2020.Sediment yield from aforested mountain basin in inland Pacific Northwest: Rates, partitioning, and sources.Geomorphology (Virtual Special Issue DENUCHANGE).Gaspar, L., Lizaga, I., Navas, A., 2020. Elemental mobilisation by sheet erosion affected bysoil organic carbon and waterfluxes along a radiotraced soil catena with two con-trasting parent materials. Geomorphology (Virtual Special Issue DENUCHANGE)https://doi.org/10.1016/j.geomorph.2020.107387.Gawrysiak, L., Kociuba, W., 2020. Application of geomorphons for analysing changesin the morphology of a proglacial valley (case study: the Scott River, SW Svalbard). Geomorphology (Virtual Special Issue DENUCHANGE)https://doi.org/10.1016/j.geomorph.2020.107449.Geitner, C., Mayr, A., Rutzinger, M., Löbmann, M.T., Tonin, R., Zerbe, S., Wellstein, C.,Markart, G., Kohl, B., 2020. Shallow erosion on grassland slopes in the EuropeanAlps–geomorphological classification, spatio-temporal analysis, and understandingsnow and vegetation impacts. Geomorphology (Virtual Special Issue DENUCHANGE).https://doi.org/10.1016/j.geomorph.2020.107446.Germain, D., Gavrilă, I.-G., Elizbalashvili, M., Pop, O.T., 2020. Multidisciplinary approach tosediment connectivity between debris-flow channel network and the Dolra River,Mazeri Valley, Southern Caucasus, Georgia. Geomorphology (Virtual Special IssueDENUCHANGE)https://doi.org/10.1016/j.geomorph.2020.107455.Masseroli, A., Bollati, I.M., Proverbio, S.S., Pelfini, M., Trombino, L., 2020. Soils as a use-ful tool for reconstructing geomorphic dynamics in high mountain environ-ments: the case of the Buscagna streamhydrographic basin (Lepontine Alps).Geomorphology (Virtual Special Issue DENUCHANGE)https://doi.org/10.1016/j.geomorph.2020.107442.Mazurek, M., Kruszyk, R., Szpikowska, G., 2020. Source-to-mainstream: Hydrochemicalwater changes in a channel head in the young glacial area (Pomeranian Lakeland,Poland). Geomorphology (Virtual Special Issue DENUCHANGE)https://doi.org/10.1016/j.geomorph.2020.107445.Navas, A., Lizaga, I., Gaspar, L., Latorre, B., Dercon, G., 2020. Unveiling the provenance ofsediments in the moraine complex of Aldegonda Glacier (Svalbard) after glacial re-treat using radionuclides and elementalfingerprints. Geomorphology (Virtual SpecialIssue DENUCHANGE)https://doi.org/10.1016/j.geomorph.2020.107304.Płaczkowska, E., Krzemień, K., Gorczyca, E., Bojarczuk, A.,Żelazny, M., 2020. Disturbancesin coarse bedload transport in a high-mountain stream channel system (WesternTatras, Poland). Geomorphology (Virtual Special Issue DENUCHANGE)https://doi.org/10.1016/j.geomorph.2020.107428.Shtober-Zisu, N., Vaks, A., Korngreen, D., Frumkin, A., 2020. Slope retreat rates estimatedfrom chronology of tufa deposits sheltered by inland notches on Mt. Carmel, Israel.Geomorphology (Virtual Special Issue DENUCHANGE)https://doi.org/10.1016/j.geomorph.2020.107319.

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