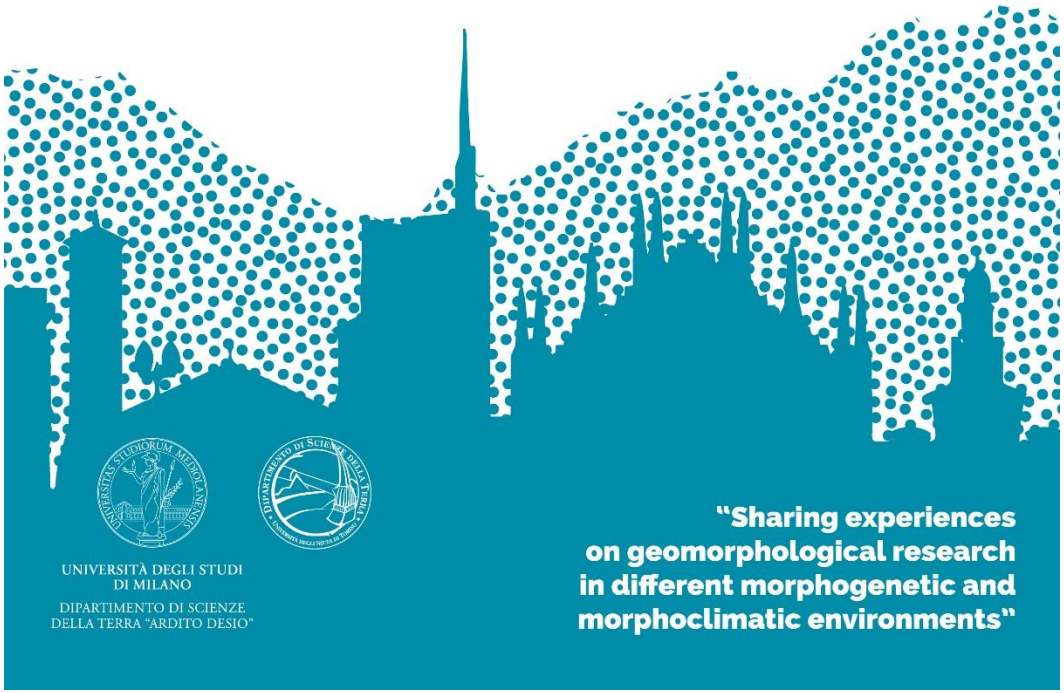
Conference proceedings of

VIII ITALIAN YOUNG GEOMORPHOLOGISTS' DAYS

Milan & Veny Valley, 26th-28th June 2019



UNIVERSITÀ DEGLI STUDI DI MILANO

DIPARTIMENTO DI SCIENZE DELLA TERRA "ARDITO DESIO"

VIII ITALIAN YOUNG GEOMORPHOLOGISTS' DAYS

Milan and Veny Valley
26th-28th June 2019

"Sharing experiences on geomorphological research in different morphogenetic and morphoclimatic environments"

Editors Anna Masseroli & Irene Bollati

Under the auspice of

Sponsored by

Beta Analytic
RADIOCARBON DATING

ORGANIZING COMMITTEE

Irene Bollati, Francesca Vergari, Gabriele Amato,
Laura Coco, Mariacristina Prampolini
AIGeo Italian Young Geomorphologists' Commitee

Andrea Zerboni, Anna Masseroli,
Roberto Azzoni, Alessio Golzio, Guido Mariani
Earth Sciences Department «A. Desio», University of Milan

Marco Giardino, Giandomenico Fubelli,
Luigi Perotti, Pierluigi Pieruccini
Earth Sciences Department, University of Turin

Costanza Morino
Laboratory of Planetology and Geodynamic, University of Nantes

SCIENTIFIC COMMITTEE

Prof. Valerio Agnesi – AIGeo President, University of Palermo (Italy)
Prof. Carlo Baroni – University of Pisa (Italy)
Dr. Susan Conway – Université de Nantes (France)
Dr. Paola Coratza – University of Modena and Reggio-Emilia (Italy)
Prof. Mauro Cremaschi – University of Milan (Italy)
Dr. Onn Crouvi – Geological Survey of Israel (Israel)
Prof. Philip Deline –Savoie Mont Blanc University (France)
Prof. Monique Fort – Paris Diderot University (France)
Prof. Simona Fratianni – University of Turin (Italy)
Prof. Giandomenico Fubelli – University of Turin (Italy)
Prof. Marco Giardino – University of Turin (Italy)
Prof. Mauro Guglielmin – Università degli Studi dell'Insubria (Italy)
Prof. Jasper Knight – Witwatersrand University (South Africa)
Prof. John Macadam – Earthwords, British Institute for Geological Conservation (UK)
Dr. Giovanni Monegato – AIQUA President, IGG-CNR (Italy)
Prof. Kathleen Nicoll – University of Utah (USA)
Prof. Manuela Pelfini – University of Milan (Italy)
Dr. Luigi Perotti – University of Turin (Italy)
Prof. Pierluigi Pieruccini – University of Turin (Italy)
Dr. Olimpiu Pop – Romanian Ass. Geomorphologists;
Romanian Young Geomorphologists (Romania)
Prof. Claudio Smiraglia – University of Milan (Italy)
Prof. Mauro Soldati – IAG President;
University of Modena and Reggio-Emilia (Italy)
Prof. Luca Trombino – University of Milan (Italy)
Dr. Matteo Vacchi – University of Pisa (Italy)

Keynotes

The training programme of the International Association of Geomorphologists (IAG): state of the art and perspectives

Mauro SOLDATI [1,*], Marta DELLA SETA [2]

[1] Department of Chemical and Geological Sciences, University of Modena and Reggio Emilia, Italy
[2] Department of Earth Sciences, Sapienza University of Rome, Italy
* corresponding author: soldati@unimore.it

The International Association of Geomorphology (IAG) established its Training Programme for Young Geomorphologists in occasion of the Fifth International Conference on Geomorphology held in Tokyo in August 2001. Since then, considerable financial resources have been invested to favour the participation of early career scientists in events organized by the IAG or occurring under its auspices. So far about 150 Young Geomorphologists from 50 countries have benefitted from this programme, which is particularly addressed to fellows coming from economically disadvantaged countries. The IAG itself has acted as either organiser or supporter of intensive courses and training schools in different countries of the World. Goals of the training activities are to help Young Geomorphologists to (i) increase their knowledge and experience in geomorphological research; (ii) discuss their learning and research experience with young colleagues from different countries; (iii) meet experienced scientists and young researchers in an informal setting, which favours scientific discussion. The IAG is at present planning the building of a network of Young Geomorphologists' groups worldwide, which is intended to favour scientific interaction and mobility for training and research. Opportunities of financial support are regularly advertised and illustrated on the IAG website www.geomorph.org.

Postglacial Relative Sea-Level databases from near- to intermediate-field regions. A key tool to quantify the on-going isostatic signal and future sea level rise along global coastlines

Matteo VACCHI [1,2,*]

[1] Dipartimento di Scienze della Terra, Università di Pisa, Italy
[2] College of Life and Environmental Sciences, University of Exeter (UK)
[*] corresponding author: matteo.vacchi@unipi.it

Reconstructions of relative sea level (RSL) have implications for investigation of crustal movements, calibration of earth rheology models and the reconstruction of ice sheets. In recent years, efforts were made to create RSL databases following a standardized methodology. These regional databases provide a framework for developing our understanding of the primary mechanisms of RSL change since the Last Glacial Maximum and a long-term baseline against which to gauge changes in sea level during the 20th century and forecasts for the 21st. This presentation will report the results of recently compiled databases in very different climatic and geographic contexts that are the Pacific and Atlantic coast of North America, the Mediterranean Sea as well as the southeast Asiatic region. Production and re-evaluation of sea-level different proxies have yielded more than 3000 RSL data-points mainly from brackish transitional environments, beach ridges, biological indicators, beach rocks as well as coastal archaeological structures. I will outline some of the inherent difficulties, and potential solutions to analyze sea-level data in such different depositional, climatic and tectonic environments. In particular, problems related with the definition of standardized indicative meaning, and with the use of old radiocarbon samples will be discussed. Finally, the implications of these results for the patterns of glacio-isostatic adjustment in these regions will be discussed.

Scientific Sessions

From above to below the surface: a geoarchaeological approach to study the evolution of the lowlands around Ravenna

Michele ABBALLE [1,*]

[1] Ghent University/University of Verona
[*] corresponding author: michele.abballe@ugent.be

Lowlands, which include coastal plains, river deltas and alluvial valleys, are very crucial environments because they have always been among the most populated areas in the world. My PhD project focuses on the lowlands around the city of Ravenna, an area part of the Po Plain that underwent severe alluvial phenomena and significant geomorphological changes until recent times. To reconstruct the evolution of such rapidly evolving landscape, a multidisciplinary approach is extremely necessary, which has to rely on several different kinds of data.

To date, I have focused mainly on the analysis of the present landscape, in order to confirm the presence of the several palaeo-channels and alluvial ridges already known in the literature. To reach this aim, a new algorithm for morphological analysis of landforms (MSRM algorithm, by Orengo & Petrie 2018) has been applied to the whole Romagna Plain, also to test the method itself. This has been followed by an extensive analysis of aerial and satellite images, to possibly confirm the genesis of the elevated areas in the landscape, which were identified by the algorithm. Targeted field campaigns will be directed to confirm the nature of the identified anomalies and to collect datable samples.

This information about the past river networks will be finally crossed with the archaeological data, to better understand the relationships between man and environment in a such fragile landscape.

Geomorphological mapping as enrichment of cultural heritage: multitemporal data collection of quarry dump deposits of the Apuan Alps

Linda ALDERIGHI [1,*], Carlo BARONI [1], Maria Cristina SALVATORE [1]

[1] Dipartimento di Scienze della Terra, University of Pisa
[*] corresponding author: linda.alderighi@phd.unipi.it

The Apuan Alps (northern Tuscany) are renowned for the extraction of marble since the Roman Period. Inserted in the European Geoparks Network since 2011 and involved in "Unesco Global Geopark" status since 2015, the Apuan Alps preserve a wide variety of geological and naturalistic elements and include a large number of geosites of international and national interest. The peculiar topographic and morphologic context, where human activity represents one of the most active processes, make this area a *unicum* for the variety of landforms including anthropogenic features.

Landscape preserves the effects due to the millennial human activity that has modified the landforms, which are not only the marble quarries but also waste deposits, referred as to *ravaneti*,

Anthropogenic landforms, such as *ravaneti*, retain relevant information on cultural heritage and represent also a tool for investigating different technique of extraction technology applied through time. It is well known that different quarrying techniques and material recovery can favour the occurrence of geomorphological hazard. Here we present the geomorphological characterization of selected extractive areas with particular regards to *ravaneti* deposit. To reach this goal, we applied a multitemporal landscape analysis using aerial photographs taken over a period of about 60 years. All data were digitized using a Geographic Information System (GIS) and contributed in populating a geomorphological dBase of the Apuan Alps.

Accounting for covariate distributions in slope-unit-based landslide susceptibility models. A case study in the alpine environment

Gabriele AMATO [1,*], Clemens EISANK [2], Luigi LOMBARDO [3]

[1] IFAC CNR, Sesto Fiorentino, Florence, Italy
[2] GRID-IT GmbH, Innsbruck, Austria
[3] Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, Netherlands
[*] corresponding author: g.amato@ifac.cnr.it

Thousands or even millions of pixels can be contained in a single Slope Unit. Hence, each covariate used in spatial predictive models is actually characterised by a distribution of values for each Slope Unit.
Here, we modelled the whole covariates' distribution within Slope Units for landslide susceptibility purposes. This was done by finely dissecting each covariate into quantiles and then model the susceptibility via a LASSO penalised Binary Logistic Regression. We chose a LASSO penalization because the common Stepwise procedure would have never been selective enough to shrink a large number of covariates to an interpretable subset. Conversely, LASSO mostly selected 6 covariates out of 372 to explain the spatial distribution of shallow landslides in the Upper Badia valley, Italian Alps. This allowed us to verify that the selection did not include any quantile close to the median hence, nor to the mean. The latter is the common representation of the covariates' distribution within Slope Units. As a result, we suggest similar approaches because the mean may not be the most informative nor the most performing way to generate Slope-Unit-based susceptibility models.
In this general context, we generated our landslide inventory by combining semiautomatic (OBIA) and manual mapping procedures.
Our inventory, quantile covariates' representation and LASSO penalization produced excellent performances and interpretable relations between covariates and landslides.

Getting awareness on geomorphological hazard and risk along touristic trails: a pilot study in the Central-Western Italian Alps

Claudio ARTONI [1,*], Irene Maria BOLLATI [1], Manuela PELFINI [1]

[1] Earth Sciences Department "A. Desio", Università degli Studi di Milano, Italy
*corresponding author: claudio.arto@fastwebnet.it

The increasing number of visitors in mountain regions pones critical issues, especially in relation with the fast changes affecting the high altitude environments. Providing effective tools to both local administrations, tourists and mountaineers could constitute a powerful tool for reducing the impact of geomorphological hazard and vulnerability of visitors. Cartographic tools have been developed in order to help people in deciphering both i) geomorphological processes affecting the touristic trails and ii) geometric features of trails that could worsen the progression along a touristic path. Thematic and cultural trails are becoming more and more interesting for tourism despite the location at high altitudes and the possible glaciological approaching. Hence, one of the glaciological itineraries published by the Italian Glaciological Committee in 2018 ("*Alpe Veglia - L'impronta dei ghiacci*"), located in the the Central-Western Italian Alps, was selected. The aim was to analyse geomorphological hazard and morphological trail features, representing potential criticalities affecting it. Starting from the geomorphological map, the trail was surveyed for collecting information on different parameters among which, slope and trail steepness, slope aspect, ground features, water or snow occurrence. Thematic maps were finally produced by overlying a series of symbols on the cartography commonly used by tourist, allowing a personal evaluation of potential criticalities along the trail.

Mount Ararat: the forgotten flood

Roberto Sergio AZZONI [1,*], Davide FUGAZZA [1], Carlo Alberto GARZONIO [2], Kathleen NICOLL [3], Guglielmina Adele DIOLAIUTI [1], Manuela PELFINI [4], Andrea ZERBONI [4]

[1] Dipartimento di Scienze e Politiche Ambientali, Università degli Studi di Milano, Italy
[2] Dipartimento di Scienze della Terra, Università degli Studi di Firenze, Italy
[3] Department of Geography, The University of Utah, USA
[4] Dipartimento di Scienze della Terra "A. Desio", Università degli Studi di Milano, Italy
[*] corresponding author: robertosergio.azzoni@unimi.it

Several diarists and scientific authors reported a calamitous event, called *diluvium*, on July 1840 in the Ahora Gorge on Mt. Ararat. A landslide triggered by a volcanic eruption obliterated several villages located at the foot of the volcano. The reasons and effects of this Ahora Gorge catastrophe event have been obscure and ambiguous. To reappraise this catastrophe and the geomorphic evolution of the Ahora Gorge, we used high-resolution remote sensing data supplemented by observations collected during two field surveys. According to our interpretation, an earthquake in 1840 triggered an abrupt volcanic eruption, which caused the consequent rapid glacier ice melting. This event produced significant mud and ice flow along the Gorge that inundated the villages downslope. The flooding, which we interpret as a lahar, deposited a wide alluvial fan at the foot of the volcano. Today, an elongated landform present within the Ahora Gorge has alternately been interpreted as a landslide deposit. Our analysis demonstrate that this feature is an unmapped glacier. Our discovery of the Ahora Gorge Glacier in context of a reappraisal of the Ahora Gorge Catastrophe demonstrates the contribution of glaciers in shaping the landscape near ice-capped volcanoes. Moreover, our data underscore the importance of being more aware of the potential future geo-hazards posed by Mt. Ararat, particularly where glaciers are still present along several valleys and seismically-induced lahar events might occur.

Extreme drought episodes over Po Plain (Italy): a weekly spatio-temporal distribution analysis in the past and future

Alice BARONETTI [1,*], Fiorella ACQUAOTTA [1], Vincent DUBREUIL [2], José Carlos GONZÁLEZ-HIDALGO [3], Sergio M. VICENTE-SERRANO [4], Simona FRATIANNI [1]

[1] Earth Sciences Department, University of Turin, Italy; [2] Université Rennes 2, France; [3] Department of Geography, University of Zaragoza, Spain; [4] Instituto Pirenaico de Ecología (IPE-CSIC), Saragossa, Spain;
[*] corresponding author: albarone@unito

Past (1985-2017), near future (2020-2049) and far future (2070-2099) weakly drought events for the Po Plain region, based on 60 weather stations and 5 EURO-CORDEX Regional Climate Models are expressed and mapped using three approaches. (1) Climate analysis: daily precipitation and temperature ground series were converted to weekly. The obtained series were reconstructed and homogenised. To facilitate the analysis of drought events, weekly series were interpolated by means of the Universal Kriging and auxiliary variables. Then the Potential Evapotranspiration (ET0) was estimated by means of the Hargreaves method. (2) Models validation: for each model 10 precipitation and temperature daily series were extracted and compared with the respective series recorded at the ground. The statistical comparison was developed by means of Co.Temp and Co.Rain software classifying episodes in weak, mean, heavy and extreme. (3) Weekly drought detection: past and future severe and extreme drought episodes were detected by two drought indices (SPI and SPEI) calculated at short (1 and 3 months) and long (12, 24 and 36 months) time-scales. Trends were analysed and the main drought events were characterised, identifying duration, magnitude and length. The results highlighted that drought episodes become more frequent and longer after the 2000s, and about the future projection is expected in all the model an increase of extreme drought in terms of length and percentage of area.

An attempt of semi-automatic detection of pipe collapses

Anita BERNATEK-JAKIEL [1,*]

[1] Institute of Geography and Spatial Management, Faculty of Geography and Geology, Jagiellonian University, Kraków, Poland
[*] corresponding author: anita.bernatek@uj.edu.pl

Soil piping has been recognized as an important geomorphic, soil erosion and hydrologic process that occurs in almost all morphoclimatic zones and in a wide variety of sediment types. Traces of soil piping become visible on the surface only when a pipe roof collapses, i.e., pipe collapses (PCs) occurred. Identification of PCs and susceptible areas are important issues to understand the piping erosion, whereas preparation of PCs inventory remains a challenging and time-consuming task. Moreover, mapping of PCs in the field is difficult because of the vegetation that might obscure them. Therefore, there is a high need to find a tool to facilitate the mapping of PCs. This study aims to present an attempt of semi-automatic detection of PCs in the Bieszczady Mts. (SE Poland), where pipes develop in Cambisols. The LiDAR-based DEM has been used in order to produce several DEM derivatives that may indicate the places of pipe roof collapses. The analysis of DEM derivatives provides good introduction to field mapping, but it seems that it cannot be a sufficient tool to the PCs detection. The study is supported by the National Science Centre, Poland within the first author's project SONATINA 1 (2017/24/C/ST10/00114).

Exploiting different satellite radar techniques to investigate interannual and sub-seasonal rock glacier displacement: a case study in Val Senales (Italy)

Aldo BERTONE [1,2,*], Mattia CALLEGARI [2], Giovanni CUOZZO [2], Niccolò DEMATTEIS [1,3], Karl KRAINER [4], Carlo MARIN [2], Claudia NOTARNICOLA [2], Roberto SEPPI [1], Francesco ZUCCA [1]

[1] Department of Earth and Environmental Sciences, University of Pavia, Italy
[2] EURAC Research – Institute for Earth Observation, Bolzano, Italy
[3] Research Institute for Hydro-Geological Protection, National Council of Research of Italy, Torino, Italy
[4] Institute of Geology, University of Innsbruck, Austria
[*] corresponding author: aldo.bertone01@universitadipavia.it

Rock glaciers are the most common permafrost landforms in alpine regions and are characterized by creeping processes that generate a downslope displacement, with velocities ranging from centimetres to meters per year. The long-term displacement trend of active rock glaciers is related to climate, whereas short-term movements are related to the occurrence of events over short time scales, such as rainfall and snow melting. The slope instabilities related to rock glacier and permafrost dynamics are monitored for a proactive management of natural hazards. Moreover, as permafrost is sensitive to climate change, observing its dynamics is a key issue in alpine environments.

In this work, we propose a satellite-based approach for monitoring rock glacier dynamics at different time scales (from sub-seasonal to annual). Satellite Synthetic Aperture Radar (SAR) data with different characteristics (i.e. different spatial and temporal resolution) were processed through different techniques to study an active rock glacier located in Val Senales (South Tyrol, Italy). The accuracy of satellite-based analysis was assessed exploiting field data, such as GPS, UAV and Ground-Based SAR data. Results show that our approach is able to investigate rock glacier dynamics when in situ measurements are scarce or not available.

Preliminary data of a landslide system in North-central Peru

Mauro BONASERA [1,*], Giusy DIMOLA [1], Claudio PUGLISI [3], Augusto SCREPANTI [2], Francesco IMMORDINO [2], Giandomenico FUBELLI [1], Vladimiro VERRUBBI [2]

[1] Department of Earth Science, University of Turin, Italy
[2] ENEA – National Agency for New Technologies, Energy and Sustainable Economic Development, Department for Sustainability, Rome, Italy
[*] corresponding author: mauro.bonasera@unito.it

The geomorphology of north-central Peru is conditioned by a strong uplift affecting the Andean Mountains. The landscape is portrayed by mass movements often involving villages and high economic importance transport routes. In this framework, we performed a study finalised to characterise a landslide system with an approximate spatial extent of 0,9 km^2, monitored with inclinometers, piezometers, geodetic and satellite data since 2007. A geological model has been realized interpreting boreholes, geotechnical and geophysical investigations, coupled with detailed digital elevation models analysis. In February 2019, a field survey has been carried out to recognize the geomorphological features and elements (tension cracks, tilted trees, fractures in the buildings) helpful to characterize the landslide. The preliminary data suggests a general large rotational slide, whose crown area is retreating and affected by debris flows and the accumulation zone is mobilised by several shallow rotational slides. Inclinometer data located along the landslide show the deepest sliding surface from 23 to 73 m describing a rotational movement, according with the morphology of the terraces. The activity of the investigated landslide exposes at risk a village, located in proximity of the crown, and the main road with related facilities crossing the smaller movements in the accumulation zone. For this reason, we warmly recommend to increase the monitoring network.

The role of colluvial deposits in gully formation: example of the upper Mkomazi basin, KwaZulu-Natal, South Africa

Alberto BOSINO [1, *], Alice BERNINI [1], Michael MAERKER [1]

[1] University of Pavia, Italy
[*] Corresponding author: alberto.bosino01@universitadipavia.it

Gully erosion is one of the most intensive process of soil erosion in South Africa. The aim of this study is to examine the driving factors for the origin and development of gully forms and features in the upper Mkomazi basin, KwaZulu-Natal, RSA. The study area covers about 600 km^2 and is characterized by the sedimentary rocks of the Permo-Triassic Beauford Group. Additionally, large parts of the study area are covered by thick sequences of Quaternary colluvial sediments, often alternated by post depositional pedogenic processes. The colluvial sediments are called "Masotcheni Formation" and are characterised by weathered claystone with subordinate siltstone and sandstone.
We mapped the colluvial deposits and generated a 1:50.000 scale geological map. Therefore, we combine remote sensing techniques (Orthophotos, Google Earth images) and field recognition methods. Moreover, we carried out a gully/sheet erosion inventory map classifying the erosional forms and features from the lithological, mineralogical, morphological and morphometric point of view. In total 279 gullies, as well as 133 sites of sheet erosion, have been identified. Subsequently, we assessed the driving factor using a stochastic modelling approach (MaxEnt). The results show that parts of the area are covered by thick (up to 6m) fine stratified colluvial deposits, with solonetzic soils. Finally, the model information about driving factors allows for a spatial assessment of gully and sheet erosion susceptibilities.

Historical cartography as a geomorphological dataset to assess the human-induced modification on fluvial landscapes

Filippo BRANDOLINI [1,*], Mauro CREMASCHI [1], Manuela PELFINI [1]

[1] Earth Sciences Department "Ardito Desio", Università degli Studi di Milano, Italy
[*] corresponding author: filippo.brandolini@unimi.it

Fluvial environments have always played a crucial role in human history. Since anthropogenic activities started altering the evolution of natural landscapes, floodplains represented complex and dynamic human–fluvial systems, where the interplay between geomorphological processes, land-use, ecosystems, and human activities was distinctive and fundamental in shaping natural environments. Being land-use changes a dynamic process linking natural and human spheres; the historical reconstruction of such processes is mandatory to evaluate the mutual interactions between anthropogenic activities and the fluvial environment. Historical maps, if available, offer a valuable archive of data to understand the causes, mechanisms, timing, and consequences of the human-induced changes in fluvial landforms and support river management at any scale. Moreover, the combination of historical data with geomorphological interpretation and remote sensing analysis of the landscape is essential to study the relationship between natural events and land-use changes through time. The digitalisation and GIS elaboration of historical cartography is therefore fundamental to interpret the landscape and land-use changes in a region. The use of Structure-from-Motion (SfM) photogrammetric techniques is a suitable procedure that responds to the necessity of digitalising historical maps and documents avoiding any direct contact with the often-fragile analogic support.

Estimate of coarse material transport in large gravel-bed rivers using the virtual velocity approach and the morphological method

Andrea BRENNA [1,*], Nicola SURIAN [1], Luca MAO [2]

[1] Department of Geosciences, University of Padova, Italy
[2] School of Geography, University of Lincoln, UK
[*] corresponding author: andrea.brenna@unipd.it

Estimating the bed material transport in large gravel-bed rivers is a challenging task since theoretically based formulas often fail to predict sediment fluxes, and it is difficult to carry out field measurements. Among the alternatives to achieve estimates of such key process, the virtual velocity approach (a hybrid solution based on a theoretical framework and use of data collected by tracer-clasts) represents a promising but poorly applied possibility. This research aims (i) to improve the virtual velocity approach and (ii) to evaluate the reliability of its transport estimates through comparison with the results provided by an independent and robust procedure as the morphological method applied at the same dam-regulated study sector of the Parma River (North-Apennines, Italy). After field and remote sensing data collection, we performed the coarse sediment transport calculations using the two approaches and compared the estimates obtained at four selected cross-sections located along the 4-km long study sector. Since the two methods provided remarkably similar transport results over the period April 2016 - April 2017, the virtual velocity approach can be considered as a viable tool for achieving reliable coarse-transport estimates in large gravel-bed rivers. Moreover, the virtual velocity approach can be applied in a broad spectrum of large gravel-bed rivers and in different physiographic contexts.

The significance of recent and short pluviometric time series for the assessment of flood hazard in the context of climate change: examples from some sample basins of the Adriatic Central Italy

Margherita BUFALINI [1, *], Piero FARABOLLINI [1], Emy FUFFA [1], Marco MATERAZZI [1], Gilberto PAMBIANCHI [1], Michele TROMBONI [2]

[1] School of Science and Technology -Geology Division, University of Camerino, Italy
[2] Consorzio di Bonifica delle Marche, Pesaro, Italy
[*] corresponding author: margherita.bufalini@unicam.it

Numerical hydrological models are increasingly a fundamental tool for the analysis of floods in a river basin. If used for predictive purposes, the choice of the "design storm" to be applied, once set other variables (as basin geometry, land use, etc.), becomes fundamental.
All the statistical methods currently adopted to calculate the design storm, suggest the use of long rainfall series (at least 40-50 years). On the other hand, the increasingly high frequency of intense events (rainfalls and floods) in the last twenty years, also as a result of the ongoing climate change, testify to the need for a critical analysis of the statistical significance of these methods.
The present work, by applying the Gumbel distribution (Generalized Extreme Value Type-I distribution) on two rainfall series (1951-2018 and 1998-2018) coming from the same rain gauges and the "Chicago Method" for the calculation of the design storm, highlights how the choice of the series may influence the formation of flood events.
More in particular, the comparison of different hydrological models, generated using HEC-HMS software on three sample basins of the Adriatic side of central Italy, shows that the use of shorter and recent rainfall series results in a generally higher runoff, mostly in case of events with a return time equal or higher than 100 years.

"Trap Efficiency" loss of artificial reservoirs through a direct and indirect evaluation of soil erosion rate in a sample catchment of Central Italy

Margherita BUFALINI [1,*], Piero FARABOLLINI [1], Emy FUFFA [1], Marco MATERAZZI [1], Gilberto PAMBIANCHI [1], Michele TROMBONI [2], Artemi CERDÁ [3]

[1] School of Science and Technology -Geology Division, University of Camerino, Italy
[2] Consorzio di Bonifica delle Marche, Pesaro, Italy
[3] Soil Erosion and Degradation Research Group, Department of Geography, Valencia University, Spain
[*] corresponding author: margherita.bufalini@unicam.it

Sediment is an essential, integral and dynamic part of a river basin, cause a healthy river needs sediment as a source of life. On the other hand, the abundance of sediments can act as a potential sink for many hazardous chemicals and, especially in the case of artificial reservoirs, produce a long-term loss of storage capacity for reservoir operation and watershed management.
Even the European Water Framework Directive (WFD), although it does not deal specifically with sediments, clearly identify a link between sediment monitoring in a river catchment and the achievement of the WFD objective itself (good status of all European water resources by the year 2015). The study, using different direct and indirect methodologies, wants to evaluate the sedimentation rate within a sample artificial reservoir (Le Grazie lake in central Italy) which, in the period 1952-2015, has caused a strong decreasing of the trap efficiency and a loss of over 70% of the water volume stored. Direct measurements of the lake bottom bathymetry, carried out in 2006 and 2015 (AGEOTEC, GEOMARINE), and 3D reconstructions performed in a GIS environment, made it possible to calculate volume and weight of filling material and, in particular, to verify that the greatest contribution comes from a right tributary of the Chienti river (the San Rocco stream), deepened in a clayey sub-basin, and flowing directly into the lake. The values obtained have been then compared with those coming from indirect

evaluations carried out using the RUSLE (Revised Universal Soil Loss Equation) Method (Wischmeier and Smith, 1982) performed in the San Rocco sub-basin. The comparison between the two approaches made it possible to compensate for errors inherent the methods themselves (uncertainties in the direct measurements or the parameters used in the RUSLE equations) and, above all, to verify an upward trend in the sedimentation rate starting since 2006.

Coastal morphogenesis in the Campi Flegrei caldera (NW sector): volcano-tectonic *vs* climatic forcing

Claudia CAPORIZZO [*, 1], Aldo CINQUE [2], Gaia MATTEI [1], Gerardo PAPPONE [1], Michele STEFANILE [3], Pietro AUCELLI [1]

[1] Dipartimento di Scienze e Tecnologie, Università degli Studi di Napoli Parthenope, Italy; [2] Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università di Napoli Federico II, Italy; [3] Dipartimento Asia Africa e Mediterraneo, Università L'Orientale di Napoli, Italy
[*] corresponding author: claudia.caporizzo@uniparthenope.it

The study area is located along the western border of the Campi Flegrei Caldera, one of the active volcanic systems in the Mediterranean region. This area has been frequented by the man since the Bronze Age and settled since the first Greek colonization of Southern Italy (800 BC), as evidenced by many archaeological remains positioned along the coast that can help to detect and to date ancient positions of coastline, the relative sea level and to measure vertical ground movements (VGM). The aim of this study is to present new additional data regarding the relative sea level position during the 1st century BC, considering also the accompanying changes of the coastal landscape and the implications in terms of human adaptation as well. By surveying the coastal sector between the modern Baia and Miseno, with a multidisciplinary approach by means of direct and indirect methods, a Roman sea level at 4.2 m b.s.l. was detected measuring the submersion of three fish tanks. Comparing this value with the eustatic models in stables areas we can affirm that the coastal sector suffered a subsidence of about 3 m (with an average rate of 1.4 mm/y the during the last 2100 century). However, a stability of the sea level during the 1st century BC can be deduced by the analysis of the submersion of structural elements of the studied fish tanks. This means a negligible influence of the VGM due to volcano-tectonic on the coastal areas. Resuming, the main coastal changes in the last 2100 years were the submersion of both the Roman shore, the anthropic structures built on it during the 1st century BC and a coastal retreat ranging between up to 150 m.

Post-wildfire landslide hazard assessment: the case of the 2017 Montagna del Morrone fire (Central Apennines, Italy)

Cristiano CARABELLA [1,*], Enrico MICCADEI [1], Giorgio PAGLIA [1], Nicola SCIARRA[1]

[1] Department of Engineering and Geology, Università degli Studi dell'Adriatico "G. d'Annunzio" Chieti-Pescara, Italy
[*] corresponding author: cristianocarabella12@gmail.com

This work focused on a post-wildfire landslide hazard assessment, applied to the 2017 Montagna del Morrone fire. This wildfire increased the possibility of landslides triggering, as confirmed by the occurrence of a debris flow, triggered by an intense, short-duration rainfall event in August 2018. The study area was investigated through a detailed analysis incorporating morphometric analysis of the topography and hydrography and geomorphological field mapping, followed by landslide hazard assessment. In detail, the analysis was performed following a heuristic or expert-based approach, integrated using GIS technology. This approach led to the identification of five instability factors. These factors were analysed for construction of thematic maps. Hence, each factor was evaluated by assigning appropriate expert-based ranks and weights and combined in a geomorphology-based matrix, which defines four landslide hazard classes (low, moderate, high, and very high). Moreover, the morphometric analysis allowed us to recognize debris-flow prone basins, which, in relevant literature, are those that show a Melton ratio of >0.6 and a watershed length of <2.7 km. Finally, all the collected data were mapped through a cartographic and weighted overlay process in order to realize a new zonation of landslide hazard for the study area, which can be used in civil protection warning systems for the occurrence of landslides in mountainous forested environments.

Val Saviana, an "Ancient Wood" archive in the heart of the Southern Rhaetian Alps

Riccardo CERRATO [1,*], Maria Cristina SALVATORE [1,2], Gino DELPERO [3], Carlo BARONI [1,2]

[1] Dipartimento di Scienze della Terra, Università di Pisa, Italy
[2] CNR–IGG Consiglio Nazionale delle Ricerche–Istituto di Geoscienze e Georisorse, Italy
[3] Comune di Vermiglio, Trento; Italy
[*] corresponding author: riccardo.cerrato@dst.unipi.it

Anthropic activities deeply modify landscapes and ecosystems in the alpine region, especially where prime materials are available. In the Rhaetian Alps evidence of sites used as charcoal kiln at high altitudes are widely recognizable since at least the Bronze Age. Furthermore, many wooded slopes in areas that were theatre of the First World War suffered deep deforestation induced by military occupation (e.g. firewood supply and construction of high-altitude barracks). This intense anthropic activity has led to the destruction of wide portion of the alpine forest. Consequently, long-lived specimens are extremely rare to find at high altitudes. Here we present dendrochronological series from Val Saviana, a peculiar site of Rhaetian Alps where a wide wood of European larch (*Larix decidua* Mill.) is settled. This valley hosts trees up to 485 years old, becoming the southern twin of "Bosco Antico" wood, a well-known and promoted site retaining cultural heritage of anthropic activities. Val Saviana represents a priceless archive for climate and geomorphological studies. Dendroclimatic analysis highlight that the temperature signal in the growth series is partially hidden, implying that other causalities affected the trees growth. The documented avalanche activity on the entire slope makes the oldest trees eligible for further dendrogeomorphological analysis. Finally, the Val Saviana wood deserve to be promoted as well as "Bosco Antico" for the beauty and natural heritage it retains.

Late Quaternary raised marine terraces along the Tyrrhenian coast of southern Italy (Calabria-Basilicata Region)

Ciro CERRONE [1, *], Alessandra ASCIONE [1], Gaetano ROBUSTELLI [2], Ettore VALENTE [1]

[1] Department of Earth, Environmental and Resources Sciences, Distar, University of Naples Federico II, Italy
[2] Department of Biology, Ecology and Earth Science - DiBEST, University of Calabria, Rende, Cosenza, Italy
* corresponding author: ciro.cerrone@unina.it

Marine terraces flight has been recognised and mapped along the Tyrrhenian side of northern Calabria and southern Basilicata region, southern Apennines, Italy, by integration of geomorphological, stratigraphic and structural investigation. Detailed topographic maps (1:5.000 scale; 1:10.000 IGM) and 1 m DTM (LiDAR) have been used to evaluate the elevation of the marine terraces.
The work aims to get new chronological constraints on the Late Quaternary motions along the Tyrrhenian Calabro-Lucano boundary. Published radiometric dating on shallow-water coral-bearing deposits allow to relate the higher marine terraces, which stand up to ~170 m, to Middle-Early Pleistocene. However, the main focus of the work has been the investigation of lower shorelines up to ~50 m a.s.l. by integration of radiometric dating on corals (*Cladocora caespitosa*) and speleothems.
The field work allows us to identify paleo-sea level indicators, e.g., tidal notches, *lithophaga* boreholes and wave-cut platforms, whereas geomorphological and stratigraphic analysis permitted to correlate the coral bearing deposits with paleo-shorelines and to reconstruct the morphostratigraphic position of speleothems with geochronological data.
First results suggest recent, Late Pleistocene, uplift for the study area.

The reconstruction of coastal environments in the Garigliano River coastal plain during the Late Pleistocene – Holocene

Giuseppe CORRADO [1, 2, *], Diana BARRA [3], Paola DI LEO [4,5], Halinka DI LORENZO [3], Gerardo PAPPONE[1], Paola PETROSINO [3], Elda RUSSO ERMOLLI [3], Marcello SCHIATTARELLA [2], Pietro AUCELLI [1]

[1] Dipartimento di Scienze e Tecnologie, Parthenope University, Naples, Italy; [2] Dipartimento delle Culture Europee e del Mediterraneo, Basilicata University, Italy; [3] Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Federico II University of Naples, Italy; [4] CNR-IMAA, Tito Scalo, Potenza, Italy; [5] Scuola di Specializzazione in Beni Archeologici, DiCEM, Basilicata University, Italy
* corresponding author: giuseppe.corrado@unibas.it

We present a multidisciplinary study on the late Quaternary evolution of the coastal plain of Garigliano River, southern Italy. In order to obtain data on climatic variations and local effects of sea level changes, we carried out a 16 m-deep borehole not far from Mt. Massico. Specialist analyses and 14C radiometric dating have been performed on the core samples. From the bottom, the log is characterized by: i) marine sand of upper infra-littoral environment with a volcanic layer; ii) silty sand and coarsening-upward yellowish marine sand with a reddish horizon of weathered sand of marine to continental environment at the top; iii) a Campania Ignimbrite-related pyroclastic interval deposited in a continental environment; iv) silty clay and clay of lagoon-marshy environment. Pollen analysis of the lagoon and marsh intervals indicates the occurrence of a forested landscape dominated by oaks all along the investigated period, with few signs of anthropogenic impact. The authigenic analcime found in the Holocene marshy deposits has to be ascribed to lacustrine or palustrine conditions during semiarid climatic conditions. In the upper part of the core, we have recognized lagoonal-swamp facies. On the basis of 14C dating, we can attribute the starting point of lagoonal sedimentation to the effects of the Post-glacial sea-level rise occurred at about 8000 y BP. The state of knowledge on the late Quaternary evolution of the Garigliano Plain is significantly improved by these data.

Characterization of glacier instabilities through Image Cross-Correlation Monitoring

Niccolò DEMATTEIS [1,2,*], Daniele GIORDAN [2]

[1] Department of Natural and Earth Sciences, University of Pavia, Italy
[2] Research Institute for Hydrogeological Protection, Nation Council of Research of Italy, Italy
[*] corresponding author: niccolo.dematteis@irpi.cnr.it

We present the results obtained from the images acquired in the period 2014-2018 to monitor the temperate Planpincieux glacier in the Italian side of the Mont Blanc massif. We processed the photographs through image cross-correlation to measure the surface kinematics of the lower part of the glacier. During the monitoring, we observed two or three periods of sharp acceleration per each year, culminated with large ice detachments, and followed by analogous decelerations. Overall, we registered more than 350 failures with a volume greater than $100\ \mathrm{m}^3$, of which 18 events with volumes included between 5000 and $60000\ \mathrm{m}^3$. The study evidenced a linear relationship between velocity and failure volume that may be used to estimate the volume of the collapses before the event. We found out thresholds of velocity and acceleration characteristic of the activation of the speedup periods. The study allowed the characterization of the different instability processes that interest the glacier terminus. In particular, we identified three classes of instabilities: i) *disaggregation,* ii) *slab fracture*, and iii) *water tunnelling failure*, which differentiate according to the rheology, the volume involved, and the trigger process.

Deep-seated gravitational slope deformations in Central Sardinia (Western Mediterranean)

Valentino DEMURTAS [1, *], Giacomo DEIANA [1], Paolo E. ORRU' [1]

[1] Dipartimento di Scienze Chimiche e Geologiche, Università degli Studi di Cagliari, Italy
[*] corresponding author: v.demurtas4@tiscali.it

Some cases of deep-seated gravitational slope deformations (DSGSD) in central Sardinia are analysed. The area is characterized by a wide plateau with a prominent Jurassic limestone scarp overlying Paleozoic metamorphic basement. In this area the uplift related to Plio-Pleistocenic tectonic activity results in a very articulated relief with high slopes. This setting favours gravitational processes such as DSGSDs and rock avalanches. DSGSDs are common phenomena in the central Mediterranean regions, but this topic has never been deepened in the Sardinia region. The present research is aimed at investigating a compound landslide characterized by lateral spreading and sackung, involving giant carbonate blocks and the underlying foliated metamorphic basement. A set of ridge top trenches are due to decompression processes of the rock mass, with width up to 50 m, length of hundreds of meters and depth greater than 50 meters. The shear surface is found at depths about 100 m. The displacement of the rock mass has been calculated of about 500 meters. The use of high resolution UAV (Unmanned Aerial Vehicle) photogrammetry and geological, structural, geomorphological surveys allowed a depth morphometric analysis and the creation of interpretative 3d models. This high-resolution data allowed the formulation of new hypotheses about the evolution and kinematics. The results indicate a high correlation between DSGSDs and active tectonic processes. Geo-structural setting, high relief energy associated with recent uplift are the most relevant control factors.

Morphotectonic evidences in the Eastern Sardinia

Valentino DEMURTAS [1,*], Giacomo DEIANA [1], Paolo E. ORRU' [1]

[1] Dipartimento di Scienze Chimiche e Geologiche, Università degli Studi di Cagliari, Italy
[*] corresponding author: v.demurtas4@tiscali.it

Connection between Plio-Pleistocene tectonic activity and geomorphological evolution in the Pardu Valley (Ogliastra, East Sardinia) have been studied. An intensive Quaternary tectonic activity in Sardinia linked to the Tirrenian Basin opening, is known. The aim of this study is to identify tectonic geomorphology conditions of the study area, which may indicate tectonic activity in the region. In Eastern Sardinia it manifests with an uplift, recording by geomorphological indicators such as deep-seated gravitational slope deformation, fluvial captures, engraved valleys, waterfalls and heterogeneous water drainage. The river networks geometry and gravity processes show a young conformation of the landscape, typical of an active tectonic setting.

A geomorphological study based on several field surveys and large scale remote sensing analysis allowed the creation of detailed geomorphological map. Morphometric analyses have been performed in order to interpret the particular geomorphological setting using orthophotos and DTM. The data obtained, like detailed mapping of tectonic structures, lithology, morphologies and morphometrics indices, allowed to formulate a first evolutionary framework. 3D geomorphological model set was buildt in order to show the surface evolution in the Quaternary period. The results show a morphotectonic interpretation of the fluvial capture processes and slope dynamics evolution in relation to Plio-quaternary uplift and active tectonics.

Investigating the role of Saharan dust deposition events on the properties of snow in the European Alps

Biagio DI MAURO [1, *], Roberto GARZONIO [1], Giovanni BACCOLO [1,2], Micol ROSSINI [1], Barbara DELMONTE [1], Valter MAGGI [1], Marie DUMONT [3], François TUZET [3], Edoardo CREMONESE [4], Roberto COLOMBO [1]

[1] Earth and Environmental Sciences Department, University of Milano-Bicocca, Italy
[2] National Institute of Nuclear Physics (INFN), Section of Milano-Bicocca, Italy
[3] Univ. Grenoble Alpes, Université de Toulouse, Météo-France, CNRS, CNRM, Centre d'Etudes de la Neige, Grenoble, France
[4] Environmental Protection Agency of Aosta Valley, Climate Change Unit, Aosta, Italy
[*] corresponding author: biagio.dimauro@unimib.it

The input of mineral dust from arid regions impacts snow optical properties. The induced albedo reduction generally alters the melting dynamics of the snowpack, resulting in earlier snowmelt. In this paper, we evaluate the impact of dust depositions on the melting dynamics of snowpack in a high-altitude site (2160 m) in the European Alps (Torgnon, Aosta Valley, Italy) during three hydrological years (2013–2016). These years were characterized by several Saharan dust events that deposited significant amounts of mineral dust in the European Alps. We quantify the shortening of snow season due to dust deposition, by comparing observed snow depths and those simulated with the Crocus model accounting or not for the impact of impurities. The model was run and tested using meteorological data from an Automated Weather Station. We propose the use of repeated digital images for tracking dust deposition and resurfacing in the snowpack. Impurities deposited in snow anticipated the disappearance of snow up to 38 d out of a total 7 months of typical snow duration. This happened for the season 2015–2016 that was characterized by a strong dust deposition event. During the other seasons considered here (2013–2014 and 2014–2015), the snow melt-out date was 18 and 11 d earlier, respectively. We conclude that the effect of the Saharan dust is expected to reduce snow cover duration through the snow albedo feedback. Possible effects of dust depositions on snow avalanches should be explored in the future.

Understanding beach evolution on the short and medium term on the Sinis Peninsula (Western-Mediterranean)

Aurelien DOUSSERON [1,*], Simone SIMEONE [2], Luca FALLATI [3], Giovanni DE FALCO [2], Alessandro CONFORTI [2], Walter BRAMBILLA [2]

[1] Paris 1 Panthéon-Sorbonne, Physical Geography Laboratory, France
[2] Institute for Coastal Marine Environment IAMC, Italy
[3] Università degli Studi di Milano-Bicocca, Italy
[*] corresponding author: aurelien.dousseron@etu.univ-paris1.fr

Beach dynamics are affected by multiple factors, such as the frequency and intensity of storms, geomorphological features and the availability of sediments. Three beaches (Is Arutas, Maimoni and San Giovanni), located on the central-western coast of Sardinia (Sinis Peninsula, western Mediterranean), were studied in order to evaluate their morphological evolution. Aerial images analysis, GIS application and comparison between Digital Terrain Model (DTM), obtained by Lidar and unmanned aerial vehicle (UAV), were used.

The results of image analysis show that the shoreline of Is Arutas did not experience a trend in retreat, Linear Regression Rate (LRR) ranged between -0.25m to +0.25m. On Maimoi beach the LRR value is generally lower and in the central part resulted about -0.4m.

Neither erosion or accretion can be detected for this San Giovanni Beach (-0.20 m < Linear Regression Rate <0.20 m).

Considering the interval between 2008 and 2018, on Is Arutas, a little decreasing of sediment volume was detected, whereas on Maimoi a general erosion was found. On San Giovanni beach a relevant loss of sediment was identified in the southern sector of the beach. Our study highlighted that the whole system experienced a loss of sediment that is higher on beach and dune systems.

Detecting erosion induced geomorphic change in small-to medium-sized agricultural catchments (Fugnitz, Austria; Nitra, Slovakia) using Terrestrial Laser scanning (TLS) and Structure from Motion (SfM) techniques

Gisela EBERHARD [1, *], Lisa HUMER [1], Ronald POEPPL [1], Elena AYDIN [2]

[1] Department of Geography and Regional Research, University of Vienna, Austria
[2] Department of Biometeorology and Hydrology, Slovak University of Agriculture, Nitra, Slovakia
[*] corresponding author: gisela.eberhard@gmx.at

In the last decades, agricultural activities and land use changes dramatically enhanced soil erosion rates, resulting in substantial geomorphic surface change. To quantify soil erosion at the catchment scale, DEM of difference (DoD) are often created with multi-temporal airborne LiDAR data. Nevertheless, this method is only reliable for change detection covering areas with a greater extent, To better understand microtopographic soil erosion processes, high resolution DEM generated by TLS and SfM are crucial. However, these methods are rarely applied in soil erosion studies.

DEM generation is done along two gullies with an extent of approx. 15m to 30m in the Fugnitz (Austria) and Bocegaj catchments (Slovakia). Both study sites are surveyed twice using unmanned aerial vehicles (UAVs) and a Laser scanner (Riegl VZ-6000) to create a multi-temporal dataset. The data are processed using Agisoft Photoscan and Riscan PRO. Point clouds of both datasets are analysed with Cloud Compare to generate DoD, in order to approve surface change quantification.

First findings suggest that UAV are useful and flexible low-cost alternatives to create high resolution surface models, requiring less time for data acquisition in the field. Its beneficial perspective easily prevents blind spots. Nevertheless, post-processing requires high computation performance. TLS as a more expensive technique provides 3D information directly and the systematic error is quite low. However, unlike UAV, Terrestrial Laser scanners mostly have horizontal scanning views, resulting in an unfavourable data noise.

AMS ^{14}C dating on *Cerastoderma glaucum* (Poiret, 1789) for the palaeo-environmental reconstruction of Mar Piccolo basin (Taranto, Southern Italy)

Paola FAGO [1,*], Gianluca QUARTA [2], Lucio CALCAGNILE [2], Giulia CIPRIANO [3], Marisa D'ELIA [2], Massimo MORETTI [4], Giovanni SCARDINO [4], Eliana VALENZANO [4], Giuseppe MASTRONUZZI [4]

[1] Environmental Surveys S.r.l., Taranto, Italy
[2] CEDAD (Centre of Applied Physics, Dating and Diagnostics), Department of Mathematics and Physics "Ennio de Giorgi", University of Salento, Italy
[3] Dipartimento di Biologia, University of Bari Aldo Moro, Italy
[4] Dipartimento di Scienze della Terra e Geoambientali, University of Bari Aldo Moro, Italy
[*] corresponding author: paola.fago@gmail.com

Cerastoderma glaucum is widely used in AMS ^{14}C dating aimed to palaeo-environmental reconstruction as it is considered a sea-level indicator. An AMS^{14}C dating survey of *C. glaucum* samples, collected in several cores drilled in the Mar Piccolo and its nearby areas, was carried out to produce a relative sea-level (RSL) reconstruction of the basin. Results were compared to precise geochronological markers unearthed in the same cores.

The data show a local age offset estimated between 600 to 800 years, interpreted as a consequence of ^{14}C-depleted carbonate rocks dissolution. This effect makes the interpretation of the data problematic and partially inconsistent with RSL curves and other RSL indicators found in the cores.

Results indicate that *C. glaucum* should be excluded as suitable ^{14}C sample for RSL studies, unless to consider the age offset on ^{14}C determination.

Quantitative analysis of an accelerated glacial decline in the Gran Paradiso Group since the Little Ice Age (Western Italian Alps)

Simona GENNARO [1, *], Maria Cristina SALVATORE [1, 2], Carlo, BARONI [1, 2]

[1] Dipartimento di Scienze della Terra, Università di Pisa, Italy
[2] Istituto di Geoscienze e Georisorse, Consiglio Nazionale delle Ricerche, Pisa, Italy
[*] corresponding author: simona.gennaro@dst.unipi.it

Alpine glaciers are very sensitive to climate variations that modify their shape and size in response to changes in their mass balance. Here we present new data on recent glacier changes in the Gran Paradiso Group and we provide quantitative data documenting a glacial decline since the Little Ice Age accelerated during the last three decades. Through detailed geomorphological and glacial geological field surveys and photointerpretation, we reconstructed the Little Ice Age glacial limits; glacier limits were outlined from multitemporal aerial photographs. The collected dataset was organized in a dynamic glaciological database organized in GIS environment.

Based on annual glaciological surveys (conducted since the beginning of the 20th century by the Italian Glaciological Committee) we reconstructed time-distance curves since the end of the 19th centuries. The curves were validated also on the basis of multitemporal aerial photographs.

The results, useful to understand the loss of water resources stored in the Italian glaciers and to create model of their future behaviour, underlined the strong imbalance of the glaciers in the study area and highlighted the rapid increase in their reduction rate during the last years. These changes are leading to impressive change in glacier shapes and dimensions and lead to an increase of the geomorphological hazard, due to the creation of new ice-free area.

Geomorphological map on extended surface: a new approach based on multiple-point geostatistics

Elisa GIACCONE [1,*], Christophe LAMBIEL [1], Grégoire MARIETHOZ [1]

[1] Institute of Earth Surface Dynamics (IDYST), University of Lausanne, Switzerland
[*] corresponding author: elisa.giaccone@unil.ch

Conventional geomorphological maps are usually constructed by mapping features on the field or directly in Geographic Information Systems from topographic data and orthoimages. This approach is time-consuming and therefore only suitable for mapping relatively limited areas. For the mapping of larger areas, automatic procedures are needed, but to be efficient those need to be driven by geomorphological expertise.

To this end, we developed an approach that performs semi-automated geomorphological mapping (SAGM) guided by an already classified map from an analogue area. The approach relies on the Direct Sampling (DS) algorithm, part of the multiple-point geostatistics framework that simulates a random variable (here the geomorphological categories) based on a training image. The training image is composed of an existing geomorphological map of a site with similar geomorphological features, along with topoclimatic attributes including aspect, slope, roughness, curvature, solar radiation, flow accumulation and an orthophoto. All these attributes, except the geomorphological categories, are also known in the target area to be classified. The DS algorithm then generates geomorphological categories in the target area, based on correspondences found in the training image.

The SAGM is tested on a focus site located in the Western Swiss Alps, where a traditional geomorphological map is available for validation.

Micrometeorology and tree recolonization in glacier forelands: Forni Glacier campaign 2017 (Central Italian Alps)

Alessio GOLZIO [1,*], Roberto S. AZZONI [2], Manuela PELFINI [1]

[1] Dipartimento di Scienze Della Terra "A. Desio", Università degli studi di Milano, Italy
[2] Dipartimento di Scienze e Politiche Ambientali, Università degli Studi di Milano, Italy
* corresponding author: alessio.golzio@unimi.it

Weather conditions are strictly related with the dynamic and the evolution of biological component, especially in the most sensitive areas as glacier forelands. Furthermore, here, the effect of the climate is more intense and fast modifications affect landscape evolution and surface processes.
In this study we focused on the interactions between the glacier retreat (and consequently the glacier foreland widening) linked with the new tree recolonization and the atmospheric boundary layer characteristics and dynamics. Changes from glacial to paraglacial and periglacial conditions continuously modify the boundary-layer conditions and the local wind valley circulation, widely affecting the ability of seeds to germinate and young trees to grow.
During summer 2017 a micrometeorological campaign was set-up at Forni Glacier foreland (Central Italian Alps) in order to measure the wind pattern and to relate the cold katabatic wind from the glacier to the distribution of new-germinated trees. Information about the position, age and species of each tree on the upper foreland of Forni Glacier were collected in a previous field campaign. We observe that sometimes tree survived only few years after their emergence from their stone-shelter, and their complete exposition to weather conditions. With the second meteorological campaign we tried to relate those data, and investigate if a relationship exists between conifers germination and growth and the micrometeorological forcing.

Bridge construction vs. Natural dynamics of a debris flows prone catchment in Central Nepal

Narayan GURUNG [1, 2], Monique FORT [2, *], Gilles ARNAUD-FASSETTA [2], Rainer BELL [3]

[1] Kadoorie Agricultural Aid Association, Pokhara, Nepal
[2] Dpt of Geography, GHES, Université Paris-Diderot, France
[3] Institute of Geography, University of Innsbruck, Austria
* corresponding author: fort@univ-paris-diderot.fr

Since the last 20 years, road construction in Nepal had increased rapidly, in most cases with poor consideration of hazards (rockfall, landslides, debris flow) that may affect them. Currently, national road construction is fostered by China's Belt and Road Initiative (Silk Road annexes), as shown by the planned 2-way black-top "Kali Gandaki (KG) corridor". Yet, the dynamics of the KG tributary catchments prone to debris flows is rarely considered by engineers despite it represents a common threat to the main road. We focus on the Ghatte khola (Myagdi District) and try to assess the relevance of its bridge under construction. Two methods (i.e. WECS and Rational Method), commonly used in Nepal, were applied for estimating the discharge. Modelling results in 72.62 m^3 by WECS and 63.76 to 95.57 m^3 by Rational Method. The provided water way of the future Dana motor bridge (1) is 39 m while it requires at least 41 m water way to safely pass that much of discharge through the bridge meaning that, the future bridge is at significant threat of high flood. (2) More specifically, in the last 6 years, the bridge would have been damaged 5 times out of 6. Note that the applied methods do model only floods, but the situation will be even more critical in case of landslide lake outburst floods or debris flows. In addition, a transmission towers field, and a bad control of runoff water, show that natural dynamics may be amplified by anthropogenic perturbations and infrastructure construction.

Effects of vegetated riparian buffer strips on lateral sediment input to agricultural river systems and the role of man-made linear flow paths in the Fugnitz catchment, Lower Austria

Lisa HUMER [1,*], Gregor LUETZENBURG [1], Gisela EBERHARD [1], Ronald POEPPL [1]

[1] Department of Geomorphological Systems and Risk Research, Institute of Geography and Regional Research, University of Vienna, Austria
[*] corresponding author: lisa.humer@univie.ac.at

Heavily intensified soil erosion by cultivation of arable land is a main contributor to the chemical pollution of freshwater ecosystems. High loads of fine sediment are transported to the channel via overland flow pathways, furthermore man-made linear flow pathways can drain substantial parts of a catchment. Vegetated buffer strips between arable fields and the river channel are a common mitigation measure, since they are highly effective in removing suspended solids, nutrients and pesticides from runoff by trapping sediment and consequently reducing sediment connectivity. Although vegetated buffer strips alongside perennial streams are a common mitigation measure in catchment management, the role of man-made linear flow paths in delivering sediment to streams is often overlooked. This study investigates the effectiveness of existing vegetated buffer strips and the role of manmade linear flow paths in terms of sediment connectivity and fine sediment input in an agricultural intensively used catchment in Lower Austria using field connectivity mapping and the Water Erosion Prediction Project (WEPP). The results show that the investigated buffer strips tend to overflow during high rainfall events, due to a too narrow fixed width. Besides the ineffectiveness of the buffer strips, the highest amount of fine sediment input into the permanent stream channel happens via the assessed entry points of the man-made linear flow paths. This shows that the assessment of anthropogenic linear flow paths is an important factor in order to understand

the sediment connectivity within a catchment and to be able to create an effective sediment management in regards to erosion-related freshwater pollution.

Rock-surface dating of slope sediments in Baksan valley (Central Caucasus)

Daria KHASHCHEVSKAYA [1,*], Alastair C. CUNNINGHAM [2,3], Andrew S. MURRAY [3], Redzep KURBANOV [4], Reza SOHBATI [2]

[1] Moscow State University, Russia
[2] Center for Nuclear Technologies, Technical University of Denmark, Risø Campus, Denmark
[3] Nordic Laboratory for Luminescence Dating, Department of Geoscience, Aarhus University, Risø Campus, Roskilde, Denmark
[4] Russian Academy of Sciences, Institute of Geography, Moscow, Russia
* Corresponding author: darisa42@gmail.com

Here we offer recent data on the history of the central part of the North Caucasus obtained by rock-surface dating. Central Caucasus region had large glacier systems in the past, that affected the climate of the entire territory significantly. Modern landscape of Elbrus highlands is a typical alpine zone with frequent avalanches, debris flows, rockfalls and etc. Geomorphological processes are taking place very intensively and because of them it is particularly difficult to study glacial history here.

Most of the previous investigations stated, that the Caucasus Mountains have experienced at least three periods of glaciation through Pleistocene. Also, there are plenty of unexplored evidences of glacial fluctuations in the valleys. However, origin of such particularly large landforms, such as Tubele hill in the Baksan valley, still remains unknown.

Since the dating by standard OSL is difficult in mountain areas, we used rock-surface dating, which allows us to establish the burial date of mostly rock material, because large cobbles are more likely to be exposed to daylight. The luminescence signal is reset by sunlight, so the methods aim to date the last time that cobbles were exposed to sunlight before burial. Recent progress expanded the range of quaternary sediments that can feasibly be dated using OSL methods. In the Baksan valley (Central Caucasus), we have investigated cobbles from fans of various genesis. Due to received data, we got ages of some presumably glacial landforms, and also slope processes activation phases.

Morphology features of Baer knolls in Volga Delta

Daria M. LOBACHEVA [1,*], Ekaterina N. BADYUKOVA [1]

[1] Faculty of Geography, Lomonosov Moscow State University, Moscow, Russia
* corresponding author: lob.dascha@yandex.ru

The history of the study of Baer knolls (BK) counts more than a century. There are several theories of the origin of BK. In this research, we provide information about morphology of Baer knolls in the western and central parts of the Volga delta.

The aim of the study is to identify the inner features of the structure of BK and the mechanism of their formation. To achieve this aim, several methods were used (grain size analysis, geochemical, malacofaunistical, radiocarbon dating). Local detail geomorphological maps were made out.

Baer knolls are ridges that are most often oriented in the WNW - ESE direction in the research area. Ridges in the Volga Delta have a morphology that differs from other areas of their distribution due to the impact of exogenous processes, such as erosion by Caspian Sea, the Volga river and its channels during the Novo-Caspian transgression. Wind-wave processes in the Ilmenia formed the latitudinal direction of the ridges. BK are absent in some sections of the central and the eastern parts of the Volga Delta, because during the Mangyshlak regression of the Caspian Sea, BK that already existed by that time, has been eroded. It emerged that some of the isolated BK groups are still preserving, apparently due to the location on elevated areas. BK are common not only in the Volga Delta. The most well-preserved forms are common nearby the Late Khvalynian plain, northerly from Astrakhan.

Characterization of active gravitational processes in the Fosso del Gallo Basin (Abruzzo, Italy)

Debora MACRINI [1,*], Marcello BUCCOLINI [1], Laura COCO [1], Mara ROSSI [1]

[1] Dipartimento di Ingegneria e Geologia, Università "G. d'Annunzio" Chieti-Pescara, Italy
[*] corresponding author: macrini.de@gmail.com

The active gravitational processes of Fosso del Gallo were studied with a standard geomorphological method, which is the most suitable for classifying landslides. The work followed three phases: bibliographic study, geomorphological survey and data processing. The aim was to analyze and map the distribution and type of superficial landslides in the Fosso del Gallo basin, the main tributary of Piomba stream, located in northern Abruzzo. The purpose was achieved thanks to field surveys and consultation of IFFI, PAI and orthophoto maps. The field surveys were conducted in Spring 2017 after a period of intense rainfalls that triggered a lot of landslides. The landslide's types were distinguished by using the Varnes classification. In the analyzed basin the types of landslides are rotational, translational, flow-type, complex and rockfalls. There are 37 landslides, of which 31 are flows, mainly distributed in the hydrographic right of the watercourse. By analyzing the influence factors of these landslides, their type is found to be influenced by the lithotechnical characteristics of the terrain, the climatic conditions and by the type of anthropic cultivation of the land. The final product was an up-to-date detailed geomorphological map that allows the visualization of the gravitational processes that influence the basin morphology. In further analyses, this work can be used as a basis for a susceptibility map.

Assessment of climate change impact over water resource of Sapt Kosi River Basin: verification through dendrochronological technique on the hydrological discharge pattern

Rajesh K. MAHATO [1,*], Jitendra SHUKLA [2], Bimal SHARMA [3], Satyapriya MAHATO [4]

[1] Ranchi University (R.U.), India
[2] University dept. of Geography, Ranchi University (R.U.), India
[3] Nepal Dendrochronological society, Nepal
[4] D.S.P.M.U., Ranchi University, India
[*] corresponding author: mahtolu@gmail.com

Climate change has been the major concern of the Society. The Kosi river basin covers an extensive land surface characterized by very heterogeneous environments. Retreating glaciers, decreasing amount of rainfall, accelerating environmental disasters have been creating several problems. In the catchment area among the problems, the impact on water resources is a very crucial aspect for which the Kosi river basin is facing a tremendous pressure. Fluctuations in the amount of precipitation and the volume of water discharge during the non-monsoon period, and a deficit in the amount of water in the river regime area, impact not only on the fauna and the flora, but also provoke the various environmental degradations in the basin area. The geographical and climatic conditions of the hydrographic basin needs special requirement to be analysed and discussed. Collected core samples were prepared and analysed using standard dendrochronological techniques. All the tree cores were cross-dated by matching patterns of relatively wide and narrow rings to account for the possibility of ring-growth anomalies such as missing or false rings or measurement error. We successfully established the discharge reconstruction of Bhote Koshi River and found that after 1956 (up to 2010) the average river discharge is increasing, whereas river discharge was minimum during 1722,

1911 and 1956. Correlation of tree ring chronologies with Dolakha temperature obtained by using negative exponential, results to be positive. Through this research we can see the present situation of climate change impact in the Kosi river basin.

From lateral migration to (in)stability: channel planform changes and riverine areas evolution along the lower Scrivia River

Andrea MANDARINO [1,*], Michael MAERKER [2], Marco FIRPO [1]

[1] Department of Earth, Environment and Life Sciences, University of Genova, Italy
[2] Department of Earth and Environment Sciences, University of Pavia, Italy
[*] corresponding author: andrea.mandarino@edu.unige.it

In the 20th century, most of the Italian rivers experienced relevant active-channel narrowing and incision processes, mainly due to anthropic interventions. Simultaneously, agriculture, facilities and infrastructures spread over floodplain areas, getting closer and closer to the active-channel banks. Meanwhile, in floodplain areas, large riverine state-owned areas became progressively private property, substantially according to the existing regulations. All these elements resulted in an increase of river-related risks and in the loss of fluvial habitats. In this light, we investigated the lower Scrivia River past and present relationships between riverbed morphological changes on the one hand, and land property and land use changes close to the riverbed on the other hand, under river management perspective. In particular, we performed a quantitative multi-temporal analysis in a GIS environment, supported by field surveys and based on historical maps, aerial photographs and satellite images. Thus, this research describes the riverbed planform changes occurred since 1878, the extent of bank protections, and the land-use variations occurred close to the riverbed, from the 1950s onwards. Moreover, it analyses the land-use and land-property conversion of areas belonging to the active channel before the most intense phase of human-induced riverbed morphological alterations.

Detecting the Late Quaternary environmental evolution of the Venetian plain (NE Italy) through deep cores correlation prograding mechanisms of the Venetian plain's megafans (NE Italy) in relation to the Late Quaternary climatic fluctuations

Arianna MARCOLLA [1,*], Alessandra ASIOLI [2], Antonella MIOLA [3], Giovanni MONEGATO [4], Paolo MOZZI [1], Cristina STEFANI [1]

[1] Department of Geosciences, University of Padova, Italy; [2] ISMAR-CNR, Bologna, Italy;
[3] Department of Biology, University of Padova, Italy; [4] IGG-CNR, Padova, Italy
[*] corresponding author: arianna.marcolla@phd.unipd.it

The Venetian Plain is part of the foreland basin of the southern Eastern Alps and represents the northernmost alluvial environment facing the Adriatic Sea. The proximity of both the orogenic belts and the sea has affected its sedimentary evolution during the glacial–interglacial cycles occurred since the Middle Pleistocene. The aggradation phase of the Last Glacial Maximum (LGM), the fluvial down cutting occurred during the Late Glacial and Early Holocene and the following infilling of the incised valleys are well studied. Instead, Middle and lower Upper Pleistocene are poorly known, due to the few available cores reaching relative sediments, usually found at a depth higher than 30 m. We are studying different proxies provided by "GER1", a 130 m core drilled in the distal part of the Brenta River megafan, and probably reaching sediments older than MIS7. At its bottom, it presents a depositional body with unclear provenance and a grain size coarser than the upper part. Through correlations with the available stratigraphic information, we are detecting the geometry of this body, which may be related to the filling of incised valleys developed during a pre-LGM post glacial phase. The formation dynamics could be similar to the ones occurred during the post-LGM. We aim to extrapolate the depositional history and the drainage pattern evolution of the area in relation to the structural setting of the plain, focusing on the Middle-Upper Pleistocene climatic and environmental changes.

Interpreting the landscape in time: the Adige River glacial amphitheatre since the Last Glacial Maximum

Guido S. MARIANI [1, *], Mauro CREMASCHI [1], Carlo BARONI [2], Giovanni LOMBARDI [2], Mattia MARINI [1], Andrea PEZZOTTA [1], Andrea ZERBONI [1]

[1] Dipartimento di Scienze della Terra 'Ardito Desio', Università degli Studi di Milano, Italy
[2] Dipartimento di Scienze della Terra, Università di Pisa, Italy
[*] corresponding author: guido.mariani@unimi.it

The glacial amphitheatres of the Southern Alps are historically a major source of useful high-resolution climate records of Quaternary glaciations. Their study in terms of landscape evolution puts these landmarks in a time context and allows to establish a chronological sequence of events which controls their formation. The Adige River Glacier Amphitheatre (ARGA) is the smallest of these moraine systems since this glacier was constrained by the much larger Garda Lake Glacial Amphitheatre for most of its duration. We present a detailed map of the morphostratigraphic units composing the ARGA as the first step towards the reconstruction of the evolution of the ARGA system. We could recognise two outermost major moraine arcs aggraded during two positive pulses of the glacier – which we attribute to the Last Glacial Maximum (LGM). Three innermost moraine arcs are smaller and less preserved; they correspond to subsequent fluctuations of the Adige Glacier. Flat areas, filled by gravel sediments from meltwater outwash streams, separate moraine arcs. Between the glacier terminus and the innermost moraine arcs, several flat terraces consisting of sandy to clayey sediments were deposited by a proglacial lake formed in the last phase of retreat. At the final collapse of the Pleistocene glacier fluvial erosion started sectioning Pleistocene deposits. This interpretation substantially confirms previously reported evidence for a two-fold LGM glacial advance in northern Italy.

Soils as useful tool to reconstruct environmental and landscape evolution: the Monte Cusna study case (Northern Apennines)

Anna MASSEROLI [1,*], Guido S. MARIANI [1], Irene BOLLATI [1], Manuela PELFINI [1], Luca TROMBINO [1]

[1] Dipartimento di Scienze della Terra 'A. Desio', Università degli Studi di Milano, Italy
[*] corresponding author: anna.masseroli@unimi.it.

The evolution of soils in mountain environments is mainly influenced by altitude and relief features, recording different bio-rexistasy phases as palaeosols or buried surfaces. Their use as proxy data could be a very useful tool to reconstruct environmental change and infer past and present morphodynamic processes.
This study aims at reconstructing the soil evolution and environmental changes recorded in palaeosols along a toposequence on Mt. Cusna (Northern Apennines). This area is characterized by widespread colluvial deposits and is partially affected by running water erosion. Therefore, particular attention was given to the role of geomorphological processes in the obliteration or potential preservation of palaeosols, through the investigation of erosion/deposition phases.
Field, laboratory and micromorphological analyses were performed along a downslope transect of ten soil profiles in different geomorphological contexts to characterize the area. The investigated soils show the complex history of the area. Different pedological units, correlated along the slope, developed from separate events of pedogenesis. Each of them can be spatio-temporal linked to recognizable slope stability phases, which allowed favorable conditions of soils formation. The interplay among geomorphological processes, Holocene climate variations and vegetation changes plays a key role in the formation and evolution of complex soil pedosequences.

Morphostructural, meteorological and seismic factors controlling landslides in NE-Abruzzo piedmont: the case studies of Castelnuovo and Ponzano (Teramo, Central Italy)

Valeria MENNA [1,*], Monia CALISTA [1], Enrico MICCADEI [1], Tommaso PIACENTINI [1], Nicola SCIARRA [1]

[1] Department of Engineering and Geology, Università degli Studi "G. d'Annunzio" Chieti-Pescara, Italy
* corresponding author: vale93m@libero.it

In February 2017, after the last seismic events pertaining to the Central Italy 2016–2017 seismic sequence and heavy rainfall, snowfall and snow melting (January 2017), several landslides affected the NE-piedmont hilly area of the Abruzzo region (Central Italy), causing severe damage, many casualties and evacuees.

In this work, we investigated two main representative landslides on weak rocks: 1) the large translational-complex Ponzano landslide (Civitella del Tronto, Teramo), which characterized the Miocene–Pliocene sandstone clay bedrock sequence of the piedmont hilly sector; 2) the complex (topple/fall-slide) Castelnuovo (Campli, Teramo) landslide, that affected the conglomerate rocks pertaining to Pleistocene terraced alluvial fan deposits. The study is based on an integrated investigation of: field geological and geomorphological mapping, photogeological interpretation, geostructural analysis, borehole investigation and FLAC3D numerical modeling (for Castelnuovo landslide).

This approach allowed characterizing the mechanisms and the predisposing and triggering factors that controlled landslides evolution in different morphologic and litho-structural conditions, providing an effective base for the correct monitoring of landslide hazard-risk assessment. Moreover, the study provided a contribution to the comprehension of the role of the morphostructural setting and seismic and meteorological factors in the development of landslides in the piedmont of the Abruzzo Apennines.

Molards as indicator of landslide processes and permafrost degradation

Costanza MORINO [1,*], Susan J. CONWAY [1], Þorsteinn SÆMUNDSSON [2], Jón Kristinn HELGASON [3], Frances E.G. BUTCHER [4], Matthew R. BALME [4], Colm JORDAN [5], John HILLIER [6], Tom ARGLES [7]

[1] Laboratoire de Planétologie et Géodynamique, Université de Nantes, CNRS UMR6112, France
[2] Department of Geography and Tourism, University of Iceland, Iceland
[3] Avalanche Centre, Icelandic Meteorological Office, Iceland
[4] School of Physical Science, The Open University, UK
[5] Environmental Science Centre, British Geological Survey, UK
[6] School of Geography & Environment, Loughborough University, UK
[7] School of Environment, Earth & Ecosystem Sciences, The Open University, UK
[*] corresponding author: costanza.morino@univ-nantes.fr

The trend of global atmospheric warming has accelerated the rate of permafrost degradation in periglacial environments. Degradation of permafrost is already known to increase the instability of slopes, which poses hazard to communities in rapid mass movements-affected areas. Distinctive landforms resulting from the degradation of permafrost are rare. However, particular landforms called "molards" can fill this gap.

Molards in periglacial environments are conical mounds of debris on landslide deposits; they result from thawing of frozen blocks of ice-rich sediments, which disaggregate into cones of loose debris. Molards can be used as a marker of permafrost degradation, and their morphometry and spatial distribution give valuable insights into landslide dynamics. Molards are readily recognisable not only in the field, but also in remote sensing data, and they can be used as an indicator of current and past permafrost conditions. Furthermore, molards-like features are identifiable on the surface of Mars and Mercury, providing evidence of their volatile-rich nature.

The triggering of landslides as a result of permafrost degradation will arguably occur more often as global atmospheric temperatures increase. As degrading permafrost is predicted to increasingly affect mountain regions in the future,

molards should be added to our armoury for tracking climate change, as well as helping us to understand landslide-related hazards. Finally, the identification of candidate molards on Mars and Mercury can inform about landscape evolution on Earth and other planetary bodies.

Comparative analysis of the GEOSSIT platform (Brazil) and specific methods for the assessment of geomorphological heritage

Vanessa Costa MUCIVUNA [1,2]*, Daniel Souza dos SANTOS [2,3], Emmanuel REYNARD [2], Maria da Glória Motta GARCIA [1]

[1] GeoHereditas, Institute of Geosciences, University of São Paulo, Brazil
[2] Institute of Geography and Sustainability, Géopolis, University of Lausanne, Switzerland
[3] Post-Graduation Program in Geology, Federal University of Rio de Janeiro, Brazil
* corresponding author: vanessa.mucivuna@usp.br

Assessment methods may be used as a tool to contribute to the conservation, use and management of geoheritage. GEOSSIT is a platform developed by the Geological Survey of Brazil (CPRM) to be the national geosites database. The platform was structured based on adaptations of Portuguese and Spanish methods, so it is not a new method. Both qualitative and quantitative aspects are evaluated, being qualitative evaluation based on physical contextualization and characterization, contents of interests and conservation status of the sites, whilst quantitative evaluation is based on scientific value, potential for education and tourism uses, and degradation risk. In order to contribute to the improvement of the platform concerning geomorphological aspects, this study aims to compare GEOSSIT with methods developed specifically for the evaluation of geomorphosites. The work was carried out based on critical analysis and comparison of (i) criteria; (ii) values; and (iii) weighting on the quantitative steps of geomorphosites assessment and shows that each method presents strengths and weaknesses, being the comparison of their different criteria an interesting tool to contribute to the improvement of the existing methods. Our preliminary results demonstrate that several criteria used in geomorphological heritage assessment could be adapted to GEOSSIT as paleogeographical, cultural and aesthetic values that are important criteria to assess the specificities of the geomorphological sites.

Investigation of landslide mechanism exploiting PSI techniques and numerical models

Nicușor NECULA [1, *], Mihai NICULIȚĂ [1], Mario FLORIS [2], Rinaldo GENEVOIS [2]

[1] Department of Geography, Faculty of Geography and Geology, Alexandru Ioan Cuza University of Iași, Romania
[2] Department of Geosciences, University of Padova, Italy
* corresponding author: neculanicusor93@gmail.com

Landslides are natural hazards that in recent years are interacting more and more with human society. Their occurrence is the effect of natural factors, but in the last decades both climate change context as well as territorial expansion of living/built-up space in areas with steep slopes and prone to slope mass movements contributed to the intensification of these events. In our study we investigate a very slow-moving landslide that affects the urban space of Iași Municipality. The analysis was carried out by means of Persistent Scatterer Interferometry (PSI) techniques and Finite Element Models (FEM). Hence, we processed the available C-band SAR data of ERS-1/2, ENVISAT and Sentinel-1A/B sensors for a 25 year time interval (from 1992 to 2017). DInSAR results outline the active sectors of landslide body that are moving at a rate of up to 20 mm/year. To understand the kinematical behaviour and the sliding mechanism of the displaced material we performed a two-dimensional Finite Element numerical modelling for a longitudinal cross-section along the slope. The material behaviour simulations suggest that the remoulded landslide body material moves depending on the water level fluctuations while the displacements are occurring on the shallow part of the landslide body. This conclusion is also confirmed by field evidences and validates the proposed geomorphological mechanism of sliding.

Paleo-drainage network, morphotectonics, and fluvial terraces: clues from the Verde Stream in the middle Sangro River (Central Italy)

Giorgio PAGLIA [1,*], Enrico MICCADEI [1], Cristiano CARABELLA [1], Tommaso PAGLIANI [2], Stefania CAPORALE [2]

[1] Department of Engineering and Geology, Università degli Studi dell'Adriatico "G. d'Annunzio" Chieti-Pescara, Italy
[2] Riserva Naturale Regionale "Cascate del Verde", Borrello, Chieti, Italy
[*] corresponding author: giorgiopaglia3@gmail.com

This work analyses the role of paleo-drainage network, morphotectonics, and surface processes in landscape evolution in a sector of the transition zone between the chain and the piedmont area of Central Apennines. Particularly, it focuses on the Verde Stream, a tributary of the middle Sangro River valley, which flows in the south-eastern Abruzzo area at the boundary with the Molise region. The Verde Stream was investigated through a drainage basin scale geomorphological analysis incorporating the morphometry of the orography and hydrography, structural geomorphological field mapping, and the investigation of morphological field evidence of tectonics with their statistical azimuthal distributions. The local data obtained were compared with the analysis of the middle Sangro River valley and the tectonic features of the Abruzzo–Molise area. This approach led us to also provide relevant clues about the definition of the role of karst features and paleo-landscapes in the general setting of the study area and to identify the impact of active tectonics, confirmed by recent and active seismicity. In conclusion, the paper contributes to defining the main stages of the geomorphological evolution of this area, driven by uplift and local tectonics and due to a combination of fluvial, karst, and landslide processes.

Predicting the evolution of ice and snow resources at seasonal time scales

Roberta PARANUNZIO [1, *], Guido NIGRELLI [1], Silvia TERZAGO [2], Jost VON HARDENBERG [2], Filippo CALÌ QUAGLIA [2], Giovanni MORTARA [1], Marta CHIARLE [1]

[1] Italian National Research Council, Research Institute for Geo-Hydrological Protection, Italy
[2] Italian National Research Council, Institute of Atmospheric Sciences and Climate, Italy
[*] corresponding author: roberta.paranunzio@irpi.cnr.it

Based on long-term climate predictions, cryosphere in the Alps is expected to be seriously affected by climate change, with significant consequences for water resources management. In such a context, increasing resilience of the society to climate variability by means of reliable and accurate predictions is crucial. The MEDSCOPE project, in the framework of ERA4CS initiative, aims at creating and providing prototypes of climate services addressing users' needs in specific sectors in the Mediterranean region. As part of the project, the added value provided by MEDSCOPE to climate services will be assessed for the hydrological sector and resources in the Italian Alps and for selected glaciated areas.
Downscaled climate variables will be employed to force a minimal glacier model calibrated with historical data and a physically-based multilayer snowpack model, in three different glaciated basins in the North-western Italian Alps. Outputs of the numerical models, based on seasonal forecasts provided by the project, will be compared to the existing observations for glacier front position change and glacier mass balance and to the available data on Snow Water Equivalent (SWE) and snow depth recorded by the automatic weather stations in the study areas.
Preliminary outcomes of this work will be showcased at the Conference.

Closed depressions in Kotido Crater, Arabia Terra: possible evidence of evaporite dissolution-induced sinkholes

Carlotta PARENTI [1,*], Ángel GARCÍA-ARNAY [2], Jorge SEVIL [2], Francisco GUTIÉRREZ [2], Davide BAIONI [3], Erica LUZZI [4], Mauro SOLDATI [1]

[1] University of Modena and Reggio Emilia, Italy
[2] University of Zaragoza, Spain
[3] University of Urbino, Italy
[*] corresponding author: parenti95carlotta@gmail.com

Many features and processes on Earth show frequency-size relationships that follows a power law or exponential distribution. However, the size range for which such relationships are valid are typically truncated for extreme values, one tail usually related to the lack of completeness and the other, in the case of sinkholes, to the coalescence of adjacent closed depressions. In this paper we analyse an area covering 30,000 m^2 underlain by evaporitic layered deposits in the floor of Kotido Crater, Arabia Terra, Mars. We mapped and characterised 513 closed depressions to shed light into their genetic processes and controlling factors. This work explores whether the closed topographic depressions inventoried in Mars show similar frequency-size relationships to sinkholes on Earth. Some closed depressions show fissures at the foot of their scarped margins, indicating that subsidence processes take part in their development. The orientation of the elongated depressions, fractures and wind direction inferred from dune fields seem to be coherent, suggesting that both factors play some role in their formation and growth.

Relationships between earthquakes, hurricanes and landslides in Costa Rica

Adolfo QUESADA-ROMÁN [1,2*], Markus STOFFEL [1,3,4], Juan Antonio BALLESTEROS-CÁNOVAS [1,3]

[1] Climatic Change Impacts and Risks in the Anthropocene (C-CIA), Institute for Environmental Sciences, University of Geneva, Switzerland;
[2] Escuela de Geografía, Universidad de Costa Rica, San José, Costa Rica;
[3] Department of Earth Sciences, University of Geneva, Switzerland;
[4] Department F.-A. Forel for Environmental and Aquatic Sciences, University of Geneva, Switzerland
* corresponding author: adolfo.quesada@unige.ch; adolfo.quesadaroman@ucr.ac.cr

Landslides are a common natural hazard in Costa Rica, recurrently triggered by seismicity and extraordinary rainfall events. Here, we investigate the coalescence of both processes and their potential to trigger massive landslides and debris flows in Costa Rica. The study focuses on Miravalles volcano, which was affected by an earthquake of 5.4Mw on July 2, 2016, and by intense rainfalls related to the Hurricane Otto only four months later, on November 24, 2016. During the passage of Hurricane Otto crossed northern Costa Rica, ~300 mm of rain were recorded in the study region. We use logistic general linear regression models (GLM) to represent the statistical relationships between the landslides controlling factors such as distance from the Bijagua earthquake, rainfall during Hurricane Otto, altitude and slope. The compound 2016 event triggered 942 landslides, 62% located within 3 to 6 km from the Bijagua earthquake epicentre, and on the eastern, south-eastern and southern slopes of Miravalles volcano, in a zone with a concentration of local faults and rainfall maxima during the hurricane. The statistical analysis support that coupled earthquake-hurricane dynamics due that more landslides densities where found closer to the epicentre on greater rainfall sites, also conditioned by higher slopes and altitudes. Besides, debris flows affected an area of ~27 km^2 and moved down the river systems, leaving eight casualties around the volcano and ca. 103 million US$ of losses in Upala and Bagaces. Results of this study can be useful for the assessment of

geological and hydro-meteorological hazards in Costa Rica and other tropical countries.

Temporal and spatial variations in uplift from quantitative fluvial analysis at the Central Anatolian Plateau southern margin

Simone RACANO [1,*], Taylor SCHILDGEN [2], Domenico COSENTINO [1], Scott R. MILLER [3]

[1] Roma Tre University, Rome, Italy
[2] German Research Centre for Geosciences, Potsdam, Germany/ University of Potsdam, Germany
[3] University of Utah, Salt Lake City, Utah, USA
[*] corresponding author: simone.racano@uniroma3.it

The Central Anatolian Plateau (CAP) southern margin experienced during the Quaternary a strong uplift phase with mean rates of 3.5 mm/yr, derived from Quaternary marine sediments dated to the Ionian and now located at a maximum height of 1500 m.a.s.l. In geodynamic active areas, spatio-temporal variations in uplift can provide key insights into the processes responsible for the evolution of topography. Fluvial landscapes record elements that reflect temporal and spatial variations in rock uplift rates, in particular through the normalized steepness index, which is affected by both rock uplift rates and the erodibility of the underlying rock. Following calibration of a river profile for an erodibility value, which can be done using independent data (in our case, uplifted marine terraces), river profiles can be inverted for the uplift histories that created them. In our study, we demonstrate how is possible define the uplift history of the CAP southern margin by quantitative analysis of multiple river profiles, obtaining both the temporal and spatial variation of uplift rates along the plateau margin. Our results, which show exponential decreases in uplift rates during the Quaternary and a west-to-east propagation in the onset of uplift, provide strong support for Quaternary uplift being driven by slab break-off.

Dendrogeomorphic investigation of snow avalanche activity in high mountain environments. Case study: Buhăescu Valley, Rodna Mountains (Eastern Carpathians, Romania)

Ionela Georgiana RĂCHITĂ [1,*], Olimpiu POP [1], Cosmin TIMOFTE [1], Flaviu MESEȘAN [1], Cristin TRIFAN [1]

[1] Laboratory of Dendrochronology, Faculty of Geography, Babeș-Bolyai University, Cluj-Napoca, Romania
[*] corresponding author: ionela.gavrila@ubbcluj.ro

Snow avalanche is one of the main natural hazards in high areas of Romanian Carpathians being a threat to human, infrastructure and tourism activities. In this remote areas, snow avalanches are not monitored and historical data related to past geomorphic events are missing. Tree-rings can provide valuable data about past snow avalanche activity, but up to now little research has been carried out with this purpose in Eastern Carpathians. In this study, a dendrogeomophic reconstruction of snow avalanche activity was performed within two paths situated on the left side of Buhăescu valley, in Rodna Mountains (Eastern Carpathians, Romania). In total, a 201 Norway spruce (*Picea abies* (L.) Karst.) trees with visible signs of avalanche activity (scars, tilted trunks, broken crown or branches) were sampled along the investigated paths. Analysis of growth disturbances (scars, traumatic resin ducts, compression wood, growth suppression) from sample collection allowed the identification of a minimum frequency of snow avalanches dating back to the middle of the 20th century. These results provide a better understanding of the behaviour of snow avalanches in space and time in the investigated area and will help the Administration of the Rodna National Park in their effort to implement appropriate management decisions for tourism activities in this area.

Geomorphological and paleo-environmental evolution of a buried post-LGM incised valley in the Friulian Plain

Livio RONCHI [1, *]

[1] University of Padova, Italy
* corresponding author: livio.ronchi@unipd.it

The modern configuration of the Venetian-Friulian Plain (NE Italy) is the result of the complex interaction of events and processes that took place since the LGM. The analysis of almost 2000 cores, integrated with geotechnical tests and a LIDAR topography, allowed a detailed reconstruction of the morphologic evolution of the Tagliamento megafan. In particular, it was possible to reconstruct the buried morphology of an incised valley formed by the Tagliamento River in the Late Glacial. This feature, which has a maximum thickness of about 20 m, can be traced for a length of almost 25 km and, according to its infilling, it was possible to recognize three main depositional environments that occupied the valley during its evolution. The first one is linked to the activity of the paleo Tagliamento River, which shaped the valley and deposited at the bottom a thick gravelly unit. This environment was substituted by a lagoon starting from 8.0 ka cal BP. Finally, the area experienced a renewed fluvial activity, which led to almost completely fill the former valley during middle Ages and moulded the landscape of the alluvial plain before the pervasive land reclamations promoted since the 19th century. This study provides a detailed description of the geomorphological evolution that encompasses almost the entire post-LGM history of the Tagliamento, allowing to reconstruct the interplay between the fluvial and marine processes occurred in the Venetian-Friulian Plain during the Holocene.

Geomorphological mapping of glacial and pro-glacial environments with repeated UAV photogrammetry

Micol ROSSINI [1,*], Biagio DI MAURO [1], Roberto GARZONIO [1], Cinzia PANIGADA [1], Francesca BEARZOT [1], Giulia TAGLIABUE [1], Paolo FRATTINI [1], Giovanni B. CROSTA [1], Umberto MORRA DI CELLA [2], Roberto COLOMBO [1]

[1] DISAT, University of Milano -Bicocca, Italy
[2] Environmental Protection Agency of Valle d'Aosta, Climate Change Unit, Italy
*corresponding author: micol.rossini@unimib.it

The acquisition of high resolution topographic data is key to many studies related to Earth surface processes and dynamics. In this contribution, we present recent results of the repeated acquisition of high-resolution photogrammetric data by means of unmanned aerial vehicles (UAVs) to detect the evolution of the surface topography and morphology over short time scales.

Structure-from-motion techniques were applied on overlapping images to create orthophotos and digital surface models of the Earth's surface from multi-view UAV acquisitions.

Examples of the deployment of small UAVs to survey morphological and dynamical features of glacial and pro-glacial environments are reported.

Specifically, multi-temporal UAV images were successfully used to monitor rapidly changing glacial morphological features and to assess changes in surface height in the Morteratsch (Swiss Alps) ablation region.

Periodic UAV surveys also allowed the evaluation of rock glacier displacement fields between different acquisitions, providing invaluable data to investigate the spatial and temporal velocity changes and improve our understanding of rock glaciers.

This research demonstrates that UAVs allow the qualitative and quantitative appreciation of the complex evolution of glacial and pro-glacial environments, providing a low-cost, rapid deployment method to obtain high-resolution aerial photography over areas of varying size.

Coastal flooding empirical model for storm event impact

Giovanni SCARDINO [1,*], Maurilio MILELLA [2], Arcangelo PISCITELLI [2], François SABATIER [3], Francesco DE GIOSA [2], Giuseppe MASTRONUZZI [1]

[1] Department of Geo-Environmental Sciences, University of Bari "Aldo Moro", Italy
[2] Environmental Surveys S.r.l., Taranto, Italy
[3] Europôle Méditerranéen de l'Arbois, Centre Européen de Recherche et d'Enseignement des Géosciences de l'Environnement, Université Aix en Provence
[*] corresponding author: giovanni.scardino@uniba.it

Coastal vulnerability assessment has been one of the major challenge in recent years in front of global climate changes, mostly considering the great damages that storm impact causes along Mediterranean coastal areas. In order to evaluate the coastal flooding entity, an empirical approach was followed on Pino di Lenne open-beach (Palagiano, southern Italy), an extended wave-dominated sandy coast strictly connected to sea hydrodynamic and to sedimentary input.
Terrestrial Laser Scanner surveys were performed with high resolution, in order to obtain the beach topography features and the micro-topography roughness, and video analyses were conducted during different storm events to obtain wave parameters in proximity of the shoreline.
Knowledge of hydrodynamic and morpho-topography has allowed to model the coastal flooding *X* reached by waves on the shoreface, considering wave height H_{sh} in proximity of shoreline and how this is attenuated with a storm duration-variable *k,* in function of coast mean slope ϑ and micro-topography roughness R_s:

$$X = \frac{k\, H_{sh}}{tan\theta + R_s}$$

Storm coastal flooding assessment during Medicane Zorbas in south-eastern Sicily

Giovanni SCICCHITANO [1,*], Giovanni SCARDINO [2], Carmelo MONACO [3], Arcangelo PISCITELLI [4], Giuseppe LOCURATOLO [4], Francesco DE GIOSA [4], Maurilio MILELLA [4], Giuseppe MASTRONUZZI [2], Gianfranco MAZZA[5]

[1] Studio Geologi Associati T.S.T., Misterbianco (CT), Italy
[2] Department of Geo-Environmental Sciences, University of Bari "Aldo Moro", Italy
[3] Department of Biological, Geological and Environmental Sciences, University of Catania, Italy
[4] Environmental Surveys S.r.l., Taranto, Italy
[5] Area Marina Protetta del Plemmirio, Siracusa, Italy
[*] corresponding author: scicchitano@studiogeologitst.com

Recent catastrophic storm events are increasing along Mediterranean coasts and coastal flooding causes significant damages and casualties in proximity of densely populated coastal stretches, especially along the Italian coasts.
A storm coastal flooding is normally defined in terms of a storm surge plus storm waves which causes two different inundation surfaces:

- a submersion surface due to a positive deviation of sea column in response of storm surge;
- a flooding surface due to storm waves impact on the coast.

Particularly devastating damages were produced by Medicane "Zorbas" on south-eastern Sicily coasts during 28/29 October 2018 and its impact was registered along Apulia, Basilicata and Calabria coasts as well.
In this work, a coastal flooding empirical parametrization was made considering the storm surge recorded at *Portopalo di Capo Passero* tide gauge and flooding limits reached by storm waves along south-eastern Sicily coasts. In order to define quantitatively all factors conditioning flooded area, high resolution LIDAR data were used in combination with hydrodynamic data recorded at mareographs and satellite altimetry. Comparison between flooding observed and modelled coastal flooding shows a strong dependence with mean coastal slope, coast roughness, storm duration for different wave heights in proximity of shoreline.

Assessment of geomorphosites as a tool for geoconservation and tourism promotion, Northern Malta

Lidia SELMI [1, *], Paola CORATZA [1], Ritienne GAUCI [2], Mauro SOLDATI [1]

[1] University of Modena and Reggio Emilia, Italy
[2] University of Malta, Malta
[*] corresponding author: lidia.selmi@unimore.it

The Maltese archipelago, centrally situated in the Mediterranean Sea, exhibits a rich geodiversity and comprises an intense variety and density of geological and geomorphological features. Over the past five decades, the Maltese Islands have rapidly developed into a popular tourist destination, in particular in the northern part of mainland Malta, where it is relatively less built up. It is characterized by areas of outstanding geomorphological features, that can be considered as geomorphosites. These geomorphosites have the potential to be recognized both as part of the islands' geoheritage and as geotourism resources with potential economic benefits. The aim of this research is to select geomorphological and geological sites in the northern Malta, through the use of current inventory and evaluation methods which are internationally tested. The results show that the study area includes a significant number of geomorphosites of great relevance for their scientific values (rareness, representativeness, integrity and paleo-geomorphological model), additional values (ecological, aesthetic and cultural values) and use values (accessibility, visibility, services and importance for education). This research is meant to support further the natural heritage protection by adding the geodiversity dimension, in order to consolidate geomorphosites conservation. Finally, this study will offer the necessary knowledge for possible enhancement of geotourism and geo-educational activities to be carried out by public institutions responsible for the management of the rich Maltese geoheritage.

Sediment budget of small catchments in agricultural areas within the Seim River Basin

Anna SEMOCHKINA [1,*]

[1] Faculty of Geography, Moscow State University, Moscow, Russia
[*] corresponding author: semanna97@gmail.com

This research is an attempt to estimate of erosion and sedimentation processes on different geomorphological position in the upstream of small rivers Leschinka and Chern (Kursk region) catchment area.

Assessment of erosion and sedimentation rates was based on compound of methods: soil profile morphology, analysis of Cesium-137 supply in soil, empirical-mathematical models USLE/ГГИ and WaTEM/SEDEM. We calculated rates of erosion and sedimentation and identified its investment in siltation of small reservoirs downstream.

The research also is concentrated on evaluation relationship between different types of the relic cryogenic features and intensity and spatial distribution of soil erosion and deposition processes on cultivated slopes.

In this paper we explain how agricultural use, climatic changes of latest decades and paleo-landscapes influence the current state of erosion system in the central part of European Russia.

Micromorphological analysis of Arma degli Zerbi cave deposits (Finale Ligure, SV)

Eleonora SESSA [1,*], Ivano RELLINI [1], Fabio NEGRINO [2], Marco FIRPO [1]

[1] DISTAV, University of Genova, Italy
[2] DAFIST, University of Genova, Italy
[*] corresponding author: eleonora.sessa@edu.unige.it

Micromorphology, the study of undisturbed and oriented soil and regolith samples with microscopic and ultramicroscopic techniques, is considered useful in disentangling issues related to the genesis, classification and management of soils, including soil characterization in palaeo-pedology and archaeology. We applied this method to the reconstruction of palaeo-environments through the identification of specific constituents and stratigraphy interpretation, starting from Arma degli Zerbi cave deposits. In every recent archaeological excavation a geoarchaeological approach is now considered indispensable, especially when a multidisciplinary method is employed. In this site study we're conducting our research on several fronts: from the study of the archaeological material, the establishment of a general chronology of the exposed sequences, and the analysis of the deposits. Here we present our preliminary micromorphological results.

Landslides effect on catchment geomorphology and ecological features in the "Monte Rufeno" Nature Reserve (Vt, Italy)

Gianluca TRONTI [1,*], Paola FREDI [1], Maurizio DEL MONTE [1], Filippo BELISARIO [2]

[1] Dip. di Scienze della Terra, "La Sapienza", Roma, Italy
[2] Riserva Naturale Regionale "Monte Rufeno", Italy
[*] corresponding author: gianluca.tronti@gmail.com

Italy is a country where the risk of hydrogeological catastrophes is particularly high. Landslides are natural disasters that occur frequently and, quite often after earthquakes, cause a very high number of damages. The landslides survey of the present work was carried out in an area included in the "Monte Rufeno Nature Reserve", located in the northern part of the Lazio region. This area is characterized by lithological conditions that facilitate slopes instability. Spatial landslides dimensions, and their interaction with the more representative environmental parameters, were analysed in *GIS* environment to create susceptibility maps. Then, attention was paid at a local scale to search for fast and effective methods to extrapolate space-time movement patterns of a single landslide phenomenon present within the nature reserve: the "Scialimata Grande di Torre Alfina". Remote sensing techniques by *UAV* drone, photointerpretation, dendrogeomorphology and *GPS* monitoring were used to this end. Finally, to underline interactions between landslides and ecosystems, an exploratory approach to analyse the relationships between morphological dynamism and *biocenoses* that respond to it was adopted. In this way a clear correspondence was found between "Scialimata"'s landslide position and the highest susceptibility class. We also found an interesting correspondence between different disturbance patterns on landslide body and biodiversity, quantified in terms of number of plant and mammal species detected.

Mid and Late Holocene evolution of Brateş Lake area (Lower Danube floodplain)

Laurențiu ȚUȚUIANU [1,*], Alfred VESPREMEANU-STROE [1,2], Sabin ROTARU [1,3], Daniela DIMOFTE [4]

[1] GEODAR Research Center for Geomorphology, Geoarchaeology and Paleo-Environments, Bucharest University, Romania
[2] Sfântu Gheorghe Marine & Fluvial Research Station, Faculty of Geography, Bucharest University, Romania
[3] National Institute of Marine Geology and Geo-ecology (GeoEcoMar), Bucharest, Romania
[4] Faculty of Geology and Geophysics, Bucharest University, Romania
* corresponding author: tzuk_laur@yahoo.com

This study proposes a local paleo-reconstruction of the Danube floodplain based on the multiproxy analysis of an 8 m core extracted from Lake Brateș. Due to lacustrine sediments sensitivity to changes in the surrounding area we chose Lake Brates which through its position within the Lower Danube valley is a proxy for the evolution of Cotul Dunării area (the region of Danube valley marking the change of direction from S–N to W–E) and provide precious information about the timing of Danube river advancement to the Black Sea after its reconnection with the Mediterranean Sea through the Bosphorus strait. The sediments were analysed to get the history of their deposition by means of accelerator mass spectrometry (AMS) 14C dating, grain–size parameters, organic matter and carbonate content, magnetic susceptibility together with paleofauna and pollen content which altogether led to the identification of main phases: i) delta front advance into Danube estuary (before 8000 BP), ii) shoreline foreshore deposits which indicate shoreline position (8000–7900 yrs BP), iii) river floodplain development (7900–5300/5000 yrs BP), iv) lake formation (5300/5000 yrs BP – present).

The pre-LGM climate-related geomorphological processes in the Alta Badia valley (Dolomites, Italy)

Vittoria VANDELLI [1,*], Alessandro GHINOI [1], Mauro MARCHETTI [2], Mauro SOLDATI [1]

[1] Dipartimento di Scienze Chimiche e Geologiche, Università di Modena e Reggio Emilia, Italy
[2] Dipartimento di Educazione e Scienze Umane, Università di Modena e Reggio Emilia, Italy
[*] corresponding author: vittoria.vandelli@unimore.it

Late Pleistocene glacier fluctuations in the high Dolomites valleys remain still today not well constrained, despite the new development of absolute dating techniques such as cosmogenic geochronology. This paper presents new data for palaeo-environmental reconstructions at high elevations in the Alta Badia valley (Eastern Dolomites). The research was based on the study and dating of sub-surfaces deposits revealed by continuous-coring boreholes and by an excavation wall on a formerly glaciated plateau, Pralongià (ca. 2000 m a.s.l.), within the Alta Badia valley. Radiocarbon dating results and interpretation of stratigraphic data, supported by geomorphological field surveys, remote sensing data analyses and palaeo-climatic and palaeo-environmental data from literature, enabled us to conclude that the investigated plateau (Pralongià, ca. 2000 m a.s.l.) was likely ice-free for most of Marine Isotope Stage 3. Moreover, before the onset of full-glacial conditions (LGM ~ 27 ka BP) clastic gravity-induced sediments were deposited on the Pralongià. This study resulted in the first Pre-LGM record of sedimentation and palaeo-environmental conditions in the Eastern Dolomites in the 46 to 38 ka BP period. Future steps of the research will include the analysis and dating of superficial glacial deposits for the reconstruction of glacier fluctuations since the LGM.

Links among rock thermal properties, climatic data and geomorphological processes in a high-elevation instrumented site (W-Alps, Italy)

Cristina VIANI [1,*], Guido NIGRELLI [1], Marta CHIARLE [1], Andrea MERLONE [2], Chiara MUSACCHIO [2], Graziano COPPA [2]

[1] Research Institute for Geo-Hydrological Protection, Italian National Research Council, Italy
[2] Italian National Metrology Institute, Italy
[*] corresponding author: cristina.viani@irpi.cnr.it

The Bessanese glacial basin (Lanzo Valleys) has been chosen to become an "high mountain open-air laboratory" for the investigation of geomorphological processes in a context of climate change. In the present research several activities were carried out: investigation of rock and air temperature variability by 7 micro temperature data loggers and an Automatic Weather Station (AWS); identification of rockfall events by the analysis of different data sources; evaluation of glacier evolution considering both areal and thickness changes. It emerges that the study area is characterized by 3 main lithologies presenting different physical properties (colour, density and specific heat capacity) and showing differences in their thermal regime mainly affected by lithology and solar exposure. Moreover, during the AWS operation period, air temperature shows significant warming trends. On the other hand, rockfall events have been identified in the summer months and several geomorphological evidences highlight a considerable rockfalls activity mainly affecting the Bessanese rockwall. Finally, since the end of the Little Ice Age the Bessanese Glacier experienced a significant shrinkage (disappearance of the left lobe and important retreat of the right one) and maximum mass loss of about 60 meters. Links among the different considered aspects have been found and their detailed study will help in enhancing the knowledge on the various effect of the climate change in high mountain areas.

Monitoring the rapid evolution of a rock glacier during a crisis phase in the Valais Alps with UAV surveys

Sebastián VIVERO [1, *], Christophe LAMBIEL [1]

[1] Institute of Earth Surface Dynamics, University of Lausanne, Switzerland
* corresponding author: sebastian.viveroandrade@unil.ch

Active rock glaciers represent the manifestation of creeping mountain permafrost, which has received considerable attention owing to their current dynamical changes in the context of the European Alps. La Roussette rock glacier (0.02 km^2) is located in the Arolla valley (Valais Alps, Switzerland) and occupies a very small cirque at 3100 m a.s.l. with a south-westerly aspect. It was recently discovered in April 2016 due to the appearance of crevasses in the snow cover. Rapid topographic changes and high creeping rates caused by the destabilisation of this active rock glacier were investigated in detail with five unmanned aerial vehicle (UAV) surveys between June 2016 and September 2017. State-of-the-art photogrammetric techniques were employed to derive high-density point clouds and high-resolution orthophoto mosaics from the studied landform. Elevation, surface kinematics and volumetric changes of this destabilised rock glacier were quantified over the study period. Between June 2016 and September 2017, the destabilised part of the rock glacier advanced up to 60–75m and mobilised a volume of around 27 000 m^3 of material which was dumped over the lower talus slope. We postulate that local topographic and meteorological factors, together with recent warm permafrost conditions are responsible for the destabilisation of this rock glacier.

26th-28th JUNE 2019

VIII

IYGD

ITALIAN YOUNG GEOMORPHOLOGISTS' DAYS

Milan and Veny Valley

Editors Anna Masseroli & Irene Bollati

ISBN 978-88-942719-0-4