Second Caucasus Mountain Forum

The Caucasus Research Agenda – a Key to Sustainable Regional Development

Proceedings
30 October – 1 November, 2019
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The Second Caucasus Mountain Forum: Overview

Forum Background

The Caucasus Mountain Forum (CMF) is a flagship initiative of the Scientific Network for the Caucasus Mountain Region (SNC-mt). The continually evolving regional context of the Caucasus provides a major motivation for organizing biennial regional forums for different stakeholders working on the Caucasus mountain region. The Caucasus Mountain Forums serve as an important opportunity for scientists and academics, governmental experts, and practitioners to meet and exchange views on opportunities and challenges, thereby seeking greater (sub)-regional dialogue and contributing to the improved coordination of sustainable development in the Caucasus region.

Sustainable mountain development (SMD) is a concept that relates to a wide spectrum of sectoral topics. SMD requires the mobilization and interlinking of diverse scientific disciplines and concerns actors from the public, private, and non-governmental spheres. SMD has implications for intergenerational equity and justice and crucially benefits from the involvement of practitioners and decision makers from local to global levels.

The objectives of the Caucasus Mountain Forums are to:

- share the latest scientific findings on SMD in the Caucasus,
- link research, policymaking and practice in the field of SMD,
- showcase scientifically informed, practical actions leading towards sustainability in the Caucasus mountain region,
- provide a forum for promoting a joint regional mountain agenda, and
- increase the visibility of the Caucasus region.

Forum Aims and Objectives

Building on the findings of the First Caucasus Mountain Forum of 2016 (CMF 2016), the members of the SNC-mt Scientific Steering Group organized the Second Caucasus Mountain Forum in 2019 (CMF 2019) and thereby continued to ensure the sustainability of scientific cooperation and exchange, as well as to maintain the science-practice interface through regular dialogue.

The Second Caucasus Mountain Forum followed in the footsteps of CMF 2016 in serving as a crucial opportunity for constructive interaction between scientists, governmental experts, and practitioners; debate on opportunities and challenges; and contributions to the improved coordination of sustainable development in the Caucasus region.

The main aim of the CMF 2019, organized under the title: “The Caucasus Research Agenda – Key to Sustainable Regional Development” held in Autumn 2019 in Ankara, Turkey, was to formally approve the Caucasus Regional Research Agenda (CRRA).

Accordingly, the theme of CMF 2019 encompassed the subject areas covered in the CRRA, with a focus on identifying the current state of knowledge in the Caucasus region, key challenges and opportunities, and priority gaps for scientific research and development.

The overall goal of the Caucasus Mountain Forum and its long-term objective is to support regional cooperation and joint research among Caucasus scientists and to thereby promote evidence-based decision-making for sustainable development in the region.
The specific objectives of the Caucasus Mountain Forum were to:

- review and approve the Caucasus Research Agenda
- exchange information on the scientific findings and practitioner experiences generated since the first CMF
- enhance the links between research, policymaking and practice in the field of sustainable mountain development
- draw attention of Caucasus countries’ practitioners to needs and priorities in research and development for a sustainable future in the Caucasus
- showcase the latest scientifically informed activities fostering progress towards sustainability in the Caucasus mountain region
- promote sub-regional, regional, and international cooperation, exchange of knowledge and know-how among concerned scientific groups working for sustainable mountain development

**Forum Overview**

The Second Caucasus Mountain Forum (CMF 2019) was hosted at the campus of Ankara University. The Forum offered a combination of plenary sessions open to the public, along with thematic research sessions, workshops and poster sessions.

The main topics of the CMF 2019, following the chapters of the Caucasus Regional Research Agenda, were as follows:

- Climate Change
- Biodiversity
- Forest Resources
- Water Resources
- Land Use
- Natural Hazards
- Population and Cultural Diversity
- Tourism and Recreation
- Socio-economic Development and Planning
- Mountain Cryosphere

On the first day, Erkan İbiş, the Rector of Ankara University along with Werner Thut, the Deputy Regional Director South Caucasus of the Swiss Agency for Development and Cooperation welcomed participants at the opening (see the Programme of the Second Caucasus Mountain Forum). Among high-level guests were the Extraordinary and Plenipotentiary Ambassador of Georgia to Turkey, Mr. Giorgi Janjgava.

The introductory presentations at the opening session included those of Prof. Dr. Martin Price, UNESCO Chair in Sustainable Mountain Development, Director of the Centre for Mountain Studies, Perth College: University of the Highlands and Islands; and Prof. Dr. Joseph Salukvadze, Human Geography Department, Ivane Javakhishvili Tbilisi State University. Salukvadze later made a presentation of the Caucasus Regional Research Agenda and invited participants to consider the document, to rank research topics by priority and to provide answers to related questions for further promotion of the document and its potential role in the strengthening of the science-policy interface.

This second Caucasus Mountain Forum covered three plenary thematic sessions: climate change (Day One), management of mountain ecosystem services and finally sustainable tourism (both on Day Two) and a number of parallel workshops and thematic sessions as described below.
The climate change plenary on Day One was led by Prof. Dr. Nuzhet Dalfes, Director, Earth System Science at the Eurasia Institute of Earth Sciences of Istanbul Technical University together with Dr. Olga Solomina, Director of the Institute of Geography of the Russian Academy of Science and Matthias Jurek, Programme Management Officer at UN Environment Programme.

Day Two of the second CMF included plenary sessions about the management of mountain ecosystem services led by Martin Price, UNESCO Chair in Sustainable Mountain Development, Director, Centre for Mountain Studies of Perth College: University of the Highlands and Islands; Ihor Soloïy, Department for Ecological Economics of Ukrainian National Forestry University; and Benedikt Ibele, Team Leader of Environmental Programme South Caucasus (ECOserve) of GIZ. A second plenary session on sustainable tourism was led by Christian Baumgartner, University of Applied Sciences of the Grisons, Vice-President, International Commission for the Protection of the Alps (CIPRA); and Natalia Bakhtadze-Engländer, Ilia State University, Advisor of Georgia’s Ecotourism Association.

Multiple thematic sessions on landscape transformation, tourism footprints, biodiversity, natural disasters, sustainable energy and climate-change impacts on biodiversity, socio-political dimensions of regional development, ecosystem conservation and ecosystem-based solutions, socio-economic aspects of mountain development, demographic processes, education for sustainable development and climate change impacts. The forum also presented workshops in which the participants discussed the role of universities in sustainability transformations in the Caucasus region and the Caucasus spatial data infrastructure and natural disasters.

The last day featured a poster session, during which the evaluation committee listened to the presenters and selected three posters for the first, second and third places. The poster winners were awarded certificates and small prizes at the closure session of the Caucasus Mountain Forum the same day.

Moreover, during the closing session, feedback on the Caucasus Regional Research Agenda was presented by Prof. Dr. Joseph Salukvadze; Prof. Dr. Jörg Balsiger, Director of the Environmental Governance and Territorial Development Hub/Institute (GEDT) of University of Geneva, Chair of Mountain Research Initiative; and Nina Shatberashvili, Caucasus Network for Sustainable Development of Mountain Regions (Sustainable Caucasus). Prof. Dr. Mehmet Somuncu, Director of Centre for Environmental Studies, Head of the Department of Geography of Ankara University closed the conference.

CMF 2019 served as an important opportunity for scientists, governmental experts, and practitioners to meet and exchange views on opportunities and challenges, and thereby seek to enhance (sub)-regional dialogue and contribute to the better coordination of sustainable development of the Caucasus region. The Forum’s overall goal and long-term objective are to support regional cooperation and joint research among the Caucasus scientists and thereby promote evidence-based decision-making for sustainable development.

As one of SNC-mt’s flagship activities, CMF 2019 benefited from high visibility, including in the Report of Secretary-General to the UN General Assembly on Sustainable Mountain Development at the Seventy-fourth session of UN General Assembly.
The Second Caucasus Mountain Forum: Proceedings

Day 1: Wednesday, 30 October 2019

Opening Session and Welcoming Remarks

The forum was opened by Mehmet Somuncu, Director of the Centre for Environmental Studies and Head of the Department of Geography, Ankara University. He welcomed participants to the second Caucasus Mountain Forum on behalf of Ankara University and the Caucasus Network for the Sustainable Development of Mountain Regions (Sustainable Caucasus) and expressed his gratitude and sincere thanks to all the participants and organizers of the Second Caucasus Mountain Forum for their efforts and contributions.

Mr. Somuncu highlighted some of the current issues inherent to the subject of this conference. Mountains cover a quarter of the Earth’s land surface and are sources of water, food, timber, minerals, and other natural resources. Mountains provide humanity with opportunities for recreation and tourism and are centres of biological and cultural diversity. At the same time, mountain ecosystems worldwide are under stress because of increased demand for their resources and they are experiencing stronger external forcing factors, such as regional landscape fragmentation and global climate change. Mountain ecosystems are usually regarded as highly sensitive to global changes. However, because of system complexity and multifaceted interactive drivers, understanding current responses as well as predicting future changes are great challenges.

Since its foundation, the Scientific Network for the Caucasus Mountain Region (SNC-mt) has implemented a number of projects and undertaken many measures. These include the development of the Caucasus spatial data infrastructure, the First Caucasus Mountain Forum organized by Ivane Javakhishvili Tbilisi State University and Ilia State University in 2016, the First Caucasus Summer School and the Caucasus Regional Research Agenda. Currently, SNC-mt is implementing a project funded by the Swiss Cooperation Office-South Caucasus through its coordination unit, the Caucasus Network for the Sustainable Development of Mountain Regions (an NGO), which was responsible for this Second Caucasus Mountain Forum hosted by Ankara University. The Second Caucasus Mountain Forum has been devoted to the discussion and approval of the Caucasus Regional Research Agenda, one of the priority activities of the SNC-mt, the purpose of which is to establish a collaborative process for identifying the current state of knowledge in core issue areas related to sustainable mountain development in the Caucasus Region.

The forum, which included plenary, thematic and poster sessions as well as workshops, included participants from 14 different countries who presented 136 papers. Mr. Somuncu highlighted and expressed his gratitude to the people who contributed to the conference and encouraged a spirit of openness and friendship to characterize this conference. The agenda provided many opportunities for intellectual discovery and for the creative exchange of ideas, experiences, opinions and knowledge.
Vice Rector of Ankara University—Sibel SÜZEN

Ms. Süzen welcomed all the participants, highlighted the importance of the forum in approving the Caucasus Regional Research Agenda and shaping the region’s sustainable future as well as the priority issues for sustainable mountain development in this region. She noted that the foundation of the Caucasus Network for Sustainable Development of Mountain Regions, which includes leading regional scientific organizations in an open network of researchers and other stakeholders interested in this discipline, had contributed to this kind of important forum which would help to improve scientific cooperation in the region. Supporting the sharing of experiences and development of dialogue between scientists and decision-makers in the region is very important. Key thematic sessions in this meeting include those on demographic trends in mountain settlements, socio-economic aspects of mountain development, water resources, ecosystem conservation, and ecosystem-based solutions, socio-political dimensions of regional development, climate change, education for sustainable development, pollution and safety, mountain development prospects and local population identity, and a workshop that is very important for Turkey on natural disasters. These are subjects that are not only important for this meeting but also vital and relevant subjects for all of humanity.

Deputy Regional Director South Caucasus, Swiss Agency for Development and Cooperation, Tbilisi, Georgia—Werner THUT

Mr. Thut extended a warm welcome on behalf of the Swiss Agency for Development and Cooperation.

For the Swiss Agency for Development and Cooperation (SDC), the three days of the event mark a highlight in an effort to promote contemporary interdisciplinary mountain research, which started six to seven years ago, and that SDC formally joined in 2015. Switzerland is itself a mountainous country with high mountains and rolling hills covering 66% of Swiss land area. We have an intrinsic interest and a proven track record in the sustainable development of mountain regions for the benefit of vulnerable mountain communities and the welfare of the country as a whole. From our own experience, we have learned that agriculture is often the backbone of sustainable mountain development.

Switzerland is committed to promoting sustainable mountain development at the international level through its development agency, the SDC. In this work, SDC operates at different levels, encouraging international policy dialogue at the global level, regional processes in four major mountain regions of the world, and also knowledge management in the Caucasus Region.

The SDC programme represents more than two thirds of Switzerland’s official development aid of roughly US$2 billion in 2018. Out of this amount, around one fourth goes to programmes related to climate change and environment, water, and disaster risk reduction and other topics at the core of the Mountain Agenda. And with the growing importance of climate change challenges, this share is expected to become even more considerable. Currently, the Swiss Government is considering increasing development aid related to climate change alone from US$300 million annually to US$400 million.

To illustrate the topicality and importance of the conference, I will share another Swiss experience, less than two weeks old: the most recent Federal elections of 20 October 2019.

What happened actually took most observers by surprise. In the context of an intensive public debate the last 12 months over either more gender equality on the one hand and a determined action to fight climate change on the other, two green parties made historic gains, marking a significant shift in power in the consensus-oriented system of our country. Some international observers even wrote about “a tectonic shift in a country where political change often takes place at glacial speed”.

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Of interest in the context of our conference, the deputies of the new centre-left majority are not only younger, and more often women; there is a significant increase in scientific expertise and knowledge related to climate change issues with deputies having backgrounds in environmental sciences, engineering, physics, climatology and more. In the new Swiss parliament, politics will meet science on a daily basis. I would not conclude that this necessarily guarantees fast progress or quick solutions. Scientific knowledge should not necessarily be the only source and reference for decision-making in politics; nor even necessary as a requisite to raise one’s voice, but if we go for rational, evidence-based decisions, science and scientists should be heard on a regular basis and without prejudice.

This brings us back to the purpose and ambitions of this conference—notably the approval of the Caucasus Regional Research Agenda 2020–2030. When it comes to the way forward:

- the paper notes that practitioners will consider the Agenda as a document that identifies areas where common practical actions are required, despite political constraints, in order to overcome existing gaps preventing the Caucasus region from achieving sustainable development.

Moreover, the draft document states that:

- the Scientific Network for the Caucasus Mountain Region will enhance the Agenda as an instrument for policymaking, regional and inter-regional cooperation, knowledge and data exchange and communication of best practices.

These are important statements. At the same time, they sound very prudent—almost a bit too prudent. From a practitioner’s perspective, I would strongly invite us to take a closer look at how to translate scientific results into action and policies with these questions in mind:

- How can the transfer of knowledge to Government bodies and the parliament be ensured?
- How can one dialogue, inform and collaborate with non-state actors such as NGOs or professional organizations?
- How can decision-making processes be structured or re-structured so that relevant knowledge is systematically taken into account?

SDC is very much committed to supporting this perspective. Together with the Green Climate Fund, we already finance a large programme to strengthen the climate-change-adaptation capacities at country level in the South Caucasus. However, more funding is needed in the coming years. First, to strengthen the policy uptake at country level. And, second, we would also very much welcome additional efforts at a regional level in terms of creating processes and spaces for regional dialogue. And of course, as a starting point, for activities at working level for discussions when appropriate.

Mr. Werner Thut reminded the audience that the Caucasus Ecoregion includes not only the South Caucasus but also parts of the Russian Federation, Iran and Turkey and that these countries have much in common when it comes to sustainable regional mountain development in terms of challenges, scope and need for action.

The Caucasus Regional Research Agenda 2020–2030

Joseph SALUKVADZE (joseph.salukvadze@tsu.ge), Ivane Javakhishvili Tbilisi State University, Georgia

The Caucasus Research Agenda defines the Caucasus Region as embracing six countries. While the entire area of Armenia, Azerbaijan, and Georgia are included, only selected parts of Iran, the Russian Federation, and Turkey are included. The total area is 550,000 km² and the population is 40 million. The specificity of the Caucasus Region is that it is a unique ecoregion that is recognized among 35 priority places by WWF and 34 biodiversity hotspots that add additional value to the
region. On the other hand, we have also some negative specificities due to the geopolitical situation ensuing from the cardinal geopolitical transformation after the collapse of the Soviet Union. The good news is that the “Iron Curtain” has been removed in this part of the world, but there has been heavy fragmentation of the inner territories due to political conflicts since the 1990s, making cooperation more complicated. However, we also have to recognize the necessity of strong interregional cooperation, otherwise it will be very difficult to have any major successes in the region. We have some economic and social issues that have to be taken into consideration and that are highly dependent on the natural resources of many mountain people. Economic growth also has a negative impact on the environment.

We are proud that the draft Regional Research Agenda was developed at the first Caucasus Mountain Forum and in the following three years we added a lot to this document, which we have published with the overall guidance of the University of Geneva, SNC-mt Coordination Unit, GRID-Geneva, and Swiss Cooperation Office for South Caucasus.

**Why do we need a research agenda?** The Caucasus Regional Research Agenda (C-RRA) is a strategic document for many stakeholders to improve the situation in the region. The identification and prioritization of research and knowledge needs are very important as well as the link from research to practice and policy, and vice versa. And finally, it will serve as an inspiration for transboundary mountain cooperation between the Caucasus countries.

The following main topics have been identified for further research: climate change, biodiversity, forest conservation and development, water resources and management, land use and land cover change, natural hazards and risks, population and cultural diversity, tourism and recreation, mountain cryosphere and socio-economic development and planning.

In addition to the ten main research chapters, several cross-cutting research topics have been identified that cover but are not limited to multidisciplinary research topics such as: soil sustainable management, air pollution, promotion of renewable energy sources, ecosystems services, Economics of Ecosystems and Biodiversity (TEEB), landscape ecology and infrastructure, governance and decision-making, and transboundary cooperation between stakeholders, especially scholars, at different administrative levels.

The cross-cutting issues demonstrate the importance of multidisciplinary studies to establish a solid scientific foundation for decision-making and to improve management. Such studies should be oriented towards balanced economic growth and achieving sustainability in the Caucasus region. The cross-cutting topics are targeted at safeguarding the uninterrupted provision of natural resources and ecosystem services important for human development and a decent quality of life.

The C-RRA is seen as a guiding document for the implementation of Agenda 2030. The second edition of Caucasus Environmental Outlook and Caucasus SDI consider C-RRA as a framing document and a tool for research and studies.

Formal approval of the C-RRA is envisaged at this Forum and resources for C-RRA implementation and utilization will be provided from conventional sources such as national science foundations and research funds, donations by interested research institutions and universities from the Caucasus and abroad, as well as joint research projects. The SNC-mt SSG and its Coordination Unit with assistance from international partners and donor institutions will enhance C-RRA as an instrument for policy-making, regional and inter-regional cooperation, knowledge and data exchange, and communication of best practices.

Participants were asked to rank priority topics for the next two years, to rate the C-RRA themes from 1 to 10 and to place them in a transparent voting box. Their feedback was collected, synthesized, presented, and addressed during the closing session.
Demographic trends in borderline regions of the East Caucasus mountains (Georgia)

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Demographic trends in Georgia have been drastically changing in recent decades, particularly in mountainous regions. The border regions of the east Caucasus Mountains (Khevi, Khevsureti and Tusheti) are facing many demographic challenges that are enhanced by various environmental, societal and economic circumstances such as complicated terrain, climate, migration, low birth rates, unemployment and insufficient communication networks. The aim of this research is to analyze current demographic trends in order to investigate how to deal with the demographic changes in the study area and how to keep these areas inhabited. In this paper, we extend the framework with available statistical data complemented with practical ideas to give answers to these questions. The study area included 144 villages of present-day Kazbegi, Dusheti and Akhmeta municipalities. The National Statistics Office of Georgia (GEOSTAT) is the main source of the statistical data contained in three national censuses (1989, 2002, 2014) that were used in the paper with population data from earlier censuses published in scientific literature. In addition, the outcomes of field work conducted in 2015 were also used. Geographic information systems (GIS) were used for spatial and temporal analyses of demographic changes and future trends. Dramatic demographic trends were observed in the study area. This investigation has demonstrated that the situations in these three regions are clearly distinct from each other. In spite of relatively similar environments, the comparatively better demographic situation is to be found in Khevi, which can be explained by the fact that the Military Road of Georgia goes through this region. The results include the similarities as well as differences among the study regions and these patterns have been summarized in this paper. This framework can be used to evaluate the demographic trends in the border regions of the east Caucasus Mountains and to answer the above-mentioned questions.

Settlement features in the Shaki-Zagatala economic and geographical region

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The Shaki-Zagatala economic-geographical region, located on the southern slopes of the Greater Caucasus, constitutes 10.3% of the territory of the Republic of Azerbaijan and contains 6.2% of the population. There are six cities, six settlements and 336 villages in the economic region. The population of the region is unevenly distributed between urban and rural settlements and depends on natural, socio-economic and demographic factors. Compared with the Republic as a whole, the region has a weak urbanization level: 72% of the population lives in rural villages, and just 28% live in urban areas.

Although urban settlements have existed since ancient history in the territory of the region, the formation of the modern urban settlement system and lifestyle was possible during the Soviet era. While Shaki, Zagatala, and Gabala cities have greater populations and economic potential in the region, Shaki has always played a leading role in the settlement system of the region.

Village settlements also play a crucial role. Thanks to the rural population, demographic development occurs in the administrative region centres of Azerbaijan. Vertical fragmentation of the relief, climatic...
conditions, and other factors led to the fact that rural settlements were located at different altitudes, with 9% of the rural population at 0–200 m altitude zones, 42% at 200–500 m, 44% at 500–1000 meters, 4.8% at 1000–2000 m, and only 0.25% of areas above 1500 m were populated.

Due to the high development of social infrastructure in demographic development in the region, migration of the population to surrounding areas, especially to Baku, has increased, which, in turn, has harmed the demographic development of the region. To solve this problem, firstly, it is necessary to provide superior development of industrial areas, which can produce labour-intensive, competitive products that meet modern standards in the regional centres.

Sustainable demographic development in Azerbaijani regions

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The aim of this research is to compare and assess sustainability of the demographic development of Azerbaijani regions and to identify the main problems related to regional demographic development while justifying the reasons for them.

To achieve this aim, factors affecting demographic development were explored; comparison and analysis of demographic data were carried out; trends in the demographic development of regions were defined and results of the research were shown in a number of compiled thematic maps.

The demographic development of regions were shown to be defined by: (1) their geographical position and spatial capacity; (2) the rate of natural increase of their population; (3) available economic and infrastructure potential; and (4) the attractive power and influencing role of cities and regional centres. The roles of each of these four major factors were analysed on the example of Azerbaijan’s regions.

Concerning the first factor, it was shown concretely which geographical factors have an impact on the demographic development of regions. With respect to the second factor, the rate of natural increase of the regions’ population was studied and analysed comparatively. Regarding the third factor, industrial potential and development level, agricultural capacity, the conditions of transport and communication infrastructure, and accessibility and territorial coverage of services were analysed and reviewed from a geographical perspective. As for the fourth factor, population growth rates were explored comparatively by region to reveal trends in their demographic development. Size, number and growth of settlements around cities, as well as migration were considered. The attractive power of cities and regional centres and their role in regional demographic development were assessed.

The study allowed to define the advantages and gaps in the demographic development of regions. Through a complex assessment, regions with high, medium and low demographic capacity were identified. Recommendations on improving the demographic development of the regions are offered by the author.

Depopulation of mountain territories: The North Ossetian example

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The problem of depopulation of mountain areas remains relevant even now. Mountains are losing inhabitants, and there is an accompanying decline in the level of economic activity, a severance of economic ties and destruction of existing infrastructure. But there are also positive examples of population levels being restored in certain parts of mountain regions.
Outflow of inhabitants from the mountains began in the 19th century. Very often, this consisted in forced resettlement, which engulfed both the North Caucasus and Transcaucasia. On the one hand, the resettled people obtained fertile lands on the plain, but on the other, the morbidity of the population, especially due to respiratory diseases, increased dramatically. Very often the sick died.

The example of North Ossetia clearly shows how the population in the mountains decreased. In 1897, 40,000 people lived in the mountainous part of the region; in 1914, this rose to 47,600; in 1926, the amount declined to 22,600; in 1959 a small increase to 27,200, in 1989 a drop to 16,800, in 2010 the population was halved to 8,200 and in 2017 the amount remained close to stable at just 8,700 people.

The development of the polymetallic ore industry, the opening of mines and concentrating mills breathed new life into mountains. With these, a network of workers’ settlements was formed. However, the depletion of ore reserves led to a gradual closure of the mines. The first “victims” were the Fasnal mines and the village of Fasnal in the Digor Gorge. Then the mines were closed in Archon, Sadon, Upper Zgid, Fiagdon and Buron. The fate of the settlements seemed predetermined. However, in the transition to a market economy, new types of management appeared in the mountains, which led to some stabilization of the population. Life was revived in the mountain villages as well.

Cities located in mountain areas of Azerbaijan and their geo-demographic development

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Currently, more than half of Azerbaijan citizens are urban residents. Out of the 78 cities in the country, 25 are in mountainous areas. There are 12 cities and 16 smaller urban settlements in the Greater Caucasus and 11 cities and 24 settlements in the Lesser Caucasus with two cities in the Talysh mountain region. The origin of cities and the development of urban culture in Azerbaijan has a long history. Time-worn towns have played a crucial role in formation of the material and spiritual culture of the nation.

As our studies show, two cities (Dashkasan and Gadabay) and seven settlements are located above 1,500 m altitude; two cities (Lerik and Shahbuz) and 12 settlements are located between 1000 and 1,500 m; and the altitude of another 21 cities and 21 settlements are between 500-1,000 m. The territories at 500-2,000 m of altitude occupy 35% of the country’s territory, where 11% of the country’s urban population is concentrated. In 2017, a total of 568,200 people lived in mountain regions.

An analysis of the demographic development of the urban population dwelling in mountain regions shows that although their natural increase and birth rates were higher than the average figure by country in 2010, in more than half of mountain regions currently, the corresponding indicators are lower than the average.

Also, there is an adverse situation regarding marriages recorded among the urban population. Thus, the weak industrial and socio-economic potential of small cities, as well as the employment problems of cities, challenges demographic development.

To solve problems in the mountain regions, establishing and improving services to be in line with modern requirements is needed. Developing tourism in towns based on traditional labour is also important. Preservation efforts for historical and archaeological monuments in ancient cities appears necessary.
**Thematic Session 2: Socio-economic aspects of mountain development**

**Caucasus mineral resources as a primary precondition of sustainable regional development**

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The Caucasus region represents a very complicated amalgamation of diverse geological settings and terrains originating from different geological processes in the time span from the Late Proterozoic to the Quaternary. Thanks to such a complicated and long history of geological development, there is a vast range of mineral deposits in the region starting from hydrocarbons (oil and gas, coal) various metals, agrochemical raw materials, and almost all kinds of rocks and construction materials. Therefore, from a mineral resources point of view, the Caucasus can be considered as an almost self-sufficient region capable of supporting different kinds of industry. On the one hand, having such mineral resources is a huge benefit for economic and social development of the region. On the other hand, unfortunately, without adequate policy and proper management these resources can cause accelerating of climate change by means of huge energy consumption, creating emissions and other environmental issues including deforestation and land degradation.

The proposed presentation is devoted to discussing the main measures and strategy approaches that will allow the development of the mining industry and simultaneously minimize the impact on the environment and climate change.

**Ecological problems of the Caucasus mountains: What are the prospects for solutions?**

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Mountains play an important role in shaping the ecosystems of their respective regions, not only through their unique biodiversity and landscapes. Throughout the history of humanity, mountains have also been a safe haven for people in troubled times, a place where a unique way of life and culture of survival has formed and a kind of sub-civilization has developed.

The importance of mountains for countries and communities is even more important today in the context of growing environmental problems of global proportions such as the shortage of clean fresh water.

Threats like massive mining along with semi-nomadic farming have created practically irreversible impacts, essentially destroying the biodiversity and landscapes of mountains. For thousands of years, the scale of such practices, though gradually increasing, was such that it still allowed nature to recover, and sometimes even served as a means of protection from fires that inflict much greater damage to the surrounding environment due to the dryness of non-grazing grasses.

However, the dramatically increasing human population led to an accompanying increased demand for livestock products. The resulting impact of large semi-nomadic cattle herds has now become a threat, causing a slow death of biodiversity and mountain landscapes. One more factor to have an ever-increasing impact on mountain ecology is tourism.

It is necessary to change the very philosophy of the human perception of mountains. We should love, respect and protect the mountains, establishing a relation of partnership with them, not of exploitation.
Socio-economic development of Georgia mountain regions: The Racha example

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According to the Law of Georgia on the Development of Mountainous Regions, 1,582 settlements were granted the status of mountain settlement, defined as such if located at an altitude of 1,500 m.a.s.l. or higher. Racha-Lechkhumi-Kvemo Svaneti region is in the northern part of western Georgia. The region is located on the southern slopes of the Central Caucasus and is considered a high mountain zone (at 4,000 m.a.s.l.). This region has a difficult demographic situation caused by low birth and high death rates and by internal and external migration (which is especially high in Georgian mountain regions). The population decline and aging are the region's main demographic problems, negatively affecting the region's social-economic development. Without taking effective measures, this region will become depressed. The tourism sector is developing in Racha-Lechkhumi-Kvemo Svaneti region, but the overall potential is not met. Natural and geographic conditions: climate, fresh mountain air, frequency of coniferous and deciduous forests, the abundance of cultural monuments, mineral waters and other natural resources create perfect and unique conditions for tourism development in this region. Different types of tourism, such as horse riding and ecotourism can be developed. The resorts of the region are Shovi, Utsera, Kveshvake, Sortuani, Khidikari, Bugeuli, where medicinal and sulphur waters are available. In Racha, the unique village of Gogolati will be given the status of a village of national importance because of its unique architecture. This paper will be dedicated to revealing the tourism potential of the above-mentioned region, introducing other economic domains related to tourism. The region as well as its economic sectors will be analysed using the SWOT analysis method. The strategic goals of the region will be discussed.

Geographical features of non-timber forest product use

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The Republic of Georgia is rich with forest resources. A high variety of non-timber forest products (NTFPs) can be found in Georgian forests that have nutritional, medicinal, decorative and other values. Some of the most significant resources are in the mountainous areas where people have left their homesteads. Mountain forests are rich with NTFPs, but they are rarely used by the population.

Market studies in Europe reveal that there is high demand for natural products that can be found in Georgian forests and that can become important income sources for the local populations. Despite growing international demand and the enormous potential of these kinds of products in Georgia, nowadays this field is completely undeveloped and therefore needs special attention. Producing and processing NTFPs potentially is the most important export sector that could provide significant income and employment for the population, improving social conditions.

As a result of our research, different types of forest resources of Georgia have been studied, including the characteristics of their geographical distribution and application possibilities. The interests of international and local businesses in NTFPs, such as confectionery enterprises, have been discussed for producing fruit juice and tea for example. Also very important are ‘green pharmacies’ and a large quantity of unprocessed materials are exported to the international market.

There are problems in the local legislation related to the NTFP-extraction period and quantity that are directly related to population awareness. Different types of NTFPs can support the development of a number of fields of economy in the mountainous regions of Georgia. Their rational use is very important for promoting development of different districts, as well as to prevent migration of the population, which is a main challenge at the present time.
Thematic Session 3: Water in the Caucasus

Sustainable management of urban water resources in Ganja

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Sustainable water resource management has become a serious topic for the growth of cities that suffer from limited water resources. One of these cities is Ganja located at 400-450 m.a.s.l. in the north-eastern foothills of the Lesser Caucasus on the Ganja-Gazakh plain in the Kur-Araz Lowland. Generally, Ganja belongs to the Ganja River Basin and is one of the poorest water resource zones in Azerbaijan.

There are several major challenges for Ganja city: its growing population, scarcity of local water resources, and a lack of economic growth. Several specific water issues result:

- contamination of the main river (Ganjachay) of the city
- regulation of river water and guarding of ecological flow
- removal of sewage water in a defined manner
- rainwater control and reuse
- efficient use of water and green infrastructure

Today, Ganjachay river water is used for agriculture and drinking water. Recent studies found that there has been a decrease in the annual flow of the river because of the enormous quantity of water used. According to other scientific research, climate change and global warming has impacted the artesian source of Ganja city too.

Nowadays, Ganja city’s water and wastewater supply network is being reconstructed. A rainwater network is needed as well. Catchment of town waters is one of the best ways to efficiently use water as part of a long-term strategy of integrated water management. Successful actions to be encouraged with the help of international experience include minimizing the distances of water and wastewater transportation, using stormwater from roofs—preferably for water supply instead of filtering and discharging—and increasing the responsibility of individuals for their impacts on local water and wastewater systems.

Urban hydrology is an effective approach that can generate new models for management of water resources in urban areas.
Lake Sevan, Armenia: Investigation of current ecological status and toxicological conditions

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Historically, Lake Sevan, the largest high mountain freshwater body in the Caucasus region, was impacted by tragic events. During the period from 1930 to the 1980s, the lake water level fell dramatically (from 1916.2 to 1897.0 m) due to large-scale hydrotechnical transformation and excessive use of water supplies for energy and agricultural purposes, resulting in eutrophication and loss of biodiversity. Since 2002, measures have been undertaken to raise the water level in order to restore the natural regime of the lake. The aim of the present work was to study the current ecological status of and toxicological conditions in Lake Sevan. Chlorophyll-a, cyanobacteria, cyanobacterial nonribosomal peptides, and mineral nitrogen and phosphorus were examined by the standard methods accepted in hydrochemistry and biology. Although some characteristics of the lake ecosystem indicated the improvement of the lake ecological status in the conditions of a lake water level rise, a massive cyanobacterial (Anabaena) bloom registered in July 2018 (averaging 3.04 mln cells/l) has shown that the ecology of Lake Sevan is still not clearly understood. Rapid cyanobacterial growth and decomposition in turn caused drastic changes in the concentrations of chlorophyll-a (0.9–46.2 µg/l) and nutrients (phosphate: 0.01–0.17 mg/l; nitrate: 0.06–0.42 mg/l; and ammonium: 0.04–0.32 mg/l). Different cyanobacterial secondary metabolites, including seven types of microcystin were found in the phytoplankton biomass of Lake Sevan. Total concentration of microcystins varied from 0.3 µg/l to 2.4 µg/l, showing serious health risks in the case of water use for drinking purposes (WHO limit: 1 µg/l) and indicating a precaution for recreational water use (WHO limit: 2–4 µg/l). These results allow us to conclude that the lake ecosystem is still ecologically unstable and that the right lake-management tools are still required.

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Kura River water quality: An assessment

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The water quality of Kur River is understood to mean its physical, chemical and biological characteristics. Kur River quality is determined by a number of features:

- river water in contact with well-wetted basin located above the erosion base,
- the effects of soil due to changes in the level of water in the rivers and low evaporation in river basins, and
a close relationship between water-quality indicators and quantitative indicators in rivers.

The observed pH values are normal and typical for mountainous rivers, especially in the upper reaches of the basin in both Georgia and Armenia. Although the river becomes quite low towards its delta in Azerbaijan, the average annual concentration of pH varies from 8.0 to 8.2 in all the stations in Azerbaijan considered.

The average annual concentration of dissolved oxygen (DO) in the Kura River Basin is satisfactory, largely exceeding 7 mg/l, conditioned by the rather natural hydro-morphological conditions and hydrological regime of the river.

Towards the Georgia-Azerbaijani border, the ammonium cation (NH₄⁺) concentrations increase between Rustavi (Georgia) and Shikhli (Azerbaijan), related to the discharge of untreated wastewater from the Gardabani wastewater treatment plant near Tbilisi, Georgia that is not highly efficient, providing only mechanical treatment.

After the Mingachevir reservoir, the NH₄⁺ concentrations decrease, due to the trapping by the reservoir of most sediments and nutrients carried by river water. At Banka, concentrations increase as a result of the local impacts of untreated wastewater released from villages and farmlands in the vicinity of the river in addition to the outflow of agriculture drainage water with a high nutrient load.

In the countries of the Kura River Basin (Armenia, Azerbaijan, Georgia and Iran), increased attention is being paid to the problem of heavy metal pollution of the aquatic environment.

A socio-ecological atlas for the Upper Kura Basin

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Part of the larger Kura River Basin, the Upper Kura River Basin is located in North-Eastern Anatolia, Turkey, which also covers the Ardahan Province of the Republic of Turkey and part of neighbouring Georgia. The region is part of the Caucasus Ecoregion and one of the most important regions of the country with key biodiversity areas and conservation landscapes such as the Yalnızçam Mountains, Ardahan Plain and Forests, Posof Forests, Çıldır and Aktaş Lakes and the Kura River itself.

Given this important position in biodiversity conservation, the Kura Basin needs to be considered as a priority basin by means of its rural structure and the socio-ecological systems and production landscapes as the main resource for rural livelihoods and sustainable development.

The study is the main component of the “Kura Basin Ecology Atlas Project”, funded by the UNDP-GEF Small Grants Programme and implemented by İMECE Association in cooperation with Akademia
Consulting Co. Ltd. and relevant stakeholders. The Kura Basin (Socio-) ecological Atlas is the first study specifically focusing on the basin, with its methodology developed using socio-ecological system analysis and an ecoregion conservation approach powered by GIS analysis and participatory design activities.

The idea and aim of the study is to provide compiled information and analysis on the socio-ecological system of the basin with its biotic and abiotic resources and production landscapes that are highly important for decision-making and strategic planning for sustainable regional and rural development—especially for local administrations and nature conservation institutions in the region. Also, the study can contribute to the Caucasus Ecoregion Conservation Plan and associated activities, as well as other national and Caucasus ecoregion-related research and policy-making initiatives.

The paper/presentation will cover the methodology, process and findings followed by comments and practical recommendations for socio-ecological system-based analysis for sustainable regional development, and relevant policy and strategic-planning processes.

**How to save the Aras Basin through water diplomacy among Caucasus countries**

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Excessive use of water from the Aras Basin has gradually led to environmental degradation and water scarcity. Therefore, reaching stable water allocation patterns focusing on preserving the environment is of utmost importance. The Caucasus region is rapidly developing and the trans-boundary Aras River plays a vital role in this region. This research focuses on preserving an environmental flow based on a coalition of these countries. Therefore, firstly, the flow duration curve is used to determine the minimum required environmental flow at two stations along the river and then a cooperative game theory between the four countries of Turkey, Armenia, Iran and Azerbaijan is modelled to assess the possibilities of coalition between countries in preserving environmental needs. The study supports strategic cooperation among Caucasus countries to save this watershed.

**Thematic Session 4: Ecosystem conservation and ecosystem-based solutions**

**Introducing payments for ecosystem services for high mountain ecosystems in Azerbaijan**

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Various types of market-driven mechanisms are designed to promote conservation and protection of natural resources and improve services provided by ecosystems. Through “payments for ecosystem services” (PES), service providers (sellers) and service users (buyers) are supported financially
to change their land-use styles and provide ecosystem services to buyers. These buyers can be direct users or non-users that are directly interested in improving ecosystem services. In almost all PES schemes, managers of natural resources and ecosystems are paid to manage their resources more effectively, protect land, biodiversity, and carbon sequestration ability through, for example, replanting trees, reducing grazing and applying more nature-friendly agricultural methods.

The target region for the study included forest and mountain grasslands of Shamakhi and Ismailli Districts of Azerbaijan. The area is characterized by extensive farming, mainly cattle breeding. Overgrazing and illegal logging are the main issues that concern current land-use activities. Recent activities make the area very vulnerable in terms of land degradation and erosion that, in turn, reduce ecosystem quality and services provided by grassland and forests.

In order to develop a preliminary evaluation of the high-mountain ecosystems (grasslands and forests) and investigate how different variables influence the values of different ecosystem services, we use a meta-analysis based on a randomly selected sample of 110 studies on a variety of world ecosystems, including those that are most relevant for mountain areas. Results of the contingent valuation survey (based on individual reporting of willingness to pay (WTP) and willingness to accept (WTA)) demonstrate that PES schemes can be successfully implemented in Azerbaijan. Various types of PES schemes have been proposed.

Valuation of carbon sequestration function in Tayemeh rangelands in Malayer country, Western Iran

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Rangelands provide important ecosystem services that are often not marketable and whose valuation is therefore difficult to determine. Among the non-market services offered by rangeland ecosystems, the service of regulating atmospheric gases, and especially the absorption and storage of carbon dioxide, is of particular importance. Plants absorb carbon dioxide and use it in the process of photosynthesis. Therefore, in addition to the production of biomass and release of oxygen, plants act as a significant carbon store and have an effective role in reducing the effects of greenhouse gas phenomena. This study proceeded to determine the economic valuation of carbon sequestration in Tayemeh rangelands located 31 kilometres south of Malayer in the west of Iran in Hamedan province. Firstly, the annual production of dry fodder per hectare was determined for this pasture. Second, using the relationship between plant biomass generation and carbon dioxide absorption, the rate of carbon capture and absorption by this rangeland ecosystem was determined. In order to evaluate this ecosystem service, we used the Replacement Cost Approach (RCA), which is one of the cost-based methods in environmental economics. The results of the study showed that the 1,787-ha area of the rangelands of the study area has an annual value of IRR 23,2487,333.033 in relation to the function of carbon dioxide gas absorption.

Representativeness of protected areas in the North Caucasus

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Russia has considerable experience in the organization of nature conservation in the Russian Caucasus. Nowadays, a network of protected areas has been established including areas of different purposes, sizes and specializations with varied levels of strictness in their protected regimes. The high diversity of flora, fauna and natural habitats are conserved in the following federal protected areas:
In addition, 829 protected areas of regional importance and 28 nature protection sites of local importance operate in the region.

The adequacy of the protected area network for biota and habitat diversity conservation for various parts of the Russian Caucasus was assessed. As a result, we can speak about an excellent representation of rare habitats (lotus, Banat pine, Samurian forests and dunes), as well as types of habitats of coniferous forests (fir, spruce and pine). But there are also some problems.

The high-mountain and alpine habitats (subalpine and alpine meadows, screes, rock-crevices) are well represented in the protected areas of the western and central parts of the Caucasus. The establishment of protected areas in the Eastern Caucasus would facilitate the completion of a full-fledged ecological network along the Main Caucasian Range and the full protection of a diversity of high-mountain habitat types.

The deciduous forests (beech and especially oak/hornbeam forests) as well as the habitats of mountainous and lowland steppes are poorly represented, they are present only on protected areas of a small size with a relatively low degree of protection. Protected areas cover only a small proportion of coastal habitats as well.

To solve these problems, it is necessary to pay special attention to improving regional and local ecological networks.

Protected areas in Azerbaijan: Landscape-ecological diversity and sustainability

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The establishment of protected areas is one of the most important steps in the protection of natural resources and gene pools, as well as world biodiversity. This article explores the principles of protected area development in Azerbaijan such as national parks, nature reserves and sanctuaries, and considers mechanisms of international experience in this field. The distribution of protected areas is provided according to the categories recognized by the International Union for Conservation of Nature. Currently, only 10% of the territory of Azerbaijan is included in protected areas. Given the anthropogenic loading of landscapes in Azerbaijan, it has been determined that the extent of protected areas does not meet the existing standards of ecological balance.

Azerbaijan’s conservation areas are grouped according to the characteristics of the location, and relevant recommendations have been presented along with challenges and difficulties in mountainous, plains and transboundary zones. The landscape characteristics and ecological diversity of protected areas were analysed, as well as their regional variation.

The concept of biodiversity conservation with sustainable development promotes the rise of socio-economic indicators while at the same time ensuring the protection of the environment and ecosystems. The possibility of creating an ecological network across the country is considered as one of the key conditions for sustainable development. The roles and capacities of protected areas have been studied in terms of the creation of an ecological network in Azerbaijan. Ecological norms of economic activity of the population have also been developed in national parks and their buffer zones.
An economic assessment of the current state of ecotourism use in protected areas has been undertaken. Tourism activity indicators in the territory of national parks have been analysed. We reveal that the share of protected areas in some regions is considerably lower for a number of objective reasons. This is an important factor in the sustainable development of regions. The organization of a number of new protected areas has been scientifically substantiated in this article for this purpose.

Ecosystem-based adaptation strategies to combating climate changes risks and food insecurity in Iran

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Climate change is one of the biggest environmental, social and economic threats to the livelihood of forest-dependent communities in developing countries. These communities are very vulnerable due to their high dependence on ecosystem services and their low capacity to reduce climate-change impacts. Trees in agroforestry systems as an ecosystem-based approach (EBA) contribute to food security in Iran in the face of climate change. Determining such strategies helps local communities to improve their economic situations and to combat poverty. This research will focus on Ecosystem-based Adaptation (EbA) to reducing climate change risks and food security in Arasbaran region, Iran. Data will be collected through interviews and field observations. We collect information on the communities’ knowledge and experiences of ecosystem services, awareness of climate change and its impacts, livelihoods, vulnerabilities and coping and adaptation strategies. We identified four adaptation strategies through field observations: changing croplands into sumac woodlands, agroforestry, changing cropping patterns, and Non-Timber Forest Products (NTFPs). Sumac income contributed about 29% to total household income. Walnut, cornelian cherry, and mulberry were the most common trees, which provided subsistence and income to households in the agroforestry system. Another adaptation strategy was emphasis on more drought-resistant crops in arid and semi-arid regions and shifting from lower economic yielding crops such as wheat, barley, and rice to crops with higher economic returns such as saffron and lentils. NTFPs were an important livelihood source during a time of climate variability with a 27% contribution to total household income.
**Thematic Session 5: Socio-political dimensions of regional development**

**Southern Caucasian students’ perceptions of Turkey**

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Recently, a significant rise in the number of foreign students coming to Turkey for their undergraduate, graduate and doctoral degrees has occurred. All universities tried to enhance their institutional capabilities to meet the expectations of these students. However, when it comes to the region of South Caucasus, there seem to be some deficiencies compared to the other regions of the world in terms of institutional capabilities. To start with, within Turkish universities and their international relations departments, except for a few research institutes, there are not many research centres dedicated to research on the Caucasian region. In other words, a lack of interest towards the region itself has resulted in difficulties in understanding the specific problems of the South Caucasian students in Turkey during their education and stay in this country. This is particularly important since South Caucasian graduates of Turkish universities will likely attain governmental, business and academic positions in their home countries, thereby contributing to the bilateral relations between Turkey and their home countries.

This study aims to measure and analyze the perceptions and attitudes towards Turkey before and after the arrival of South Caucasian students in Turkey for studies in Turkish higher education institutions. Moreover, this study also aims to put forward common values shared by Turkey and South Caucasian countries, as well as to advise on what can be done to develop cooperation in the field of education to strengthen cultural ties and, additionally, to create a social memory among regional countries. In other words, this study intends to put forward whether South Caucasian students’ perceptions of Turkey have progressively developed during their stay in Turkey.

**Development of Georgia’s pipeline infrastructure and Caucasus transit corridor**

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In modern society, effective transportation systems play a crucial role in ensuring a country’s economic well-being, providing vital assistance to the development of international and domestic trade. Transport plays an important role in socio-economic development in Georgia as well and is considered as a strategic sector of Georgia’s economy. The development of transport in Georgia during the Soviet period played an important role in the enhanced economic growth of the country, providing enrichment through its fossil wealth, expansion of economic relations with other areas of the Caucasus region, further development of urban centres, etc. A difficult situation was created in the transport sector for objective and subjective reasons in the period after the collapse of the Soviet Union and the transition to a market economy. To overcome this situation, pipeline infrastructures will play an important role in the development of foreign trade and economic relations and the integration of the Georgian economy into the world economy.

Oil and gas production in the Caspian Sea has increased. In the 1990s, the Azerbaijan and Georgia “Early Oil Project” (EOP) later became the Baku-Tbilisi-Ceyhan (BTC) pipeline project. Through the years, the South Caucasus pipeline (SCP), North-South Main Gas Pipeline (NSMGP) and Western Route Transport Pipeline (WREP) were added. These show that the number of actors and their geographic origin increased and that the whole Caucasus region has become involved.
The aim and novelty of the research is to analyze the development of Georgian pipeline transport, covering the following objectives and issues: analysis of existing modern literature around Georgian pipelines, determination and explanation of causes and consequences of the development, comparison of current trends with those of the past and determination of future perspectives. An examination of Georgian pipeline infrastructure will provide a good case study for understanding sustainable development in the Caucasus region. Being part of international infrastructural systems and transit corridors is key to Georgia’s geo-economical location. Studying pipeline infrastructure will provide information for its work and the future spatial arrangement of Georgian and Caucasian nodes.

Political geographies of Georgia’s parliamentary capital: State-building in Kutaisi

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In 2012, an important event occurred in the history of Georgia. The main legislative body of the Parliament of Georgia changed its location, moving to a new building in Kutaisi, 230 kilometres away from the capital. In January 2019, the Parliament was relocated once again, this time back to Tbilisi. Due to its great importance, the issue has not lost its actuality. Georgians often ask questions regarding the parliament. What was behind the decision of moving the parliament back to Tbilisi? What will happen to the building constructed for the Kutaisi Parliament? Were large sums of public funds spent in vain or not? What was the damage caused to Kutaisi when the Parliament was moved back to Tbilisi? This work intends to answer these questions.

The purpose of this study is to determine the impact of the presence of the parliamentary capital on a city’s development, through the example of Kutaisi. Transferring the Parliament to Kutaisi created positive expectations in the local population in terms of improvement of welfare. They had the prospect of development and progress. However, development is a long and difficult process, and Parliament’s short-term presence in Kutaisi was not enough.

The task of this research was to determine what goals were served in transferring Parliament from the administrative capital and returning it back just a few years later; and how this event influenced Kutaisi’s infrastructure and economic development, local population and the political life of Georgia in general. The paper also discusses the current function of the Parliament building of Kutaisi and its role as a monument of political architecture.

The findings and conclusions presented in the final part of the work will give us the ultimate summary of the process of transferring the parliamentary capital to Kutaisi and then returning it to the capital.

New research trends for the Caucasus mountains: A bibliometric analysis

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The Caucasus, of which a large part is covered with mountainous areas, has been an important habitat for people from past to present. Unique events and phenomena occurring in the Caucasus Mountains have been investigated by scientists over time and throughout the region. Therefore, considerable number of Caucasian studies exist in the long-term scientific literature. This research focuses on international studies about the Caucasus Mountains as a scientific object. On a macro scale, distribution of issues studied by discipline and region will be determined. The aim of the
Research is to provide quantitative data to guide new research on the Caucasus Mountains. Another aim is to discover implicit information in the literature through indicators and bibliometric analysis. Research questions included: Which themes have been studied most in the Caucasus Mountains? What has been studied by science? What is the spatial and disciplinary distribution of research and researchers? How interested are geographers in the field? A bibliometric analysis was performed to answer these questions. Scopus database, which is the largest index of peer-reviewed literature, was used for data acquisition. In the database, which contains “Caucasus Mountains” studies in “article title”, “abstract” and “keywords” sections, was searched and the results analysed. According to the findings of the research, the number of studies on the Caucasus Mountains has increased significantly in recent years. The three most important countries in terms of number of publications were Russia, Georgia and Turkey. The most widely published topics are in the natural sciences and engineering. Analysis of the works cited by the publications by source countries constitutes four different citation sets. In the last analysis, the most-used terms in the keywords, title and abstract sections of the published works were determined and an attempt was made to establish gaps in the literature.

Plenary Session 1: Climate change

The future of climate: a regional climate modeler’s perspective

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Understanding the climate system can give us a better vision of our future. However, the predictions or projections of future climate change and increasing or decreasing greenhouse gases in the atmosphere are not solely a natural scientific matter, rather, they rely on political and social behavior. Global climate models that made progress in the last 20-40 years are the only way to define atmospheric processes’ complexity, which helps everyone interested in the field. The outputs of these models are freely accessible in CMIP archives. The simulations of the observed temperature time series show the scenarios with all possible human impacts and without human contributions to the climate system. The models depict that human impact on climate change is real.

Sometimes models do not provide enough details; global models’ results are used for running a regional model. However, the central question is if these models are performing well enough to believe them. For example, Turkey and the countries represented at this forum are challenged to maintain stations in mountainous areas, which leads to a lack of data from high altitudes.

Another interesting and important fact is the hydrologic balance of regions. In Turkey, there is a substantial change in runoff. Seasonality plays a crucial factor; the lack of snow is one reason for the changing regimes of rivers.

Climate change has happened at all time scales, but the concern is the faster processes today threatening natural and human-made ecosystems. We need to have an information-based decision-making system in place with appropriate time and space scales. Helpful information and significant variables as well as extreme value statistics are essential to examine sophisticated modeling.
Climate and glacier variations in the last millennium in Caucasus in the global context

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Proxy records are useful tools for the reconstruction of past climate and environmental changes. This is important to assess the long-term natural trends and to better understand the drivers of modern climate variations. In the last decades, this field has successfully developed around the globe as well as in different regions, including the Caucasus.

At this forum, I will discuss the paleoclimatic data such as glacier fluctuations, ice cores, tree rings, buried soils, lake and peat sediments (biostratigraphy and geochemistry) in Caucasus and surrounding areas. As almost everywhere else in the world, the glaciers in Turkey are recessing, and in some places, the glaciers are rapidly retreating and even disappearing. The same trend is observed in the southern and northern slopes of the Caucasus. However, these dramatic changes in glacier sizes cannot be explained only by warming, making us think that there should be other reasons for glacier shrinkage such as, for example, the seasonal distribution of precipitation. Using tree ring dates of moraines of the Little Ice Age we identified the retreat of the glaciers in Caucasus since the beginning of the 19th century: the glaciers have lost 2 km and more and continue to retreat. The terrestrial cosmogenic isotope dating allows to extend the chronologies of glacier variations back in time and to assess the magnitude of glacier advances over the Holocene and beyond. The tree ring analyses including the study of ring width, ring density, and stable isotopes, can be used for paleoclimatic reconstructions. In Caucasus the most reliable tree-ring reconstruction is based on maximum ring density (Dolgova, 2016), while precipitation signals are identified in carbon isotopes of pine (Brugnoli et al., 2011). The ice cores (e.g. in Elbrus) provide high-resolution reconstructions of temperature, solid precipitation, air pollution, biomass burning etc. Summarizing our understanding of the climatic changes in the area we can state that the warming similar to the current temperature rise occurred in Caucasus in the late first millennium and the early second millennium AD, but the magnitude of this warming is still under discussion.

According to some modeling experiments, in the Caucasus region, rising temperatures with increased precipitation in January and decreased precipitation in July is projected.

The mountain: A gap in the Caucasus and at the global level

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I represent the findings of a series of outlooks prepared for the various regions of the world under the Inter-regional Climate Change Project. I focus on the South Caucasus (SC) region and synthesize it with the global context. The project’s central aim was to identify critical risks for vulnerable sectors and see if the policies in South Caucasian countries responded to those risks.

The damage caused from natural disasters is interpreted in several policies in three of the SC countries. The forestry sector is more likely to focus on adaptation, but other economic sectors such as tourism or energy policies lack adaptation instruments. Unfortunately, none of the policies are designed to promote climate change adaptation. However, several countries are aware of the climate change threat and are working on national adaptation plans. Looking at the gap analyses, regional cooperation on climate-related topics is essential for planning and implementing climate adaptation measures. Furthermore, there is a lack of climate monitoring networks at the national level, including historical observational data on both sensitivities of settings for these systems and unified methods for climate change assessments.
The study results in different mountain regions of tropical Andes, Central Asia Himalayas, East Africa cap and in the Balkans are similar to South Caucasus regarding climate change impact and integration of adaptation mechanism in policy documents, especially sectoral policies. Some countries recognize the problem and give importance to mountain ecosystems. For example, Georgia, Pakistan, and other countries have worked on national adaptation plans but are still missing an adaptation focus in their sectoral policies.

We will work on national adaptation policies with the mountain countries as we are already working with Georgia. The process is meant to be supported by science with specific content to mainstream the mountains and to scale up regional cooperation.

**Thematic Session 6: Climate change**

**Paleoclimate of eastern Black Sea region in Turkey and the importance of glacial lakes and the sediment record**

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To be able to make sustainable management plans, we should know the previous conditions of any region. Natural archives and their preserved proxies are used to track past environmental and climatic changes in time scales longer than instrumental records. Most of the natural archives that have been used to reveal the past come from central, south central and north-western Anatolia. However, glacial lakes and their sediment in the north-eastern part of Turkey are an untapped source of information. Here, existing knowledge from different natural archives in Anatolia and the southern Black Sea coast since the Late Glacial Period is explored as well as possible future research questions in north-eastern Turkey.

**Ice-core reconstructed winter and summer precipitation for the central Caucasus since 1774**

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A 181.8 m-long ice core was recovered at the western plateau of Mt. Elbrus, in Central Caucasus (5115 m.a.s.l.) in August–September 2009. Drilling was performed in a dry borehole with a lightweight electromechanical drilling system. Borehole temperatures ranged from -17°C at 10 m depth to -2.4
°C at 181 m (Mikhalenko et al., 2015). The ice core has been analysed for stable isotopes (δ18O and δD), major ions (K+, Na+, Ca2+, Mg2+, NH4+, SO4²-, NO3⁻, Cl⁻, F⁻), succinic acid (CH2)2(CO2H)2, dust, and tritium content (Mikhalenko et al., 2015; Kutuzov et al., 2019; Preunkert et al., 2019). Seasonal ice-core layers were identified based on the stratigraphic ammonium and succinic acid records, both exhibiting well-marked winter minima for the 1774-2009 period. The seasonal snow accumulation rate was calculated from the layer thickness record using the Nye ice flow model.

As a predictor of seasonality, we use the index of convective available potential energy (CAPE) of the atmosphere, reconstructed with ERA-Enterim reanalysis data. It is assumed that during the period of active free convection, the ammonium content in the ice core is high, and during this period one can sum up the precipitation of the warm half-year, while the period with low ammonium content is associated with precipitation of the cold half-year.

High-resolution accumulation/precipitation records were compared with meteorological data recorded on high-mountain weather stations in the Caucasus. It was shown that the relationship between precipitation on the western plateau of Mt. Elbrus and the nearest weather stations is linear and statistically significant when warm and cold seasons are allocated using the CAPE index, whereas it is almost absent without convective potential energy use.

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Thematic Session 7:  Education for sustainable development

**Understanding the societal role of universities as a precondition for implementing transdisciplinarity: An exploratory case study from Armenia**

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The concept of transdisciplinarity (TD) has been introduced to respond to real-life problems and enhance the societal role of universities. We discuss the potential for implementing transdisciplinarity in the academic system of Armenia, which is undergoing a transformation process after the disintegration of the Soviet Union. We propose that the understanding of the societal role of universities affects the
integration of transdisciplinary approaches into an academic system.

Qualitative research was carried out by analysing legal documents referring to the role of universities and conducting semi-structured expert interviews along with focus group discussions with university teachers, students, and local community members. Based on this analysis, six factors were determined to affect the understanding of the societal role of universities in Armenia: (1) perceived lack of responsibility towards society; (2) different perception of the value of academic work; (3) perception of incompetence and lack of mutual trust; (4) different understandings of the societal relevance of research and teaching; (5) missing culture of communication and cooperation between academia and society; and (6) a lack of motivation towards teaching and learning by teachers and students.

The statutory documents do not explicitly refer to TD but provide space for university-society cooperation and for integration of TD into Armenian universities. Interviews show that societal actors are ready for collaboration, but the initiative is expected to come from academic actors. We believe that the results could be insightful for universities in other Caucasian countries (i.e. Azerbaijan, Georgia, Russia), as many of them are undergoing similar transformation processes.

Implementing transdisciplinary case-study approaches in Caucasus Universities: Experiences from Armenia and Georgia

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Universities could play an important role in solving challenges relevant to society. Integrating transdisciplinary case-study approaches into research and teaching practice can facilitate societal engagement of universities, while at the same time enhancing research and learning opportunities for students and faculty.

We present our experience in developing and implementing transdisciplinary case studies in Armenia and Georgia that focused on co-creating solutions by university students and teachers, together with relevant practice and policy actors in the field of sustainable rural tourism development. Our main research questions address the challenges and opportunities of implementing transdisciplinary case study research and teaching, as well as the benefits of this approach to academia and the main case actors.

The research methods constitute qualitative analyses based on conducting the case study courses in Armenia and Georgia in 2018 and 2019, evaluating the courses via participant observation, and focus group discussions and semi-structured expert interviews with university teachers, students and local societal stakeholders.

Our preliminary results will be presented including the outputs and outcomes of each case study, the reflection of the participating students and teachers on their experiences as well as considerations with respect to the main research questions.

The study was conducted within the framework of the Transdisciplinarity for Sustainable Tourism Development in the Caucasus Region (CaucasusT) project, funded by the Austrian Partnership Programme in Higher Education and Research for Development (APPEAR). The project goal is to implement transdisciplinary approaches into the academic systems of Armenia and Georgia, specifically addressing sustainable tourism development in rural communities.
Establishing a distance-education model for disseminating the use of geographic information systems in planning in the Caucasus region

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Geographic information systems (GIS) are of vital importance to comprehend a settlement and its features for the process of making physical designs and planning. This is especially true in rapidly developing countries like those in the Caucasus region in which urban investment is significant. The features of a settlement should be analysed during the process of design, planning and decision making. It is undeniable that using GIS is essential to achieving the most effective results of an analysis. However, Caucasus region countries do not generally have public and private sector personnel with full GIS knowledge and skills. It will thus be vital to provide an opportunity for personnel to take part in designing and planning processes to be trained on GIS via distance education.

In this article, a model will be built to train people on how to use GIS by using virtual education. The main aim of this study is to develop a distance-education model to increase GIS usage capabilities of technical personnel involved in physical and environmental planning processes in the Caucasus region countries.

The main objectives to be achieved in this paper will be:

● developing a distance-education model for GIS training for planning processes in the Caucasus region,
● determining the needs of physical and environmental planning problems in the Caucasus region countries,
● ascertaining the principles for developing open courseware materials for GIS training for planning professionals, and
● determining the needs for an online distance education course management system and open course material portal.
Thematic Session 8: Pollution and safety

Geochemical composition of atmospheric aerosols in the South of European Russia

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Climate change has led to increasing desertification in the semi-arid landscapes of South Russia. The increased quantity of dust in the terrestrial atmosphere negatively affects human health. Atmospheric aerosols are an important component of the geochemical migration. The aim of this research is to determine the geochemical composition of atmospheric aerosols in the South of European Russia.

The study of air composition requires a comprehensive geophysical and geochemical approach. Key observation aerosol points are located in the forest-steppes (Kursk region), steppes (Rostov region) and in the foothill plains (Mount Strizhament) and high mountains of the Caucasus (Shatzhatmaz plateau, 2100 m a.s.l.) and South-Western Caucasus (Huko, 2000 m a.s.l.).

Aerosol complex used measurements made in the summer. The ICP-MS method determined aerosol chemistry. Natural indicators are the initial starting point. Anthropogenic influence was determined by the appearance of high concentrations and atypical chemical elements.

The differentiation of elements of global distribution shows that the maximum concentrations are typical for the dried plains of the steppe zone, where there is a maximum of plowing. However, the first wave of dust hits the foothill zone through prevailing north-western air masses (Mount Strizhament).

Elements of regional and local distribution record the features of geochemical provinces and local pollution. Anomalies of heavy metals are confined to the appearance of crystalline rocks in mountain landscapes. However, the lead pollution of Shatzhatmaz is due to anthropogenic influence on the plateau. Radioactive elements from Western transport are recorded in the steppe and foothill zones.

Thus, identification of the geochemical characteristics of atmospheric aerosols in the landscapes of the South of Russia has determined the local and regional sources of atmospheric dust and revealed the influence of the transboundary transport of substances.

Work based on the materials of research under the grant RFFR-RGS No. 17-05-41121.

Animal-vehicle collisions in the autonomous province of Bolzano, northern Italy spatiotemporal analysis

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Animal-vehicle collisions (AVCs) are a serious socioeconomic, health and traffic-safety issue all over the world. To get an overview of the AVC situation in the Autonomous Province of Bolzano-Alto Adige (Northern Italy), the local hunting association started systematic data collection all throughout the provincial road network in 2012. In the last seven years (2012-2018), 5,987 AVC events have been noted (on average 855.28 ± 100.17 per year). AVC data collected include information about the time, date and GPS coordinates of the collision as well as the involved species’ sex and age. In 86.5% of the cases, roe deer (Capreolus capreolus) were involved, while red deer (Cervus elaphus) were involved in 12.3% of cases. The remaining 1.2% of AVCs implicated chamois (Rupicapra rupicapra),
red fox (*Vulpes vulpes*) and smaller mammals. The collisions occurred mostly during or immediately after daytime with reduced daylight at dusk. The statistical method of kernel density estimation (KDE) was used to analyze the spatial distribution of AVCs on the local road network, allowing the identification of 64 significant ‘hotspots’—road sections where AVCs occur more frequently than expected. The results from KDE+ allowed for better use of limited financial resources in order to reduce the phenomenon on the most dangerous road sections. In the Autonomous Province of Bolzano, nearly 25% of the registered collisions occurred directly on, or immediately next to these hotspots, which are located on only 4% of the local road network. This information could lead in the future to science-based management, increasing road safety and decrease animal mortality in a territory where wildlife and linear infrastructures have to find a way to coexist.

**Assessing heavy metal concentrations in potatoes and beans in mountain regions using Spot 7 satellite images**

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Heavy-metal (HM) pollution of different environmental compartments remains a concern all around the world. The issue is particularly topical to mining regions and surrounding areas. To manage HM-pollution problems, the combination of traditional in situ and advanced remote sensing (RS) methods is becoming widely applicable. However, most RS research on HM pollution of agricultural crops covers vast plots of agricultural land located in different geographical areas that are flat. Consequently, there is a need to develop an RS method for assessing HM concentrations of agricultural crops typically laid out as small land plots within mountainous regions. The research goal was to develop an RS method for assessing HM concentrations of agricultural crops in the industrial town of Kajaran, Armenia. For this purpose, fieldwork was conducted simultaneously with SPOT7 image acquisition. A total of 38 samples of inedible parts (leaves) of potatoes and beans were collected (15 potato leaves and 23 bean leaves). The biogeochemical analyses were completed using atomic absorption spectrometry: Mo, Cu, Ni and Cd concentrations were determined and a database was produced and statistical analyses implemented. In order to ensure the accuracy of spectral values, SPOT7 satellite image pre-processing was done. Then raw and hyperspherical direction cosine (HSDC) normalized bands of the images were correlated with absolute contents of HM. The results show that the higher the contents of HM in plants, the higher were the spectral reflectance values in the visible spectrum, whereas in the near IR spectrum an inverse process was observed. The significant correlation (p<0.05, 0.01) was established between Cu and Mo contents in beans and green spectral band data; between Ni and Cu contents in potato and all HSDC normalized bands data. The latter allows to develop RS methods for HM prediction in agricultural crops, which was done using linear, nonlinear, parametric and nonparametric regressions and an artificial neural network (ANN).
Workshop 1: Natural disasters

Distance-learning module on natural hazards for the Caucasus

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This presentation provides an overview of some activities in the project “Strengthening Climate Adaptation Capacities in the South Caucasus: Enhancing Regional Cooperative Action for the Benefit of the Caucasus Mountain Region” (SCAC). The project aims at reducing the vulnerability of populations to climate-induced natural hazards and strengthening regional cooperation on climate change adaptation and sustainable mountain development. One of the project’s expected outputs is to increase learning and teaching capacities in higher education institutions in the domain of disaster risk management (DRM) in Armenia, Azerbaijan and Georgia. Some key activities linked to this expected output will be presented, including: i) a distance-learning module for hazard and risk assessment; ii) a comparative analysis of international practices including master’s programmes, stand-alone training courses, postgraduate diploma/certificates, open online courses, webinars and transnational academic programmes in disaster risk management higher education; iii) the background for an in-depth assessment of national higher education offer in DRM and hazard mapping in South Caucasus countries. Preliminary recommendations for teaching practices in South Caucasus will also be presented and discussed.

GIS-based multi-risk assessment of potential losses and impact to key infrastructure induced by earthquake scenario in the city of Kapan, Armenia

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Kapan, the main city of the Syunik province with a population of 45,500, is located at 900 m.a.s.l., 300 km away from the capital city of Yerevan in the south of Armenia. A large mining industry centre, Kapan is also traversed by a strategic international highway linking Armenia to Iran and through Iran to other countries. The area of Kapan is exposed to a wide spectrum of geological and associated technological hazards.
The seismic regime and the presence of active faults within the city area support both the urgency of the proposed studies and their paramount importance in view of hazard evaluations and risk reduction.

A GIS database was compiled including the results of all projects realized to address assessment of the natural and technological hazards in the area of Kapan over the last 15 years. A multi-stage methodology of damage and loss assessments was developed applying this database and based on the experience of works implemented under the international Earthquake Model of the Middle East Region (the EMME project).

City scenario damage and loss calculations were performed accounting not only for the seismic impact, but also for secondary effects and factors (high slope gradients, landslides, presence of toxic waste dumps and others). The results produced were handed over to the Ministry of Emergency Situations (MES) and the Kapan city administration. The developed scenarios served the as basis for the disaster risk reduction plan and training exercises with participation of the local MES branch and all municipal services.

Natural hazards in the Mountain regions of the Azerbaijan region and their GIS mapping

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The Caucasus mountains are characterized by the occurrence of hazardous contemporary endogenous and exogenous processes such as earthquakes, mud volcanoes, rockfalls, screes, avalanches, mudslides, flooding, etc. Desertification, wind erosion, reduction of glacier and water basin size, landslides, mudflows etc. have been active in recent decades as well. Hazards of geomorphological origin can be emphasized in particular. Natural hazards are classified for their geographical coverage, duration, impact, effect and degree of impact.

Natural and anthropogenic factors define hazards. Endodynamic activity in certain geological blocks is a key factor defining the balanced development of geocomplexes in the Caucasus. As for anthropogenic impact, it can be remarked that from the 1960s until the early 1990s, the landscapes of foothills and low mountains were degraded at a higher degree due to the expansion of vineyards, grain fields and orchards, while the forests in the middle-mountain and low-mountain areas have not been subjected to intensive cutting. In more recent decades, intense deforestation has been observed following the movement of huge numbers of flocks towards the alpine- and sub-alpine meadows of the Greater Caucasus. Mountain slopes without vegetation have been extended in the medium and upland parts of the Greater Caucasus. Seismicity, rockfalls, landslides and mudflows are typical also for the Lesser Caucasus of Azerbaijan and parts of the Talysh mountains.

The results of the studies on natural hazards were mapped in GIS. The developed maps show morphodynamic stress, landslide processes and hazards, mudflow hazards etc. The total area of landslide-prone plots in Azerbaijan has been determined to be more than 4,000 sq. km. Data on settlements subject to landslides in Azerbaijan are shown.

A total of 13% of the territory of Azerbaijan (over 10 sq. km) is shown to be under the influence of hazardous natural processes including: flooding hazard (700 km²); mudflow hazard (1,300 km²), seismic shift hazard (6,518 km²); heavy snowfall and avalanche hazard (400 km²), and rockfall hazard (150 km²).
Landslide risk in the mountainous areas in Turkey

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Landslide risk is much higher in some mountainous areas in Turkey than in others. The largest number of landslides is in the Black Sea region and specifically in the mountainous areas of the Eastern Black Sea sub-region. Geological and climatological features are the main natural factors that are implicated in high landslide risk in these areas. However, anthropological interventions, e.g. roads and buildings, can also affect landslide occurrence. Landslides that are close to settlements can cause material damage and death. These landslides usually affect narrow areas, while some landslides affect very large areas. Factors such as population growth, urban expansion and climate change increase this risk further.

The purpose of this paper will be to explain the factors causing landslides in the Black Sea region in Turkey with the help of examples and to discuss the risks of landslides and measures that may affect large settlements in particular.

Modelling of stochastic processes implementing various combinations of dangerous meteorological phenomena in the Caucasus mountains

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The mountainous regions of the Caucasus are characterized by an exceptional variety of dangerous meteorological phenomena that often cause significant material damage and human losses. These dangerous meteorological phenomena often occur simultaneously, which exacerbates the situation. For example, increased wind can occur during heavy rains, fog during blizzards, hurricanes with hail, etc. To reduce the negative effects of such phenomena, it is necessary to know their probabilities in given areas.

The following combinations of meteorological phenomena are most dangerous for the mountainous regions of Caucasus:

- Catastrophic rainfall + hurricane wind (R50-Hu)
- Catastrophic rainfall + dangerous fog (R50-Fd)
- Hail + hurricane wind (Ha-Hu)
- Hail + dangerous fog (Ha-Fd)
- Hurricane wind + dangerous fog (Hu-Fd)
- Snowstorm + dangerous fog (B-Fd)

These meteorological phenomena are independent of each other and therefore the physical process of their occurrence has a stochastic nature which can be investigated as a random process based on the well-known probability theorems of multiplication and addition:

\[ P(AB) = P(A)P(B) \text{ and } P(A+B) = P(A) + P(B) - P(AB), \]

where A and B are meteorological phenomena and P is the probability.

Using these theorems, the stochastic process of realizing various combinations of dangerous meteorological phenomena in the Caucasus mountains is modelled. For the Caucasus mountains, the most likely event is the occurrence of snowstorm, hurricane wind or hail in combination with dangerous fog. The occurrence probabilities of one of the complex events, the probability of the joint implementation of both events and the periods of risk recurrence are identified.
Thematic Session 9: Mountain development prospects and local population identity

Ethno-cultural aspects of the problem of socio-economic development in mountainous territories of Dagestan

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The consequence of the mass resettlement of residents of the high mountain regions of Dagestan to the Caspian lowlands since the 1920s and the increasing growth rate of the urban population since the 1950s became factors in the lessening of the anthropogenic impact on mountain landscapes. In the circumstances of the total ethnic mixing of the population on the plains and in the cities of Dagestan, the highlands are the primary factor in the preservation of particular ethno-cultural identities. The depopulation of the highlands can thus have serious consequences on ethnic and cultural assimilation. In order to improve the socio-economic development of mountain areas, a programme called “Social and Economic Development of Mountain Territories of the Republic of Dagestan for 2014-2018” was adopted. However, the programme did not define mechanisms for its implementation, nor did it provide for specific measures aimed at the sustainable development of these territories.

It is necessary to solve the problem of the economic turnover of abandoned mountain-terraced arable lands and garden plots, to strengthen the material and technical base of producers by providing small-scale mechanization (mini tractors, tillers, mowing machines, etc.), to create consumer cooperatives, and to revise the price policy for higher quality, ecologically pure mountain agricultural products. Equally important are restoring the traditional foundations of animal husbandry, terraced farming, expanding gardening and traditional crafts; and creating a full-fledged social infrastructure (road networks, communications, transportation, gasification, energy supply, etc.). Without advances in areas such as these, a socio-economic revival and development of the mountain areas bringing the quality of life of mountain residents in line with that of plains residents will remain impossible.

Undoubtedly, the implementation of these measures will contribute to overcoming negative trends, weakening the depopulation processes in high mountain regions, and ensuring the socio-economic and cultural revival of the peoples of Dagestan.

The potential of religious identity for the sustainable cultural development of the multi-religious Caucasus region

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The sociocultural and political processes that took place in the North Caucasus at the end of the last century led to a change in the role and place of religion in the system of social relations. Through religion, a significant part of the population seeks to revive the traditional values and moral foundations of society today. The actualization of religious identity has been a natural consequence of the transformation of the socio-political system. Religious identity appears as a highly concentrated expression of a person’s worldview, the quintessence of the most pressing issues of their “life world”.

Religious identity is one of the possible paths for the spiritual correlation of oneself with other people on an individual level. However, the growth of religious identity is characterized by the spread of
religious extremism—a kind of reaction to forced modernization. For the Caucasus, this is a serious problem, whose solution is associated, inter alia, with the development of religious identity.

It is necessary to use the value potential of religious identity in view of the emerging new reality in Russia. Many of the established forms of religion in the past clearly do not fit into modernity, but the content, value meaning and consonance with the present suggests a rethinking in the context of a multi-paradigmatic approach. The impact on ethno-social processes should be based on an appropriate ideology aimed at identifying the unifying bond of cultural diversity and strengthening the unity of polyethnic Russian regions.

Politics in the country and regions should be aimed at understanding the value of patriotism, which is the unifying factor for Russian ethnic groups and the Russian nation. Patriotism, it seems, will help to shape the idea that “We are Russians”, while maintaining the ethno-cultural orientation and confessional diversity, which, in turn, will contribute to the sustainable development of the Russian regions.

Focusing the work of sociocultural institutions on the understanding that the interrelationship of pan-Russian ethnic and religious identities in modern Russia would be based on new value-ideological orientations that are formed on the basis of civic culture, while preserving sociocultural diversity. In this regard, it is relevant to encourage the formation of ideas about the constructive role of this relationship as a mechanism for overcoming tensions in a multi-ethnic and multi-confessional region. It seems that such work can and should be carried out by the country’s elite, provided that science and politics are combined.

Ethnic diversity among populations living in the north-eastern Caucasus part of Azerbaijan

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The favourable landscapes and climate conditions of Azerbaijan have served as the main motivation for the settlement of various nationalities in these lands over many centuries. The Guba-Khachmaz economic region covering the north-eastern slope of the Greater Caucasus is one of the regions where ethnic variability has been clearly observed. The ethnic minorities such as Tats, Lezgins, Jews, Khinalugs, Turks, Gryz and others are settled in this territory. We carried out research on the ethnic origin of populations living in the Guba-Khachmaz region. Our analysis revealed that 98.3% of all Tats, 62.9% of all Lezgins, and 30.8% of all Jews living in Azerbaijan are to be found in this region alone. Azerbaijanis are the majority in all administrative units of the region except Gusar district where they comprise 67.6% of the total population. The rest are Lezgins (21.6%), Tats (5%), Jews (0.6%), Russians (0.2%), and other ethnic minorities (5%).

The Lezgins are the second largest ethnic group in the north-eastern Caucasus after Azerbaijanis, who live mainly in Gusar, Guba and Khachmaz districts. Lezgins comprise 2% of the population of Azerbaijan and 22.5% of the population of this region. Their number by district is 73,278 (90.6% of population) in Gusar, 26,248 in Khachmaz, 9,312 in Guba, 180 in Siyazan, and 105 in Shabran district.

Jews live mainly in the Gyrymyzy Gasaba settlement of Guba district. The historical settlement of Gryz is Dag Gryz village, which is also located in Guba. The Gryz communities live in 26 villages of the Khachmaz district. Tats comprise 5% of the population of Guba-Khachmaz region and mainly live in Khachmaz, Guba and Shabran districts. According to the 2009 census, their number in Guba district is about 13,880.

Changes occurring in the population of the above-mentioned ethnic minorities of the north-eastern Greater Caucasus are identified and explained in this study.
Plenary Session 2: Management of mountain ecosystem services

Applying the Biosphere Reserve concept in mountain areas

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Biosphere reserves (BRs) are designated under the UNESCO Man and the Biosphere (MAB) Programme as “sites of excellence to explore and demonstrate approaches to sustainable development on a regional scale” with suitable governance arrangements. Each BR is a region with a strong identity, and must have three types of zones: “core areas” are existing legally protected areas; adjacent to these are “buffer zones”, with clearly-defined boundaries, where only activities that are compatible with the conservation objectives of the core area should take place; and the “transition area” is devoted to sustainable development and is where most of the inhabitants live. BRs have three functions: biodiversity conservation, sustainable development and the logistic function of research, monitoring, education and training, all of which support and inform the other two functions. The designation of a BR is beneficial for the region and the country as a whole. Apart from the quality assurance and strong identity, it gives recognition to the region. In order to deliver the functions of BRs, there is a need for effective partnerships among local administrations, businesses, people, communities and authorities. Moreover, it is essential to support the processes with science.

There are currently 714 biosphere reserves in 129 countries, two-thirds of these (475) are in mountain areas with 190 in Europe and North America, 119 in the Asia-Pacific, 91 in Latin America, 48 in Africa, and 27 in the Arab states. In the last few years, there have been a number of projects in the South Caucasus countries with the aim of creating the first biosphere reserves, which would support progress towards the Sustainable Development Goals.

An ecosystem services approach as a tool to inform decision-making towards sustainability: Progress in the Carpathian region

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The origin of the concept of ecosystem services dates back to so-called “nature services” (also called “environmental services” or “ecological services”). The concept of “ecosystem services” emerged during the 1970s and gained increasing recognition in the following decades in science and international environmental policy. The methodological approach to the ecosystem services concept was based on the theory of ecological economics. Ecological economics is the study of “ways of choosing rational ways of production of material goods in conditions of limited natural resources, unlimited needs and unstable (dynamic) conditions of natural living environment” (Tunystya, 2006).

Working with ecosystem services generally is not possible without involving local communities. In the Carpathians region, the project was successful because of an active local community that includes young volunteers, local NGOs, and local volunteer organizations that work in taking care of the environment. During the project, we collected data about which forest products in the Ukrainian
Carpathians are more important and essential for the local population. We analysed provisioning services at the local level, assessing what is used. The most attention was given to non-wood forest products (mushrooms, berries) as a typical forest product for the local people and we also concluded that they play a more important role as traded products for cash. In some periods, these products contribute considerably to family budgets, specifically in some marginal villages. At the same time, such products are an important part of ethnic culture and traditional forest knowledge.

It is very important that this idea of ecosystem services becomes a part of the decision-making process. We as scientists should pay more attention to its advancement and implementation. There is a lot of research that confirms this. One of the new Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) reports entitled “Key knowledge gaps to achieve global sustainability goals actually mentions ES as one of the key components. Decisions should be based on science. We should be collecting a large amount of data on ecosystem services. Otherwise we will not make the right decisions as we would be ignoring something important in policy decisions without the recognition of the full range of benefits and costs associated with actions that affect those services. More interaction should take place between scientists, stakeholders and researchers to understand ecosystem service concepts in practice.

Integrated biodiversity management in the South Caucasus

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Challenges to biodiversity are global but particularly prevalent in the South Caucasus. Rising pressures on natural resources are related to the economic growth agenda, which in itself is understandable from the perspective of national development. In particular, demand for energy and raw materials puts pressure on the environment. At the same time, unfortunately, governments also have to deal with poverty throughout the region. In addition, the ongoing political transformation makes the creation of strategies, policies and practices for an integrated management of biodiversity challenging.

In our work, we promote the exchange of experiences on integrated biodiversity management between Armenia, Azerbaijan and Georgia. Our work is part of the Environment Programme of the German Government cooperation in the South Caucasus. It contributes basically to the EU approximation agenda of three countries of South Caucasus. As official development assistance, our direct political partners are the governments, specifically environment ministries, with whom we promote the improvement of framework conditions. The mainstreaming of biodiversity into different sectors is a precondition for the sustainable development of the countries. Beyond that, we also partner with subsidiary organizations, the civil society and the private sector. In order to create good examples, we work on the local level where we pilot approaches for integrated biodiversity management. Those are different in the three countries, depending on the respective conditions. An important part of our work focusses also on awareness-raising campaigns. In addition, we cooperate with universities and colleges in order to support formal education on biodiversity in related sectors.

In order to give you a better understanding of our work, I am going to present one aspect of our work in Georgia in more detail, where our cooperation focusses on the forestry sector. More concretely, we support the implementation of the forest sector reform that Georgia has embarked upon. Now let us look into one specific part, the establishment of a forest information monitoring system for the sustainable management of the country’s forests. Our partner is the Ministry of Environment Protection and Agriculture of Georgia. The objective of our activity is to obtain reliable data about forest resources and enable the efficient use of this data for a sustainable and biodiversity-friendly close-to-nature management. An important part of the system is a regular national forest inventory, which is the systematic assessment of forest resources of Georgia with regard to quantitative and
qualitative aspects. This forms one of the most important data layers of the information system and will enable decision making about strategic directions of the forest sector development of the country. At the same time, we also work to improve the forest management planning system in the country. And all of these go closely together with our general approach to capacity development. We work very closely with NGOs and universities, especially in the framework of the national forest inventory, which is basically scientific work, but also with companies to develop capacities in the private sector.

What should come out of it, in the end, is that Georgia can make strategic decisions for an important sector of the country, after all 40% of the country is covered by forest. Forests are important for rural livelihoods and play an important role in the sustainable economic development of the country.

In Azerbaijan, the focus of our work is on biodiversity-friendly agriculture and in Armenia, integrated landscape management, including sustainable pasture management. The countries of the South Caucasus are quite lucky to have rich natural ecosystems, such as forests. Our focus here is to work on preserving these natural ecosystems, but of course, by enabling also a sustainable use.

In the future, we will continue to focus on improving the availability of data on biodiversity in all three countries, improving the legal framework on biodiversity friendly land-use, focus on piloting sustainable land use practices in all three countries and information and education.

**Thematic Session 10: Landscape transformation**

**The role of anthropogenic factors in the transformation of Lankaran zone biomes**

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Understanding the nature and amount of land cover change is important among land use planners and environmental scientists because these changes are one notable source of global environmental problems with deep and disturbing impacts on ecological, hydrological and soil evolution and on society at large. These changes usually have an obvious anthropogenic source, but several ecological and geographic variables such as industry, fossil-fuel use, and transportation also influence the nature and magnitude of these changes. Land transformation, habitat degradation, and fragmentation are typical processes that cause the transformation of biomes in Lankaran province, Southern Azerbaijan. In this perspective, the study of the problem of anthropogenic landscape transformation is necessary and practical.

**Change of soil surface and ecology of the Gobustan area as a result of mud-volcano influence: Investigation of the dynamics of landscapes on the basis of vegetation indicators**

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A third of the world’s mud volcanoes are spread throughout the Caspian Sea. Many are found in the Gobustan settlement. Mud volcanoes attract tourists with their aesthetic appearance but their activity has negative impacts on the environment and as a result leads to changes of soil surfaces, the atmosphere and a deep transformation of the landscape of the area. The eruption products of
mud volcanoes significantly affect the soil surface. The territory is rich with clay rocks that lead to high evaporation due to the wide capillaries in clay. The rate of salinization is rapid and has already reached high levels. The salt layer formed on the soil surface is winnowed by blowing wind whose speeds reach 4 m/sec. This leads to environmental pollution of nearby areas. As a result of the complete water withdrawal analysis of samples extracted from the area, it was determined that CO$_3$, HCO$_3$, Cl, SO$_4$, Ca, Mg salts were present. According to the sample results, we can say that compounds consisting of sodium sulphur and chlorine are found throughout the area. As a result, the soil has an above normal salt content and soils are devoid of plants.

Investigation of the dynamics of landscapes on the basis of vegetation indicators

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The dynamics of landscapes in the highly populated Kura River Basin were studied based on the change in the nature of the surface cover using the normalized difference vegetation (NDV) index. During the study, vegetation was thus considered a key indicator. The NDV index was compared with Landsat 5 and 8 satellite data for different years (14 June 2002 and 9 June 2019) to determine anthropogenic changes. Acquired materials were processed in ArcGIS version 10.3 and maps showing the NDV index for the relevant periods were made. In the end, these maps were compared, as was the area of the territories reflecting the performance of the index, and the impact of anthropogenic factors on the dynamics of landscapes was analysed.

Kura River is used both in irrigation and for drinking water throughout the country. Tugay forests have existed along the Kura river, however, as a result of anthropogenic impact, the area of these forests has diminished.

The study area covered 1,764 km$^2$, extending 255 km along the Kur river. The area extends from Mingachevir Reservoir to Carli village of Kurdamir district. The study area was divided into five sectors, each covering a distance of 50 km along the river for a clear view of the dynamics of landscapes.

The first 50-kilometre sector along the Kura River continues from the Mingachevir reservoir to the settlements of Eymur and Arabshaki villages of Agdash district covering 387 km$^2$. The second 50-km sector includes 390 km$^2$ up to the Bichagchi settlement of the Zardab district. The third 50-km sector continues to the village of Allahkulubagi, covering 320 km$^2$. The fourth 50-km sector continues to Seyidlar village covering 272 km$^2$ and the last 50 km covers 395 km$^2$. Areas with an index of 0.2–0.5 during the compared periods have doubled. These areas correspond to cultivated lands and show that the anthropogenic load has increased in the landscape over the past 17 years.

Transformation of high mountain landscapes on the Greater Caucasus

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The landscape-ecological systems of the southern slope of the Greater Caucasus region are characterized by a complex land structure. The complex tectonic-geological structure of the area shows vertical and horizontal disintegration. This is reflected in the uniqueness and diversity of the
landscape-ecological systems of the region and their adoption by humans.

Landscape complexes of the southern slope of the Greater Caucasus have been subjected to strong anthropogenic loading as a result of the activity of local residents and entrepreneurs. Although a number of legal and administrative measures have been taken by the government of Azerbaijan in nature protection, the use of nature in mountainous areas is not effective. The lack of modern technology and the low level of environmental culture involved in the interaction of people with nature have led to dramatic changes in the natural complexes of the region. Natural destructive processes (sliding, flood, erosion, avalanche, etc.) have intensified, biodiversity has diminished, natural-historical boundaries of forests have changed, soil degradation has occurred and so on. As a result, less sustainable natural-anthropogenic complexes have formed.

Thus, the ecological situation in the southern slopes of the Greater Caucasus draws attention to the comprehensive study of the anthropogenic change of natural landscapes, in particular, the elaboration of sound measures to restore degraded natural-terrain complexes.

The role of static and dynamic factors in the eco-geomorphological regionalization of relief (North-eastern slope of the Lesser Caucasus)

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Located between the Khram and Zeyam Rivers on the north-eastern slope of the Minor Caucasus, the total area included in the research was 2,358 km².

Relief is an essential factor shaping land use, making the eco-geomorphological assessment of the area very important. The influence of a relief’s static and dynamic factors on ecological conditions was analysed on the basis of a conception of the environment as a function of relief. We first studied the structural-lithological, morphological and morphometric (horizontal and vertical dissection of relief, slope of surface, exposition of slopes) features of relief and their influence on ecological conditions. We also explained the influence on the ecosystem of endodynamic and exodynamic processes, recent and current tectonic movements, the mobility of magmatic bodies, fluvial processes, gravitational processes and karst processes of morphogenesis. The results of the analyses’ estimation of eco-geomorphological tension was accomplished in Arcmap 10.4 and regioning of studied territory was carried out. In the same eco-geomorphological tension region, there is a limited range of tension areas of varying degrees. The tension in the endogenous and exogenous relief-forming processes and low morphometric indicators in the region where eco-geomorphological tension is poorly evaluated gives a basis for a high resistance of the relief to outside forces and, therefore, the eco-geomorphological point of view to relatively hazardous or weak tension. The regions are divided into weak (36%), mild (24%), moderate (35%), and high tension (5%) areas.
Invisible footprints of rapid tourism development: the evidence from high mountains of Georgia

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The ongoing international interdisciplinary research project "Linkages between tourism and community-driven economic activities: Shaping sustainability in mountain regions (2018-2020)" serves the primary aim of studying the spatial and sectoral inclusiveness of mountain residents’ economic priorities in the tourism supply-chain to promote the establishment of relevant linkages and synchronized development of economic fields in mountainous Georgia. The project was launched by Ivane Javakhishvili Tbilisi State University (TSU) in close collaboration with the Justus Liebig University, Giessen, Germany (JLU) and is generously funded by the Shota Rustaveli National Science Foundation.

The project applies a qualitative research approach in which information was collected using the triangulation method involving focus group discussions, in-depth interviews and focused interviews with target groups made up of various local stakeholders. This complex qualitative study was carried out in Mestia municipality, which is among the most visited tourist destinations in mountainous Georgia.

The paper argues that despite significant positive inroads in overall tourism development, a controversial reality can be observed in mountainous Georgia. Particularly, economic domains such as agriculture, retail, etc., which should be growing in tandem with tourism to chart an inclusive development course, do not enjoy the same expected growth as does the tourism sector. Hence, signs of fragmented development are revealed that are expressed in the minimal coexistence or even the full alienation of these economic sectors. This significantly hinders the expected improved economic welfare of local residents and, day by day, reduces the perspectives of creating a sustainable socio-economic environment.

Based on the denoted phenomenon, the paper will consider the spatial peculiarities and barriers of the integration processes of local, community-driven economic activities with the local tourism supply chain. Importantly, the research is based on a synthesis of mainstream approaches with traditional methods of collecting and analysing information.

Second-home tourism in the eastern Black Sea region of Turkey: Development issues and mobility patterns

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This study explores the development issues and mobility patterns of second-home tourism in the eastern Black Sea region of Turkey, one of the most important regions in second-home tourism areas in the mountains of Turkey. The subject of second-home tourism in mountainous areas is subject to an important literature gap in Turkey that we hope to remedy. The sample of the study included 30 yaylas in the eastern Black Sea region. A total of 60 digital TIFF-format monoscopic aerial photographs were interpreted to show that second homes are increasing in the area. The distribution of second homes in the area was mapped using ArcGIS 9.3 software. The primary data was collected by conducting surveys with second-home owners and visitors in the area. Questionnaires were conducted with a total of 900 second-home owners and 280 visitors selected.
by cluster and convenience sampling during July 2010. According to the results of the study, second home ownership has increased in the area over 30 years. Second-home owners generally come to the area in May and June and most leave the area in September. They therefore spend 91-120 days in the region. Their main motivations to acquire a second home in the region are the beautiful landscape and weather conditions. According to the results of the visitor survey, visitors mostly come to the region to visit their relatives and friends. Most of them (75.4%) stay in second homes that belong to their relatives and friends. They usually spend 7-10 days in the region. Istanbul, Giresun and Trabzon have the highest number of residents that visit the provinces. Second homes constitute an important accommodation supply in the region. Second-home demand in the region is gradually increasing. Investigations show an increase in the number of buildings in the yaylas from 5,380 in 1973 to 8,210 in 2004 for a mean rate of increase of 152.6%. Accordingly, economic, social, cultural and environmental impacts are also increasing. For example, while road networks, tourism and recreation, new job opportunities and women’s employment have increased, livestock has decreased, noise and air pollution has increased, ecosystems have been damaged and traditional rural lifestyles have changed. The pattern of the movements of second-home owners and visitors provides useful information for planning. The results obtained from the study will be useful to determining second-home development and movement for mountainous areas.

**Socio-economic and spatial aspects of tourism industry development in Georgia: Case study of the Samegrelo region**

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This paper deals with the main characteristics of sustainable tourism development in Georgia, with a case study of the Samegrelo region. Tourism and its development are a very important component of the modern world, especially in the economies of the developing world.

For the last two decades, tourism has been considered one of the priority sectors of Georgia’s economy. The main factor has been a variety of tourism resources, ranging from the most beautiful natural conditions to very interesting anthropogenic tourism resources.

The purpose of this work is to reveal the main trends in the development of the local economy. For this purpose, theoretical approaches for local economic development and tourism are identified. We also have the results of research conducted in Martvili and Tsalenjikha municipalities.

I will discuss the main theories that are connected to tourism and economic development, tourism and sustainability, regional tourism and the well-being of the local population. In addition, based on the analysis of conducted research and theories in academic literature, I would like to emphasize the main trends that are shown in parallel with the growth of tourism in the country. The survey results will help us to answer the main question: How does tourism development affect the wellbeing of the local population?

Summary of theories and research can help us to conclude that the development of tourism in Samegrelo region did not bring significant benefits to local populations. In addition, we will also see that the steps taken by the government in the direction of tourism are less likely to respond to the principles of sustainable development.
**Primary problem identification for sustainable tourism development in destinations**

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Over the last decades, tourism has become one of the leading industries in Georgia in terms of generating income, compensating the country’s trade deficit and employing the local population. However, tourism lacks development in the mountain regions of the country. On-going re-development requires new approaches to encourage the industry’s sustainable development.

The purpose of this study is to apply the method of trans-disciplinary research to identify interrelated core problems hampering sustainable tourism development. The research employed a case study approach. The method was tested at the mountain resort of the Caucasus-Tsaghveri (Borjomi Municipality).

The study revealed four categories of destination-related problems: leverage, critical, buffering and restricted. The outcome of the analysis serves as preliminary information for the problem-solving strategy as well as for making decisions on rational development of destinations. The research gave opportunities to the involved parties to develop the skills of participatory research to structure responses to complex problems.

**A GIS-based, multi-criteria decision-making approach for ecotourism site suitability evaluation in the Arasbaran protected area, Iran**

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Today, ecotourism is a major tourist activity around the world. Since uncontrolled ecotourism, similar to any other kind of development, can have negative effects on culture, economy, environment and even the security of eco-tourists, it is necessary to identify and prioritize potential ecotourism sites. The Arasbaran protected area, a mountainous area in the northwest of Iran, has high potential for attracting ecotourists due to its pristine nature and biodiversity. This study developed a spatial method for evaluation of ecotourism potential using geographic information systems (GIS). First, the effective criteria were chosen according to a literature review. Standardization of the criteria was conducted using suitable fuzzy functions and the weights of the criteria were derived through the analytical hierarchy process (AHP). In the next step, criteria were combined using the Weighted Linear Combination (WLC) method to reveal the suitability of ecotourism. Eventually, for land zoning according to ecotourism value, the module of Zonal Land Suitability (ZLS) was applied and around 37 zones were introduced for ecotourism as a study area. The result of this study showed that the most suitable ecotourism area of Arasbaran protected area is an area of 6.45 percent (5200.62 ha) with attention to pixels with suitability above 200. Overall, the results revealed that the multi-criteria
Thematic Session 12: Biodiversity

Thematic Session 12: Biodiversity

Taxonomic diversity of Desmidials from the North-eastern Slopes of the Greater Caucasus mountain range in Azerbaijan

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This article presents the results of algological studies in the Guba district, located on the north-eastern slopes of the Greater Caucasus mountains on the border of the Azerbaijan Republic. Despite the fact that there is information about algal taxonomy in various regions of Azerbaijan, a majority of the country has yet to be explored extensively. No such studies have been conducted in the Guba region to date. Algae are used as bio-stimulating organisms to determine the state of the freshwater ecosystem and to monitor water quality. The main purpose of this scientific research is taxonomical identification of algae species (Cyanophyta and Chlorophyta) from different freshwater ecosystems of the region.

Algal samples were collected from different continental water bodies (rivers, wetlands, mineral and thermal springs, waterfalls, lakes and etc.) in different villages of Guba district during frequent visits between 2016 and 2018. Sample collecting was carried out by common methods accepted in phycology. Species were determined according to morphological features, such as cell shape and size, structure (unicellular, filamentous or colonial), end of cells etc. Identification of samples was done based on modern taxonomic approaches with relevant identification books and monographs.

According to the results of systematic investigations of freshwater algae of the surroundings in Guba district, the following blue-green algae species from the genera Anabaena, Nostoc, Scytonema, Gloeocapsa, Microcystis, Oscillatoria, Phormidium, Lyngbya, Coelosphaerium, Merismopedia, Synechocystis, etc. and green algae species from the genera Spirogyra, Zygnema, Closterium, Cosmarium, Draparnaldia, Stigeoclonium, Pediasstrum, Selenastrum, Cladophora, Ulothrix, and Uronema.

The breeding status of Velvet Scoter (Melanitta fusca) in Georgia

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The first-ever survey of all seven potential breeding lakes for Velvet Scoter (Melanitta fusca fusca) in the Javakheti plateau region of southern Georgia found that nesting was confined to just one traditionally occupied site, Lake Tabatskuri. Intensive observations revealed that c. 25–35 pairs were present at Lake Tabatskuri from mid-May to mid-June in 2017 and 2018, but substantially fewer pairs actually nested at the lake, and all those that did so built nests on the only island in the lake. Hatching success (65% of eggs successfully hatched in 2017, 51% in 2018) was lower than the
67–92% found in studies of the North American white-winged scoter (Melanitta deglandi). Fledging success in Georgia was 29% of hatched ducklings surviving to fledge compared to 5–10% in North America and 30% in Finland, suggesting challenges to the long-term perpetuation of the population. More research is required to determine the direct causes of the scoters' poor overall reproductive success. Information from a questionnaire survey of local residents and observations made during the study suggested that interactions with Armenian Gulls (Larus armenicus) nesting on the islands, disturbance and removal of eggs by humans, and drowning of ducklings in active or abandoned fishing nets all contributed to poor overall reproductive success. Conservation actions to ameliorate some of these factors have already been initiated, but further research, monitoring and conservation is needed to safeguard for future generations this tiny disjunct population at its last location in Georgia, potentially in the entire region.

**Study of an endangered species of yew (Taxus baccata L.) in different conservation situations in Arasbaran forests, Iran**

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One of the most important conservation actions that can be taken in disturbed forests is the development of enclosed areas that can substantially impact the structure and composition of vegetation. Yew is one of the most important and threatened tree species in the Arasbaran region in north-western Iran. One of the main goals of forest management plans is to maintain the natural structure of stands. Therefore, we assessed the structural characteristics and composition of yew forest communities using the nearest neighbour and full callipering methods at three sites with different management histories. Within a one-hectare sampling area, tree species' identity, diameter, height, and crown diameter were measured. In each of these sampling areas, 56 sample points were surveyed in a 25 m × 25 m grid for tree species' identity, diameter, height, and distance of reference to neighbouring trees. To quantify the structural characteristics in areas of different conservation status, some indices were calculated including mingling, distance to neighbour, diameter and height differentiation, uniform angle, and Clark Evans. The average height of yew trees at the long-term sites (coded as SKA and SVA) was about 5 meters. These trees were located in the lower layer. However, in the short-term site (SKU), yew trees were approximately the same height (4.04 m) as other trees (4.3 m). Results revealed that four species – hornbeam (68%), maple (8%), yew (7%), and oak (5.2%) – composed 88% of tree species. The majority of trees had a low distance (2–3 m) between neighbours. The mean DDI for long-term and short-term conservation areas was 0.59 and 0.06, respectively. The uniform angle index showed that there was no class value 1 at all three sites. In the long-term enclosed area, the Clark-Evans index was 1.18 while in short-term enclosed areas, it was less than 1 (0.82). At all sites, yew trees were in the least vital class. The results of this research showed the conservation effects on yew stands in long-term and short-term conservation periods, which helps to provide effective and useful conservation solutions. Reducing tree density and basal area of other species will lend strength to yew trees in the studied sites. However, because yew trees need moderate light conditions, excessive decreases in the tree density can be detrimental.

**Morphological boundaries among Caucasian Rock Lizard species (Darevskia genus)**

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Rock lizards of the genus Darevskia (Arribas, 1999) are a genetically diverse group mostly found in the Caucasus Mountains. It is difficult to delimit the four closely related Darevskia species due to a high degree of morphological similarity and overlapping identification characteristics. Once they hybridize, individuals with intermediate morphology and genetic characteristics are found (Tarkhnishvili et al., 2013). As a result, it is difficult to assign individuals to distinct species. This is particularly true for...
traditional methods such as qualitative morphometrics where multiple measurements of the body and scales are compared. In a recent publication (Gabelaia et al., 2018), we showed that 3D geometric morphometrics (GM), i.e. the inclusion of the integral shape of the head, provides better results but still fails to define the morphological boundaries associated with genetically defined species of *Darevskia*.

We assume that the skull shape, which is distinct from the head shape, is more species-specific and conservative for delimiting species’ morphological boundaries. The skull shape is less prone to homoplasy than the scalation pattern involved in the external head shape analysis, which is highly variable in *Darevskia*. We plan to conduct landmark-based and landmark-free GM analyses (following the approach of Pomidor et al., 2015) on 3D skull models of the different *Darevskia* species to see if the skull shape is more powerful in delimiting the species boundaries, at the same time comparing the two GM methods.

**The ichthyofauna of separate reservoirs of the Republic of Armenia and factors influencing its formation**

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In the territory of Armenia, there are around 85 reservoirs currently being exploited, and the ichthyofauna of most of these reservoirs, such as Tavush, Joghaz and Ayghedzor, has not yet been studied. The water from these reservoirs flows into the territory of neighbouring countries and into the Kura River.

The goal of this study is to investigate the ichthyofauna composition and conduct the identification of the main factors of its formation.

A total of 599 fish individuals belonging to ten species, captured from Tavush, Joghaz and Ayghedzor reservoirs, were collected for this study over the period 2015-2019.

In all three reservoirs, the dominant species are limnophile species (*Carassius gibelio*) and those that are suited to both river and lake conditions (*Capoeta* sp., *Pseudorasbora parva*). Other species (*Alburnoides eichwaldi*, *Barbus cyri*, *Squalius ahdamicus*, *Alburnus filippii*, *Cyprinus carpio*, *Sabanejewia aurata* and *Cobitis derzhavini*) that are most common in river conditions are found in small quantities, above all, they are to be found there where the river flows into the reservoir and the level of oxygen and other hydrological conditions are better.

One of the reasons for such a widespread expansion and acclimatization of fish is the large development of reservoir constructions as a result of which the changes in river water and thermal regimes are evident. This, in turn, makes unfavourable conditions for the native rheophile species which are currently gradually disappearing, yielding to the acclimatized eutrophic species.
Workshop 2: The role of universities in sustainability transformations in the Caucasus region (Boku University)

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Universities in the Caucasus countries can and should play an important role in facilitating sustainability transformations in the Caucasus region. Enhancing cooperation between science, policy and practice and providing opportunities for co-creation of knowledge between academic and non-academic actors are important steps towards ensuring the active contribution of universities towards the sustainable development of the region. The Scientific Network for the Caucasus Mountain Region could potentially facilitate this process.

The aim of the workshop was to discuss challenges and to highlight ways towards strengthening the role of universities in the sustainable development of the Caucasus region.

The workshop consisted of statements from the panellists, representing various sectors from the six countries of the Caucasus region, followed by a panel discussion involving all workshop participants. The panellists were invited from each Caucasus country with various levels of experience and knowledge of different aspects of the science policy-practice interface.
Plenary Session 3: Sustainable tourism

Experience of the Alpine region and sustainable tourism development

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From the second part of 19th century, British people coming to the Alps with the aim of enjoying their time created services such as accommodations, guiding systems and transportation in Alpine regions. Mass tourism simultaneously created both resistance and forces in tourism development. Nowadays, everyone in the Alps wants to invest in infrastructure, tourism management and innovations. The Alps have a new promising market in Chinese tourists who will be beneficial to the local economy. However, this new population is not necessarily promoting sustainable transportation. Around 80% of tourists come by private car and less than 10% by trains. The Alps have 500 million overnight stays plus 60 million day tourists every year whose expenditures make up 10-15% of the regional GDP, but the real issue is the unequal geographical distribution of tourist visits.

Emissions are one of the challenges for Alpine tourism and are estimated to double by 2030/2037, leading to the risk of climate change. The impact of climate change on tourists has already started. Snow reliability is decreasing, winter comes later every year, and the locals have to invest in artificial snow production. Another challenge is food waste. Between 20% to 60% of all purchased food is going directly to waste. Compared to all the other industries in Europe, working conditions are not good in the Alps. There is a huge gap between male and female workers and childcare options are very limited. Another issue is limited accessibility for people with special needs. Only 1% of hotel rooms meet the needs of wheelchair users.

Today, there is a lot of EU funding for new projects and cross-border alliances create original approaches for Alpine tourism and regional development. Projects concentrate on niche products, game watching, hiking trails, national parks and architecture in order to gain credibility among the tourists and benefit the local economy. Some networks like “Alpine pearls” are looking for sustainable transportation solutions and this is very promising. However, there is a need for strategies in which sustainability is the main focus and not only a marketing tool. Tourism in Alpine regions needs to implement sustainable development goals as well as political strategies. Moreover, the key to success is governance models and intensive public participation in these processes.

Nature in living culture/transboundary tourism products reflecting South Caucasus

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Before describing how South Caucasus colleagues from three countries created products that can be sold on niche markets, we must start with the definition of “ecotourism”. This is no longer simply being in nature and taking time to reflect in the outdoors, enjoying beautiful landscapes. It also refers to conservation. Without community we cannot do anything. The third element is interpretation. Recently the global ecotourism network redefined ecotourism, noting that it is the same approach for visitors and hosts as well, because sustainability is for everyone.

The cooperation between three countries, Georgia, Azerbaijan and Armenia, started with WWF/TJS support. The approach was to identify the importance of ecotourism in and around protected areas in the South Caucasus. The general findings were that tourists do not want to just see nature, they
want to be a part of the culture and community.

After much research in transboundary, biodiversity-based tourism products, we saw how people conserve nature, we saw the balance between intangible culture and nature, and we created the slogan “Wind of Diversity” for transboundary tourism products based on the leopard’s habitat. But the main approach was storytelling about nature and culture in the South Caucasus. The interpretation was diversity of nature and flora, cultural heritage, opportunities for adventures, local craftsmen, communication between three countries, legends, personal stories of families.

“From mountains to the villages” in cooperation of GIZ was created to strengthen mountainous communities in Armenia and Georgia and diversify already existing tourism hotspots suffering from overtourism.

**Thematic Session 13: Natural Disasters**

**Proposals for geophysical investigations of landslide bodies and counter-landslide measures: The example of the Republic of Armenia**

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In mountainous areas, the sustainable development of populated areas requires the study of geological hazards. High-gradient relief of mountain slopes facilitates landslide development. The study and mapping of landslide bodies and recommendations on counter-landslide measures are important to ensure quality of life for populations and environmental protection.

Landslide hazard areas exist in all countries of the Lesser Caucasus. Armenia has more than 3,000 landslides that have not been properly studied and the country does not have permanent monitoring networks. Landslides are often activated by abundant precipitation and manmade constructions and other factors. A recent example was the abrupt landslide activation recorded in the Toumanian community of Lori Marz on 12 January 2018. Landslide activation threatened the M6 international highway linking Armenia to Georgia and a roughly 200-m-long railway section. Moreover, damming of the Debed River was likely. After the Armenian Ministry of Emergency Situations received an emergency call, a joint group composed of ministry staff and experts of the Institute of Geological Sciences of Armenian National Academy of Sciences was dispatched to the site.

The landslide body was mapped on site by means of a drone survey and the motion of its scarp was documented as corresponding to vertical and horizontal dislocations of 0.7 m and 0.3 m, respectively. The task was set to evaluate and identify the sliding plane of the landslide body, as well as any likely causes of the activation. A complex of geophysical methods was applied to address the problem.

The techniques of micro-tremor measurements, seismic prospecting based on the multi-channel analysis of surface waves, electrical prospecting by vertical electrical sounding and geo-radar...
Surveying were applied in the course of complex geophysical studies of the landslide body. The data produced by the studies were processed by means of both qualitative and quantitative analysis. At the next stage, the results of the geophysical studies were cross-correlated and conclusions and recommendations were formulated and on that basis.

The complex investigation enabled identification of weathered, crushed and water-saturated zones within the site that were mainly associated with the landslide body activation. The thickness of the identified zones varied, ranging up to 30 m.

The sliding plane was identified based on the complex geophysical data and the landslide body section was plotted. Locations for drilling and water diversion activities were proposed considering the geological and geophysical data.

Survey of landslides and debris flow hazards in the Upper Svaneti region, Georgia

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In Georgia, the Upper Svaneti region is unique with its natural landscapes, architecture, ethnographic and historical-cultural monument diversity. This region is also one of the most important centres of mountaineering and tourism. In addition, this region has been made particularly vulnerable to such natural geological processes as mudslides, snow-glacial avalanches and landslide-gravitational processes, whose periodic activation has a serious effect on the local population, infrastructure, environment, ecology and most importantly, on human life. Recently, geological disasters and their activation have been caused by climate change, high anthropogenic pressure on the geological environment and regular earthquakes. From the point of view of intense manifestations of spontaneous geological processes, the region of the Upper Svaneti (Municipality of Mestia) stands out among the regions of Georgia. The Enguri river basin with high mountain relief and complex geological structure, climate-meteorological conditions and anthropogenic scales all affect the geological environment. For the entire national territory and the Upper Svaneti region, monitoring and forecasting of dangerous areas is conducted annually by Geology Department staff of the National Environmental Agency. Based on the monitoring system and modern research methodology, the mapping of landslide and mudflow hazards zones for Upper Svaneti region has been conducted.

Investigation of flooding event impact on territorial planning using the remote-sensing method in the Shaki district

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The Shaki region located in the northwest of the Republic of Azerbaijan covers 2.8% of the country’s territory (243,000 km2) and contains 1.86% of the population (184,200 people). In Azerbaijan’s geographical division of labour, Shaki region contributes silk fabric, folk art, food production (peanuts, halva), grain and tobacco cultivation and so on. The Shaki region also has repeated flood events that cause extensive damage to the economy in Azerbaijan. For this article, we carried out comprehensive research about flooding processes and their destructive influence on territorial planning of Shaki region, in particular, their impact on industry, agriculture, transport systems and social infrastructure.

Natural and anthropogenic factors involved in the formation of floods in Shaki, flood damage to the region’s economy and measures taken against them were thoroughly analysed in the paper.
People are unintentionally damaging nature in order to make more profit from the environment. As a result, people contribute to increasing flood events. Neutralization of damaging flood events on human settlements and the territorial organization of production requires scientific studies.

In this article, we tried to determine the impact of flooding processes on the territorial planning of Shaki region by using the following techniques:

1) Collection and analysis of statistical data
2) 1:100,000-scale topography maps
3) Comparison of methods between 30-year territorial planning maps and current maps
4) Remote sensing
5) Spatial analysis
6) Analysis of satellite images

Flood-risk assessment in the mountain rivers of Azerbaijan:
The example of the Zayamchay basin

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Flood risk management in mountain rivers is one of the current issues that have been subject to complex studies such as on the Zayamchay Basin with the use of statistic and field-investigation data, hydrometeorological monitoring results, various assessments and comparative analysis methods. Within the research, concrete proposals for preventive measures, monitoring, notification and predictability issues were given. At the same time, current problems in flood risk management were reviewed and various possible solutions proposed. The reasons for floods were investigated thoroughly and climate impacts on the flow of the Zayamchay River were studied. In addition, thematic maps in different scales were prepared and maps of flood-vulnerable zones and flood risks were compiled. The maps have been composed according to hazard categories of floods that occurred in the relevant time intervals on the basin (low, average, high and extreme).

Evaluation of flash-flood risk of Tbilisi antrum rivers

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The intensive production of agricultural and engineering activities of the population on the territory of Tbilisi has led to violations of the natural hydrodynamic and morphodynamic regimes of the rivers that existed over centuries. During this time, there were different negative impacts on the environment. All this contributed to the increase of catastrophes caused by natural disasters, which were reflected in the natural or material damage caused to the city and population. We can recall many similar instances in history.

The steep slope of the riverbeds, caused by the form of relief in the Tbilisi antrum, facilitates rapid movement of water and other masses accumulated therein. Especially during intensive rainfall, there is a danger of flows coming from these valleys. In intense rain, sometimes it is impossible to contain the water flow within the riverbed, and its overflow can result in damage to inhabited territories with an increased water mass.

This article covers possible risks, assessing rarely repeated exceptionally powerful floods and flash floods in the ravines of the Dighmistskali, Gldanula and Varaziskhevi rivers, all belonging to the hydrological system of the Tbilisi antrum, also identifying potentially endangered housing and infrastructural facilities in flood-prone areas.
Thematic Session 14: Sustainable energy

The creation of a geographical information database of solar energy distribution in Azerbaijan

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This research is devoted to the creation of a national Geographical Information Database (GID) of Solar Energy (SE) distribution in Azerbaijan using a new model and analysing its economic advantages. To provide for the increasing electricity demand for the world population, electricity production using SE that is renewable, clean, and environmentally friendly, is a new and developing field in Azerbaijan, considered profitable from both economic and social perspectives.

In fact, in practice, former consumers are gradually becoming producers. People either provide for their own electrical demand in part or in total or become vendors of their excess electricity. The increase of such consumers in the electricity sector is important in terms of securing the country’s electricity system, ensuring its sustainability and supporting continual improvement.

However, this process also brings a number of requirements such as awareness on the part of electricity-production entrepreneurs. Although there are various GID, like maps and several atlases describing SE distribution in Azerbaijan, they do not fully cover modern solar technology needs in geographical and mathematical aspects.

One of the essential challenges to obtaining benefits from this unlimited renewable resource is to create a reliable, durable, convenient, easy-to-reach, easy-to-understand GID for users. If an entrepreneur decides to get electricity from the sun, they should be able to choose a suitable geographical location, determine SE facilities’ direction(s), economic benefits of this electricity, the amount of potential energy, and other dynamic climate factors. The advantage of the above-mentioned model is that it uses astronomic, climatic, and digital-elevation modelling data of the area simultaneously to calculate daily, monthly, and seasonal SE potential at any point.

The research consists of two stages: the first stage was the creation of a GID by using dynamic data obtained using the model and mapping the SE Atlas, the second stage is the evaluation of economic and social benefits.

Aspects of climate change and power engineering interrelationships and the role of renewable resources in this context: The example of Georgia

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The special role of power engineering when considering climate change is due to its universal character and its impact on virtually all spheres of the economy. In addition, power engineering is the largest emitter among economic sectors. Current climate changes are considered to be caused by anthropogenic factors, namely by intense industrial activity, and power engineering is at the basis of any industrial process.

We consider the two directions of the interrelationship between climate and power engineering: problems created by power engineering for the climate system and challenges for power engineering generated by climate change. These two processes are tightly bound to each other: development of power engineering increases greenhouse gas emissions that cause climate change, while climate
change increases energy consumption and thereby power engineering faces additional challenges since it requires more energy resources. Taken together, this poses an energy security problem worldwide with great force.

In our opinion, this task can be accomplished only in the case of the wide use of renewable resources. Energy consumption would grow in that case while greenhouse gases would not be emitted. This problem would then be solved through the development of flexible sectoral policies.

The contemporary status and prospects of the development of non-traditional, renewable alternate energy sources (solar, wind energy, geothermal waters and biomass) will be considered in the article through the example of Georgia. In particular, we will deal with the newest innovative devices operating on geothermal waters producing heat and cold using liquid sorbents.

Drone mapping for a dam: A detailed geological investigation in the Caucasus region

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The Caucasus region, as a segment of the alpine oceanic mountain system, has gone through a long and complex evolution that has created diverse units of different ages, types, sizes and genes in an earlier alpine origin era. The Caucasus mountain region is characterized by large-scale disasters such as landslides, flooding and rockfalls. The relief of the area is one of the main components of the geological environment. On the one hand, it is the basis of every kind of engineering and, on the other hand, it is a founding factor of modern exogenic processes and their development and intensity. Remote sensing, 3D-mapping or manned aircraft are often too expensive to use, therefore, the advantage of drone mapping is its simplicity and multifunctionality.

In Georgia in the last 10 years, the construction of dams has increased significantly due to mountainous relief and to the fact that rivers have energy to generate electricity.

The aim of the research is to show the possibility of drone mapping to study the following issues for a detailed geological investigation for dam site selection:

- geological toposheet
- the area with reference to geology
- rock types
- structural geology of the area
- seismic data of the area
- natural hazards
- geomorphological study
- preparation of geological map of the area in detail
- detailed engineering of geological properties of the area
Thematic Session 15: Climate change impacts on biodiversity

Changing alpine plant communities and soils in the Teberda Nature Reserve under climate change conditions

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Climatic and plant community changes have been noted in the alpine belt of the Teberda Reserve (the northwest Caucasus) in the last decades. The increase of average monthly temperature in the summer months between 2006 and 2018 was 1.8 – 2.2 ºC above temperatures from 1966-1990. For the last 13 years, the minimum temperature in July and August did not fall below -1.8 ºC whereas in 1966 –1990 it could fall to -7.0 ºC. A significant increase of low shrub with ericoid mycorrhizal symbiosis (Vaccinium vitis-idaea) in the plant community of alpine lichen heath has been noted at the same time. As ericoid mycorrhiza is characterized by high enzymatic activity capable of transforming and mobilizing soil organic matter, we assume that the appearance of Vaccinium vitis-idaea in grass ecosystems can change soil properties and influence neighbouring plant species with arbuscular mycorrhiza or non-mycorrhizal species. To confirm this hypothesis, we study how Vaccinium vitis-idaea influences soil and vegetation characteristics when it appears among the alpine lichen heath. Comparison of vegetation structures of grass/forbs community within plots with and without Vaccinium vitis-idaea showed their high similarity. Though participation of some dominating species (Alchemilla caucasica, Oxytropis kubanensis) considerably differs, occurrence of the majority of the dominating types (Anemone speciosa, Antennaria dioica, Campanula tridentata, Carex umbrosa, Carum caucasicum, Festuca ovina, Helicotrichon versicolor, Trifolium polyphyllum) remains high at both sites. Two species (Campanula tridentata and Carum caucasicum) demonstrate a decrease of δ15N, indicating some change in nitrogen nutrition. The differences in soil properties in the presence or absence of Vaccinium vitis-idaea, in general, meet expectations of soil organic matter mobilization by enzymes of ericoid mycorrhizal fungi. Increased concentrations of extractable organic and microbial biomass C and N and their enrichment by nitrogen and higher microbial activity demonstrate increases of nitrogen availability to soil microorganisms in the presence of Vaccinium vitis-idaea.

Impact of trophic status and climate change on the benthic community in Lake Sevan, Armenia

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Artificial water-level declines and eutrophication radically changed the ecosystem of Lake Sevan. During 1928–2018 the values of primary production of the lake (VPPL), which includes phytoplankton
production + phytobenthos production, varied between 2.4 and 31 mJoules m⁻²/year. Meanwhile, the energy equivalent of biomass (BZ) varied between 13 and 119 kJ m⁻² and gross production (PZ) of zoobenthos varied between 18 and 240 kJ m⁻². Strong positive dependencies of BZ and PZ from VPPL were revealed. Similar dependencies were revealed separately for Chironomidae, Oligochaetae and detritophages.

The above-mentioned equations were used to estimate the development of zoobenthos under the different trophic conditions: oligotrophic, mesotrophic and eutrophic.

Significant climate change has been observed in the last 80 years. From 1935 to 2012, the annual mean temperature increased by 1.03 °C. The climate change projections for Lake Sevan are for an increase of mean annual water temperature by 0.5 °C in 2030, 2 °C in 2070 and 4 °C in 2100 against the baseline 9.4 °C. The temperature factor Q10 = 2.25 was used to adjust growth and production rates for water temperatures differing from initial ones.

Observations revealed that in conditions of Lake Sevan, an order of magnitude increase of VPPL (from 3 to 30 mJoules m⁻²/year) resulted in an elevenfold increase of the gross production of zoobenthos. Meanwhile, temperature increases of 0.5 °C, 2 °C and 4 °C will increase the rate of zoobenthos production (PZ/BZ) by factors of 1.1, 1.5 and 1.9, respectively.

Bearing in mind the above statements, the measure required for mitigation of the consequences of climate change on the Lake Sevan ecosystem is keeping the trophic status of the lake as low as possible, and should include:

- prevention of penetration of organic material of agricultural, industrial and communal origin into Lake Sevan; and
- prohibition of any activity that involves the release of organic phosphorus or organic nitrogen directly into the lake.

A bioclimatic characterization of high-elevation habitats in the Alborz mountains of Iran

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The Alborz mountains in Northern Iran at 36° N rise from the Caspian Sea to reach 5,671 m.a.s.l., with warm-temperate, winter-deciduous forests in the lower montane belt in northern slopes, and vast treeless terrain at higher elevations. A lack of rainfall (ca. 550 mm at high elevations) cannot explain the absence of trees. Hence, which parts of these mountains belong to the alpine belt is an open question. Here we use bioclimatic data to estimate the position of the potential climatic treeline, and thus, define bioclimatologically what is alpine and what is not. We employed the same miniature data loggers and protocol that had been applied in a Europe-wide assessment of alpine climates and a global survey of treeline temperatures. The data suggest a potential treeline position at ca. 3,300 m.a.s.l., that is ca. 900 m above the upper edge of the current oak forest, or 450 m above its highest outposts. The alpine terrain above the climatic treeline position shows a temperature regime comparable to sites in the European Alps. At the upper limit of angiosperm life, at 4,850 m.a.s.l., the growing season lasted 63 days with a seasonal mean root zone temperature of 4.5 °C. We conclude that: (1) the absence of trees below 2,850 m.a.s.l. is clearly due to millennia of land use. The absence of trees between 2,850 and 3,300 m.a.s.l. is either due to the absence of suitable tree taxa or the fact that the only potential regional taxon for those elevations, Juniperus excelsa, had been eradicated by land use as well; (2) these continental mountains provide thermal life conditions in the alpine belt similar to other temperate mountains; and (3) topography and snow melt regimes play a significant role in the structure of the alpine vegetation mosaics.
Climate change effects in the mountain regions of the North Caucasus

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Changes in the boundaries of high-altitude mountain belts can be treated as a proof of climate change. These changes were caused by the termination of human activities. The paper presents the role of climatic factors in changes of the boundaries and state of sub-alpine landscapes in the North Caucasus where a transformation of land-use systems was observed. Weakening and even termination of economic activity, population outflow and abandonment of the mountain grasslands make marginality a many-sided problem of mountain regions. These processes are occurring in the background of climate change. The estimate of changes in heat and humidity was made for the mountains of Central Caucasus using the normalized difference vegetation index (NDVI), the vegetation conditions index (VCI), the sum of active temperatures (air temperature above +10 °C) and precipitation. Methods of remote sensing and mapping of vegetation indexes (NDVI, VCI) prove that there is a trend to increased humidity from the beginning of the 21st century in the mountain grassland areas studied. In the middle mountains of the North Caucasus, regeneration of natural boundaries of altitude zones is observed: the expansion of the mountain-forest belt and restoration of pine forests on the southern slopes; restoration of mountain meadow steppe and steppe sub-alpine meadows on former agricultural terraces; northern slopes overgrown with crooked birch. Thus, climate change and weakening economic activity on the territory lead to restoration of vegetation in the area of the middle mountains. Climate change with positive consequences for the mountain landscapes can be one of the opportunities to overcome some aspects of marginality of the territory.

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Workshop 3: Caucasus SDI

Development of spatial data portal with open source data for the Caucasus region

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One of the biggest problems for researchers who want to analyse a region with spatial analysis tools is getting the relevant information and material about the region. This is a problem especially for researchers who want to research relatively less studied regions like the Caucasus region. In this study, a spatial data platform (SDP) that will assist the researchers to gather the needed data of the working area will be presented. The data will be gathered periodically through both open-source data sources or licensed sources (for which users have licenses) and will be stored in the portal for future use. When a researcher tries to fetch data from the portal, the portal will produce either actual
satellite photos or list time-based satellite photos or the actual data of region or a time series of data of the region, regardless of user choices. Also, the system will automatically produce some basic analyses such as NDVI, NDWI, NDMI, NBR etc. for the user-selected region. The most important aim of this study is to present a base map and base data of the Caucasus region to researchers through a simple and user-friendly portal. The studies for the development of such a portal have started and continue.

Establishing a landscape information system model for the Caucasus region using the Mil Valley as a case study

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Rapid advancements in technology have facilitated research and studies conducted on human interactions with nature. One of these technologies is geographical information systems (GIS). The rich and beneficial tools and functions of GIS software have become inevitable assets for planning processes. GIS helps gather, store and manipulate spatial data quickly, precisely and accurately for planning purposes and thus supports the realization of more rapid, accurate and rational analyses and decision-making when compared to traditional planning processes.

The Caucasian landscapes present a heterogeneous territory with rare diversity as well as rich natural and cultural characteristics. Precisely determining the varying landscape characteristics of the geographical context is crucial to making sustainable land-use decisions. Therefore, it is vital to develop an efficient model that will provide a platform for capturing the scientific data required for the analysis, planning and protection of natural and cultural landscapes of Caucasia, especially the Mil Valley. The “Mil Valley Landscape Information System Model” is aimed at the evaluation of the physical landscape characteristics of Mil Valley via landscape analyses. The model proposed for Mil Valley is supposed to present a sample model for all Caucasian landscapes.

This study focused on the realization of landscape characteristic analysis of Mil Valley and development of the Landscape Information System Model. Natural, physical and cultural data (geology, geomorphology, soil, vegetation, land cover, historical patterns etc.) of the study area were gathered, organized and edited in a GIS environment. Remote-sensing capabilities were also utilized. The findings and the results of the study were also evaluated and discussed so that the methodology of this study can be used as a basic model for further similar studies.
Multi-temporal analysis of the ecological state of Lake Sevan based on remote-sensing, geochemical and bioindication methods

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High mountain lakes, which are often a resource base for recreational development in mountainous regions, have undergone significant changes in recent decades. These changes, primarily caused by anthropogenic impacts on lake ecosystems, may be multidirectional in different parts of the water area, especially in landscapes with a high degree of coastal development.

Lake Sevan is the main source of water in Armenia, providing great development of irrigated agriculture and hydropower. Problems have arisen, however, with the use of lake resources from the age-old reserves of its waters. In the process, the lake water level has been lowered and there has been a significant deterioration of the ecological status of the lake. The short-sightedness of the idea of large-scale use of the lake’s resources is evident and has led to a radical change in its natural conditions. In order to preserve the lake and restore its disturbed ecological balance, a number of water-management measures have been initiated and implemented with the aim of slowing and suspending the lowering of the lake level and later increasing it. The problem has acquired new meaning in terms of restoration of water quality and lake ecosystems, protection and rational use of the natural resources of the lake basin and the integrated use of water resources of the entire region. The idea of using the waters of the lake arose mainly from the need for the development of energy and agricultural irrigation. The availability of the lake waters was evident as was the high command position of the lake over the Ararat plain and the surrounding foothills and the large age-old water reserves of the lake and its hydrological features.

The purpose of this study is to develop new methods for assessing the ecological status of mountain lake waters using remote sensing data of ultra-high spatial resolution and adaptation of existing remote methods for assessing the state of coastal landscapes and water areas of mountain lakes in conditions of high anthropogenic (recreational) influence.

The study is based on space imagery from satellites WorldView2, SPOT 5/6, Resurs-P, Kanopus-V, materials taken from the International Space Station (ISS), archival materials, aerial photography and data obtained from the UAV, combined with other cartographic data sources, including digital topographic maps, land use maps, statistical and literature data.
Ecological and geochemical state assessment of components of the transformed landscapes in the lake’s water area and coastal zones was carried out using various indicators: coefficients of technogenic concentration of chemical elements in surface waters, the total indicator of pollution by the poly-element association of heavy metals, coefficients of radial differentiation and local migration of elements.

Bioindication studies are based on the registration of findings of characteristic (indicative, or representative) organisms and analysis of the species structure of biocenoses. The surveys were carried out according to the standard methodology officially adopted by the Russian Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet). Zooplankton communities are used as bioindicators. During the field work, qualitative and quantitative samples were taken to determine the species composition and dominant complex of this ecological grouping.

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Detection of spatiotemporal changes in agricultural landscapes using satellite images

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Land degradation is a major problem for agricultural landscapes in Azerbaijan. Long-term use of excessive irrigation methods resulted in an intense increase in water tables, which in turn caused salinization of lands and loss of fertility in upper soil zones. Salinization occurs due to intensive flood irrigation that increases the groundwater table and connects deep salty land ground layers with soil surfaces. The problem is worsened by a lack of environmentally sound solutions.

This study aimed to use remote-sensing techniques to assess soil salinization and degradation in the left bank coastal areas, primarily the Shirvan plain of Azerbaijan. Application of historical satellite images clearly shows temporal changes in salinization areas and confirms that an increase in salinity and extent of salinization resulted in land degradation. Satellite images taken from the same areas clearly show “whitened areas” in intensively irrigated places which is a clear indication of the salinization in the plains (non-mountainous areas). Using these images, it is possible to assess the scale of salinization and detect the most important areas with respect to water-induced degradation. Different pictures may effectively show gradual changes in soil conditions and a surface survey would help to identify the causes of these degradations.

The study results may be used in soil remediation and melioration activities. This will considerably reduce costs of assessments and very expensive melioration activities.

Automatic surface temperature mapping in ArcGIS using Landsat 8 imagery: A case study of the Ajinohur lowlands and surrounding areas

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Landsat 8, the latest satellite from the Landsat series, has provided many possibilities to study land processes using remote sensing. In this study, an attempt has been made to estimate land surface temperatures (LST) over the Ajinohur low mountainous and surrounding areas using Landsat 8 Operational Line Imager (OLI) and Thermal InfraRed Sensor (TIRS) satellite data. The variability of retrieved LST has been investigated with respect to normalized difference vegetation index (NDVI)
values for different land use/land cover (LU/LC) types determined from the Landsat visible and near infrared (NIR) channels. The present study focuses on developing an ERDAS IMAGINE image-processing method using the Landsat 8 thermal imagery of band 10 data.

The temperature maps have been constructed in ArcGIS software based on the images obtained from the Landsat 8 satellite. It was determined that in June 2017 the temperature was 15-25 °C in the western part of the research territory and 30 °C and above in the east. It was impossible to accurately determine the temperature due to cloudiness in the highest area of Ajinohur and surrounding areas. In semi-desert landscapes, the temperature is above 30 °C, in plain forests 15-30 °C, in arid forests 15–25 °C. In dry steppes, the temperature differs. In western areas, the temperature is 15–30 °C, the eastern part, 30 °C. At the beginning of September, the temperature indicator was above 20 °C. In semi-deserts, it is 30–35 °C, on the shore of Ajinohur lake it is above 35 °C, in the western part of dry deserts 35 °C and in the eastern part, 30–35 °C. In arid forests, it is 20–35 °C. The temperature in December was -13 to +19 °C. This indicator varies depending on landscape types, in arid forests -13 to +5 °C, in plain forests 5–10 °C, in dry steppes and semi-desertic landscapes it is 5—15 °C. Temperature and precipitation also affect vegetation cover. We used NDVI maps in the constitution of temperature maps for the investigated territories.
Thematic Session 16: Natural disasters II

Space-borne SAR-based techniques, a powerful tool for land surface change analysis

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The occurrence of natural and man-made hazards is on a steady rise and the reduction of the associated risks represents a challenging issue worldwide. In this work, we show the relevance of remote-sensing techniques as tools for supporting disaster risk management providing repeated Earth observations over large areas with high/moderate spatial resolution. Indeed, the mapping and monitoring of land surface changes are not easily performed with traditional in situ technologies that usually provide point-wise measurements at significant costs and whose results are not suitable for long-term investigations at a regional scale. With this respect, space-borne sensors represent an important breakthrough owing to their spatial coverage, short revisiting time and high spatial resolution, providing up-to-date data covering wide areas in unprecedented detail. In this work, we mainly focus on the use of satellite data acquired by active microwave sensors, in particular synthetic aperture radar (SAR) sensors from the ‘first generation’ (e.g. the European Space Agency ERS-1/2 and ENVISAT) to the second generation of SAR systems (e.g. the Italian COSMO-SkyMed and the German TerraSAR-X), to the more recently launched Sentinel-1 constellation of the Copernicus programme that provides free-of-charge data with global coverage.

We present examples of application of SAR amplitude and phase-based techniques to the analysis of different phenomena (e.g., landslides, subsidence, floods, wildfires) occurring in different environmental settings (e.g., Italy, Turkey, Spain), showing the capability that such remote-sensing techniques to provide relevant information on land changes and surface deformations in high-risk regions worldwide.
Natural hazards in the mountain regions of Georgia, the example of the Upper Svaneti

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For most countries of the world, protecting the population from geological disasters, maintaining ecosystems and safe functioning of engineering-economic structures has become the most important social-economic, demographic and ecological challenge. Georgia is particularly vulnerable to this problem, since mountainous relief covers 70% of the territory. Upper Svaneti region, located on the south slope of the Central Caucasus has 35% of its territory at up to 1000 m altitude, and 65% above 2000 m.

Upper Svaneti mountains are unique with their natural landscapes and diverse architecture, ethnographic and historical-cultural monuments. This is one of the most important centres of mountaineering and tourism in the country. In addition, this region has become particularly vulnerable to such natural hazards as mudslides, snow-glacial avalanches and landslide-gravitational processes, whose periodic activation has a serious effect on the local population, infrastructure, environment, ecology and most importantly on human lives. From the 1980s to the present, several dozen families have become eco-migrants in the historical areas of the Upper Svaneti.

The last occurrence of a natural disaster was observed on 5 July 2018 in the Nenskra river basin in the Tchuberi community (municipality of Mestia). Strong floods and mudflow processes developed in the mountain gorge, accompanied with high temperatures in the territory of Georgia and heavy rains in the Okrila River mountain gorge. Mudflows created in the mountain gorge of Okrila river (right tributary of Nenskra river), temporary blocked and dammed the Nenskra river. Overflow of the Nenskra river caused damage to nine villages of the Tchuberi community. Dozens of houses, power lines, roads, bridges and other infrastructure were damaged and destroyed. The damage inflicted in one day by the disaster exceeded seven million Gel.

Tectonic activity in the Javakheti Volcanic Highland

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The Javakheti Volcanic Highland, located in the central Caucasus, is part of the Arabia-Eurasia continental collision zone. This area is characterized by increased seismic activity and volcanism and diffuse earthquake distribution. In this study, source mechanisms of earthquakes using digital waveform data recorded by seismic stations of the Armenian, Georgian, and adjacent seismic networks have been investigated. Analysis of the distribution of focal mechanisms demonstrates present-day tectonic activity in the study area. The solutions of the different mechanisms vary between strike-slip, thrust, and normal, but are predominantly thrust. Normal faults with minor strike-slip components have fault planes trending in the NE-SW direction. The events characterized by thrust fault mechanisms are related to the zone of active faulting within the study area, trending NE-SW. The strike slip (SS) faults primarily trend in the N-S direction.
The events characterized by SS-faulting mechanisms largely occurred in the northeastern part of the study area, along both sides of the Javakheti Ridge where there are supposed faults. Note that the events with normal faulting mechanisms are concentrated within the Javakheti Ridge area. This indicates that SS mechanisms can be linked to the supposed faulting activity, while normal faulting mechanisms can be linked to the volcanic activity in the Javakheti Ridge area.

The kinematic compression (P) and dilatation (T) axes of fault planes have been determined to be dominant sub-meridian directions for P axes and sub-horizontal directions for T axes. According to the orientations of P- and T-axes, the region experiences NE-SW compression and NW-SE tension.

Evaluating the role of forest vegetation in the erosion and loss of main nutrient factors in soil

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Soils containing different nutrients like nitrogen, phosphorus and potassium (NPK) are one of the most important terrestrial resources. Soil erosion is a natural phenomenon that has been accelerated by human activities. Erosion results in loss of soil nutrients and organic matter and impacts soil fertility. The main objective of the present research is to evaluate erosion-induced soil nutrient NPK loss in Shahed Forest Park of Malayer City, Western Iran. For this purpose, work unit maps were prepared in the study area based on GIS overlay of digital thematic maps and NPK were measured in non-eroded areas (control points) and eroded areas. Then using the MPSIAC method, erosion and sedimentation rates in each working unit were calculated and nutrient loss on eroded and control areas were compared to measure NPK. The results showed that the specific erosion average in the study area corresponds to 3.25 t/h, which is less than the world standard (5 t/h). T-tests and Mann-Whitney U tests showed that NPK values differ significantly in eroded and non-eroded areas, reflecting the role of erosion in nutrient loss. Also, results showed that annual losses of NPK nutrients as a result of soil erosion are approximately 7.47 kg per hectare and for the whole study area corresponds to 1,112 kg. This implies the role and contribution of forest cover to prevent erosion and nutrient loss.

Study of near-surface active fault structures in the regional compression and extension zones of the Lesser Caucasus: The example of the active Pambak-Sevan-Syunik fault

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As a consequence of a collision between the Eurasian and Arabian plates, folding zones have developed mainly in eastern Anatolia and the Caucasus. A high rate of seismicity is typical for such sites. Respective orientations of the regional compression and extension forces in the Lesser Caucasus are north-south and east-west. The Pambak-Sevan-Syunik Fault is among the main active faults of the Lesser Caucasus, originating in north-western Armenia and continuing to the southeast up to the Iranian border. The fault is composed of segments that are located within the zones exposed to the impact of versatile regional forces. During the study, the Fioletovo and Syunik segments of the active Pambak-Sevan-Syunik Fault, respectively located in the regional zones of compression and extension, were investigated. The purpose was to study near-surface tectonic
structure elements in the regional compression and extension zones of active faults. The studies were conducted by means of geological and geo-radar surveys. The near-surface tectonic elements of the Fioletovo and Syunik segments of the active Pambak-Sevan-Syunik Fault were identified and mapped. The contribution of the regional compression and extension forces in the process of formation of those structures was analysed, and the tectonic settings for the development of the Fioletovo depression were clarified. For this purpose, the north-eastern slope of the depression was studied and a fault was identified there. The presence of this fault supports the suggested pull-apart basin-type structure of the Fioletovo depression. The results of the study will enable upgrading of the accuracy of the seismotectonic model, eventually leading to reduced rates of seismic risk and hazard.

Thematic Session 17: Rural development in mountain regions

Eco-corridors Fund for the Caucasus: A case study on linking landscape conservation and rural development in the South Caucasus

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The WWF Caucasus Programme Office has been implementing the Eco-corridors Fund for the Caucasus (ECF) programme in the South Caucasus (Armenia, Azerbaijan, Georgia) from 2015 to the present, with the financial support of the German government. The purpose of the programme is to establish and secure connectivity between protected areas within Priority Conservation Landscapes as identified by the Ecoregion Conservation Plan for the Caucasus. This is to be achieved by funding ecologically sustainable land use without reducing the incomes of the local rural population.

The ECF offers pilot payments for ecosystem services related to biodiversity conservation to the local communities in one pilot Conservation Landscape in each country. A total of 19 long-term (7 to 10-year-long) conservation agreements will have been signed with community-based organizations representing villages that traditionally use such land that covers around 83,000 ha. Payments are based on habitat management plans, including measures selected from a menu of conservation measures, agreed upon and performed by the locals. These measures aim at conservation of species and habitats, but at the same time strengthen the economic and social capital of the rural communities.

The preparation of the conservation agreements involved a combination of setting conservation priorities using Habitat-suitability modelling methods from conservation science and of empowering and mobilising local communities using a financially participatory approach method rooted in critical pedagogy. By combining good practices of conservation and societal change, the ECF bridges the gap between ecosystem services and human wellbeing, addressing the social-ecological system at the village community level as a whole. So far, the programme is a successful example of empowering rural communities to become stewards of their land, connecting traditional values and practices to scientific and conservation-related actions and embedding them into national and international legal and governance systems. The signed agreements prove that win-win solutions to conservation and socio-economic development are possible and feasible.
Mountain residents’ livelihoods: Adaptation strategies in the swiftly progressing ‘weather’ of tourism in urbanized protected areas

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Protected Areas (PA) play a pivotal role in tourism development, which in itself creates vital economic opportunities for local communities in terms of promoting alternative livelihoods. Importantly, locals have limited possibilities to generate income in most mountain regions worldwide; therefore, mountain PAs as sustainable tourism destinations are seen as a source of employment and additional economic benefits. While this appears straightforward, protected areas may also trigger disorganization in traditional economic performances of local residents living in or at the edge of PAs.

Now that significant inroads have been made in the development of PAs globally, Georgia as a country with a transition economy joins this international movement. Remarkably, the data collected within the protected areas of Georgia reveals the rapid increase in the coverage of PA and the number of visitors.

This paper, based upon data collected during the scientific research project “Transformation of livelihood practices in rural settlements located at the edge of protected areas in Georgia”, places great emphasis on empirical information analysis gathered through the triangulation method (interviews) and sustainable livelihood concepts in Adjara (south-west Georgia). Selected research areas are located close to the newly established Machakhela National Park (created in 2012). The collected qualitative information will be analysed using a combination of type building and quantizing approaches through CAQDA software.

The paper delves into the process of how global phenomenon, namely expansion of tourism and PAs, shape livelihood practices of local mountain residents in Georgia. Importantly, the study sheds light on the ongoing transformation pathways and their impacts on societies in transition. Restrictions on traditional livelihood practices accelerated short-term out-migration (rural to urban) but differences in owned capital caused inequality during the adaptation process to the new livelihood strategy (guesthouses).

On not-building: Mountain, village and visitors

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The aim of this presentation is to offer a perspective for managing a growing number of tourists in a remote Georgian mountain village south of the Greater Caucasus mountain range. While trying to offer a sufficient strategy for villages and mountains to keep their identity, here the architect’s role not only in building but also in leaving some places unbuilt is emphasized.

My perspective and passion for the subject has arisen from climbing mountains in the Greater Caucasus range together with fellow Georgian climbers and friends. They have shown me the hospitality and wonder that local villages have to offer. I introduce the potential of a selected mountain village, Ushguli, in becoming the gateway for visiting the mountains at the foot of which it lies. The talk introduces five architectural interventions that seek dialogue between building and not-building. Therefore, all interventions have two sides, seeking answers to what needs to be present in a village in order to have nothing built on the mountains.

The presentation includes a discussion of about three main subjects: building, not-building and the synthesis of the two. The first subject investigates how our perception concerning accessibility has changed. Building in the mountains is analysed critically from the perspectives of safety, danger and local settlements versus big-scale mountain mountain resorts.
The subject of not-building debates the value of nothingness. Like locality, emptiness is an asset, not something in need to be solved. In dangerous places, an absence of built structures evokes more responsibility and awareness. The argument is supported by the example of Iceland's SAR (Search and Rescue system) framework. The presentation is based on my MSc thesis in architecture.

**New strategies for Alpine mountain marginal area development through the empowerment of local communities: Case studies of Seren del Grappa (Belluno, Italy) and Montagne Vitali (Trentino, Italy)**

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Socio-economic changes in the past 50 years have favoured settlement dynamics and development models with low sustainability in most parts of Alpine areas. Therefore, the most marginal areas have suffered from strong depopulation and processes of abandonment. So far, traditional planning tools, together with the change of lifestyle and the scarcity of economic resources, among other factors, have not been able to counter these dynamics.

The survival chances of vital communities in these specific regions depend on a multi-sectorial development approach that takes into consideration economic growth, environmental conservation, traditions and cultural issues. This approach should be combined with the enhancement of local communities’ capacities of maximizing endogenous natural capital and local potentials by leveraging a technological qualitative leap and establishing new relationships within the surrounding territories in order to be more attractive on a global level.

This contribution describes two case studies located in mountain marginal areas, highlighting common features and differences. The first case study describes the development of an innovative and demonstrative strategic plan for the community of Seren del Grappa (Belluno, Italy); the other introduces “Montagne Vitali”, a project aiming at counteracting the abandonment of the most marginal mountain areas in the Autonomous Province of Trento, Italy.

The authors will present the identified essential prerequisites and the process of community empowerment and involvement that made it possible to reach the project’s aims, to fulfil the innovative methodological approach and to adopt interaction techniques as planned.

The analysis hereby presented aims to foster the academic discussion about the innovative and self-sustainable development of smart communities, and its potential replication in other international contexts.
The return of the wolf to South Tyrol (Italy): The importance of human dimension aspects in future management strategies

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After more than 120 years of absence, the wolf naturally returned to South Tyrol in 2010. This renewed presence of the predator and some predation activities caused heated discussions among livestock breeders, hunters and the tourist sector who consider the wolf as a major threat to the local economy.

Stakeholders’ groups play a central role in enhancing the coexistence of traditional local economies and the protection of wildlife species. In order to involve such groups in the conflict resolution process and to identify possible heterogeneities in attitude between and within these target groups, we conducted, for the first time, 46 qualitative interviews with economic operators asking their opinions, expectations and challenges related to the return of the wolf in South Tyrol.

Results demonstrated that when people are approached personally, a diverse range of attitudes may appear even within supposedly homogenous groups. Half of the interviewed livestock breeders are open to installing protection measures, but only if their effectiveness is guaranteed. People from the tourist sector expect new business possibilities from the wolf’s presence.

These findings support the necessity to consider nuanced heterogeneity in attitude and contradict the decision to automatically reduce target groups to a single homogeneous segment. This study showed that the human dimension is a central aspect in the wolf coexistence process and calls for case-by-case adapted actions, supported by all the interested groups and stakeholders who should collaborate to enhance sustainable development of human activities and to guarantee species protection.

Thematic Session 18: Climate change II

The impact of climate change on the west coasts of the Caspian Sea

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As in all regions in the world, influences of global warming impact the Caspian Sea basin by increasing replication cycles of hazardous atmospheric processes that are not constant over time.

In this article, the influence of climate change was researched on the basis of temperature data and rainfall observation data collected by 10 hydrometeorological stations in the Azerbaijan coastal areas of the Caspian Sea within the period 1991–2016.

Climate conditions are varied in the coastal areas of the Caspian Sea. The orientation of the south-eastern slope of the Greater Caucasus towards the north-western coasts of the Caspian Sea play a role of a high barrier and cause air masses from the north to move to this area.

Studies show that in a long cycle, average annual temperature values were 13.2 °C in Khachmaz, 14.9 °C in Sumgait, 14.8 °C in Mashtaga, 15.0 °C on Chilov Island, 15.1 °C in Neft Daşlıları, 15.5 °C in Neftchala and 14.9 °C in Lankaran.
Average annual temperatures in 1991–2016 increased by 0.6–0.8 °C compared to the climatic norm. The temperature increase in all coastal areas in 1991–2004 was 0.3–0.5 °C, while in 2005–2016 temperatures rose by 0.9–1.2 °C. This is an indicator of a higher speed of climate change dynamics in last years.

The results of analysis of the study revealed that rainfall increased by 26.5 mm in Khachmaz and decreased by 0.8 mm in northern territories. This indicates that rainfall from northern territories to the south is decreasing. The value of rainfall in Pirallahi was 5.6 mm per year and 14.3 mm in Mashtaga, 77.3 mm in Baku, 34.4 mm per year in Chilov, 46.6 mm in Petroleum Stones, 54.6 mm in Lankaran, 31.6 mm in Alat, 20.8 mm in Neftchala and 105.3 mm in Astara. A decline in precipitation is occurring towards the south. Such a variation in the climate will not leave agriculture untouched. It is thus imperative to grow climate-resistant crops and rapidly grown varieties of countryside plants to last through the periods of spring and autumn.

**Change in glacier area and number in Georgia from repeat inventories**

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The Greater Caucasus is one of the major mountain systems in Eurasia, stretching 1,300 km from the Black Sea in the west to the Caspian Sea in the east and with glaciers covering about 1,200 km². As the Greater Caucasus Range is located on the boundary between temperate and subtropical climatic zones, the orientation and height of the range determines the contrasts between the northern and southern macroslopes, with generally larger glaciers in the north than in the south.

We present the percentage and quantitative changes in the number and area of glaciers for the Georgian Caucasus in the years 1911, 1960 and 2014 including analyses of various glacier attributes (aspect, slope), length change and location. Changes in glacier extent between 1960 and 2014 were determined through analysis of large-scale topographic maps (1:50,000 scale) with a contour interval of 20 m from several hundred aerial photographs taken between 1950 and 1960 and images from Landsat 8 Operational Land Imager (OLI) and the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). Several 1:42,000-scale topographic maps from the first Caucasus glacier inventory were used to evaluate glacier outlines for the 1910s. The 30-m-resolution ASTER Global DEM (GDEM, 17/11/2011) was used to determine the aspect, slope and height distribution of glaciers.

The Georgian Caucasus region experienced glacier area loss at an average annual rate of 0.2% per annum between 1911–1960 and 0.7% per annum between 1960–2014. Overall, the glacier loss was 0.4% per annum between 1911-2014.
Changes in Caucasus glaciers during the 20th and 21st centuries

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Almost all glaciers in the mountainous areas of the world have receded over the past few decades. The process of glacier retreat leads to landscape changes in the glacier zone and to the increased risks of hazards and natural disasters associated with glacial melt. All these processes have social and economic consequences requiring close attention. We present a review of estimates of changes in glaciers of the Caucasus over the 20th and 21st centuries. The sources for the estimates include satellite imagery, topographic maps, field research results, as well as scientific publications. The area of the glaciers in the Caucasus decreased in the second half of the 20th century by 18% to 28%. The first decade of the 21st century is characterized by an intensification of the reduction in the area of glaciers. Over that time the glaciers of the Central Caucasus decreased by 5.0% ± 2.4%. The results of the analysis demonstrate that the changes in the main climatic factors, i.e. air temperature and precipitation, determine the general trend in glacier changes. The summer temperatures in the Caucasus have increased by 1.5 °C in 67 years. There has also been an increase in precipitation, which can partly compensate for the influence of summer warming. The magnitude and rate of contraction of a particular glacier depend on a number of factors: the size of the glacier, its morphology, exposure, presence of a moraine cover and glacier feeding conditions.

The paper includes results obtained within the framework of the following research projects: № 0148-2019-0004 of the Research Plan of the Institute of Geography of the Russian Academy of Sciences and the research project supported by the Russian Geographical Society (№ 05/2018/RGS-RFBR).

Studying the relationships and spatiotemporal distribution of urban heat and green spaces using remote-sensing data

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In this study, the land surface temperature (LST) and normalized difference vegetation index (NDVI) were quantitatively derived from Landsat images of the city of Yerevan (Armenia) and analysed for the spatiotemporal distribution of changes in LST and NDVI and their relationships. Standard geoprocessing of 11 satellite images for the period 1984–2017 were performed. The results show that there is a significant increase in LST (approximately 7 °C), particularly in the last 10 years.
Simultaneously, significant decreases in vegetated areas were observed (approximately 20%). In order to study the relationships between LST and NDVI, a testing site was selected where the impact of anthropogenic transformations are strongly expressed (an urban park was transformed into a built-up area). A significant negative correlation ($r$) was observed between quantitative (vegetated area) and qualitative (mean NDVI) changes of vegetation cover and LST ($-0.84$, $p = 0.001$ and $-0.78$, $p = 0.005$, respectively).

**Evaluating vehicle GHG-emission pollutants using the Copert-4 software programme to model the pollution zones in the city of Sumgait, Azerbaijan**

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In this research, the contribution and modelling of greenhouse gases (GHG) from the transport sector as part of the total pollution in the atmosphere in Azerbaijan has been evaluated. The transport sector is the main source of air pollution in Azerbaijan (responsible for 82% of total pollution released into the air in 2017) according to official sources. In this investigation, the modern evaluation programme COPERT 4 (Computer Programme to calculate Emissions from Road Transport) has been applied to estimate the carbon-dioxide ($CO_2$), nitrous oxides ($N_2O$) and methane ($CH_4$), which are the main emissions responsible for global warming and climate change. The key results of the study show that calculating vehicle emissions using the COPERT 4 methodology can improve the estimation methods and could help to model pollution and fuel consumption in the coming years.

Evaluated emission data on the COPERT 4 was used to compile a map of pollution zones of emissions by vehicles in the selected pilot area in Sumgait city. The monitoring and evaluation was organized in the central streets of Sumgait (Sulh Street) to find out the movement in density, number and type of cars. The programme of UPRZA Ecology was used to make a map showing the spreading of pollution into the air dependent on distance, city geography and hydrometrical conditions.

The key results show that in the streets that have the highest vehicle density, pollution levels are high and decrease depending on the distance from that area. The results of this investigation show that assessment and map making of pollution zones may be implemented in other cities of Azerbaijan.

**Thematic Session 19: Tourism potential in mountainous regions**

**The role of tourism resources in the socio-economic development of mountain rural settlements of Azerbaijan: Example of Guba and Gusar administrative districts**

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Natural resources play a leading role in the development of mountainous rural settlements in Azerbaijan. Natural conditions and resources have a decisive influence on the future development of
tourism centres. They enhance the socio-economic development of mountain villages and affect the importance of ecotourism and environmental tourism. However, the level of use of natural tourism resources in Azerbaijan is quite low.

The development of the tourism industry, along with identifying the socio-economic potential of the regions, is also closely linked to the employment of the local population. This area helps to identify regional differences, and its development provides full and effective utilization of potential capabilities of a number of infrastructure areas. Mountain villages of Guba and Gusar administrative districts (Kuzun, Laza, Suvar, Khinalig, Griz, Jack, Haput, Alik and others) are considered to be regions well-endowed with natural tourism resources. However, tourism infrastructure (hotels, sanatoriums, restaurants, internet etc.) have been poorly developed in these areas. We can also observe the dynamics of tourists and excursions visiting mountain villages.

The advantages of the above-mentioned natural tourism resources and existing problems in the creation of a tourism economy will be analysed in this article, and ways forward for tourism development will be shown.

Analyzing tourism’s influence on agricultural product markets: A case study of Mestia municipality, Georgia

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Mestia Municipality is a highland district of northwest Georgia, located in the Greater Caucasus Mountain range. Tourism is a relatively new and rapidly growing economic activity in Mestia, while traditional economic activities of the population are focused on agriculture. Analysing linkages between tourism and agriculture is a vital part of the sustainable development process of the municipality.

The present paper is related to an interdisciplinary research project that was conducted in two high mountain regions of Georgia (Mestia and Kazbegi) in 2018: “Linkages between tourism and community-driven economic activities: Shaping sustainability in mountain regions”. The project was initiated by Ivane Javakhishvili Tbilisi State University in collaboration with the University of Giessen, Germany.

Fieldwork revealed that tourism has a significant impact on agricultural product markets in Mestia municipality. Agricultural products were sold mainly outside the municipality before tourism developed. Now, one part of the population has changed their economic activity from agribusiness to tourism and a huge number of visitors became customers of agriculture outputs. Tourism has thus created a great chance to realize production inside the region.

The purpose of this paper is to explore and analyse links between the influence of tourism and changed or diversified agricultural markets in the Mestia municipality.

The paper applies a triangulation method with qualitative in-depth interviews and desk research. MAXQDA qualitative data-analysis software is used for data processing. In-depth interviews were conducted with two target groups: 1) locals of the municipality and 2) representatives of the tourism industry who operate in Mestia municipality. In total, 60 interviews were conducted. The research area covered the centre of the municipality and several villages in 15 communities.
Perspectives of wellness (healthcare) tourism in Georgia
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Wellness (healthcare) tourism is increasingly becoming popular throughout the world. More than 50 countries are involved in this sector and demand is gradually growing. Georgia has great potential to develop wellness tourism, which can enable the country to improve the socio-economic situation and have tangible outcomes. Georgia has already made some steps in this field and has chosen a few disciplines such as dentistry, plastic surgery and cardiology. In addition, the balneological resorts are being rejuvenated. However, it is necessary to work out a marketing strategy that will make wellness tourism competitive at an international level.

The purpose of the research is to determine what potential Georgia has, both in terms of demand and supply, to identify and structure problems, their analysis and implementation to bring efforts to fruition. According to the research conducted, existing and potential competitive advantages were determined as well as problems that can be overcome. Subsequently, on the basis of the above-mentioned analysis, certain recommendations for wellness and healthcare tourism development were worked out.

The social-economic and spatial aspects of development in Georgia: The example of the City-Museum of Mtskheta
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This research reviews tourism development trends in Mtskheta region, taking sustainable development principles into consideration. Tourism is one of the fastest-growing and highest-revenue sectors of the world economy and, precisely because of this, an interest in this sector is growing day by day. Along with tourism development, an interest towards assessment of tourism sustainability is growing. One of the main elements of developing tourism is how more tourism influences welfare of local populations and the private sector. In addition, one of the major components of tourism’s sustainable development is retention of cultural sustainability of the territory. Much cultural heritage is located in Mtskheta, and their conservation through a sustainable development approach is especially important.

On the basis of theoretical analysis and research conducted in the city of Mtskheta, this work aims to clarify how growth in the tourism industry influences the welfare of local micro-business owners; whether or not economic profits follow; and how development of the sector is based on two major concepts of sustainable development, economic and cultural development.

The objective of the paper is to determine how structures are involved in the field of tourism in the area to be researched and whether their co-participation serves the sustainable development of tourism in the city. Is tourism promoting the improvement of local populations’ quality of life and development of the city’s economic opportunities?

The subject of the research is the City-Museum of Mtskheta as a tourist product and socio-economic development trends. The subject of the research is local private businesses involved in tourism and government structures.

The theoretical concept of the research is based on the theories of coordination failure and comparative advantage. The main question is if the afore-mentioned theories are universal for every country or are specific to a territory and how they fit the reality of Georgia and the City-Museum of Mtskheta.

On the basis of the major findings presented in the concluding part of the research, we can determine how the sector’s development strengthens the local economy. In addition, we can consider how
culture can be sustainable in the tourism development strategy. On the basis of the afore-mentioned results, we can determine whether the development strategy is selected correctly and what kind of changes are needed.

Geographical assessment of tourism and recreation resource potential of Racha region

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Racha is a distinguished region of Georgia with geographical and historical-cultural peculiarities that create great opportunities for sustainable tourism development.

The urgency of the topic is related to several key factors. Racha is one of the most problematic regions in Georgia. Racha is characterized by depopulation and difficult social, economic and ecological conditions, the current development of large energy projects, and the creation of new protected areas. Such a situation creates new challenges to the sustainable development and spatial arrangement of Racha. Tourism development can be considered as one way to improve the social, economic and demographic situation. Tourism-development planning can be done through a thorough assessment of its potential.

A comprehensive assessment of the potential of tourism and recreational resources (medical, educational, agricultural, adventure, etc.) of Racha has not yet been implemented. This kind of assessment will allow us to determine the areas of tourism centres (bringing together tourist resources) that will be granted priority status in spatial arrangement and planning.

In order to achieve this goal, the environmental, ecological, demographic and socio-economic conditions of Racha, as well as the impact of ongoing and expected economic projects on tourism development have been studied. Based on the assessment of the potential of tourism-recreational resources of Racha, the areas with high, medium and low potential for tourism development have been identified. These kinds of areas are located in the following places: high importance areas include Ambrolauri city, Shaori reservoir, Nikortsminda church, the source of the Shareula river, Tchelishi monastery, Castle of Khotevi, Oni city, Shovi and Utsera resorts; middle importance areas are close to the regional centres (i.e. Tsesi, Tsakhi, Tchrebalo, Khvantchkara villages etc.); low importance areas are located far from regional centres (i.e. Gendushi, Mukhli, Likheti, Nigvznara and Sori villages).

Thematic Session 20: Socio-economic aspects of mountain development II

Evaluation of population quality of life and the Human Development Index

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One of the main elements of the socio-economic development of society is a high quality of life. Quality of life is a key indicator that characterizes and evaluates the socio-economic development of each state, but the evaluation of a country’s development level on the basis of economic indicators
alone is not accepted worldwide. For this reason, several concepts have been proposed by the United Nations to evaluate human development. One of them is the Human Development Index (HDI), presented in 1990 by the United Nations Development Programme. The HDI has a special place among different indicators for the assessment of quality of life. Acting as the basis of data in the Human Development Reports, the HDI is based on three indicators: the Life Expectancy Index (LEI), Education Index (EI), and the Gross National Income Index (GNII).

Countries are ranked according to the HDI from 1 to 0 and conditionally divided into four groups: Very High Human Development, High Human Development, Medium Human Development and Low Human Development.

The HDI is calculated for each country and its separate regions. The Republic of Azerbaijan was included in the list of comparable countries for human development after gaining its independence. In 1995, the Global Human Development Report ranked Azerbaijan 99th out of 174 countries on the HDI. However, since 1997, as a result of the acceleration of economic growth as well as the increase in life expectancy and education levels, its HDI has increased. From 1995 to 2010, the HDI of Azerbaijan increased by 27% from 0.563 to 0.713. According to 2018 data, Azerbaijan ranks 80th out of 189 countries. To improve quality of life, first of all, it is important to raise the country’s gross national income and to develop education and health.

Changes in the types of mountain management in the modern period: The example of North Ossetia

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With the transition to a market economy in the mountains of North Ossetia, mountain management systems have changed significantly. If during the Soviet period the mining industry prevailed in the mountains and pasture livestock breeding and tourism were heavily dominant, now hydropower engineering, tourism and balneology have begun to prevail. Mountain villages are starting to revive.

Upper Fiagdon got lucky. This settlement was built as a centre of the mining industry. While the depletion of polymetallic ore reserves led to the closure of the Fiagdon mine, developed infrastructure remained that people began to use for resort and recreational purposes. Bars began to function within the village children’s sanatorium and pulmonological hospital and many other structures are being built. In addition, the construction of several mountain skiing routes are planned. The village will be used both in summer and winter. Tourism and balneology are developing in other gorges as well. Mizur is gradually being reclassified into a village of hydraulic power by engineers—the construction of Zaramag HPP-1 is nearing its completion.

The village of Buron is another example. In total, these settlements are home to almost 60% of the population of the mountains. Life in mountainous villages has been revived and the types of economic activity have significantly changed. The mining industry has practically ceased to exist. In the Soviet era, sheep raising was the most important branch of farming. Now the number of sheep has fallen sharply, but the number of livestock has increased. Animals graze on the natural meadows of the middle reaches and then are sold at very high prices as environmentally friendly products. With the sale of meat alone, the average income per farm is 12,000 dollars per year.
Placer gold occurrences of the Upper Svaneti, Greater Caucasus, Georgia

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Distribution regularities of Upper Svaneti gold mineralization are conditioned by the combination of metallogenic, structural and magmatic factors. Gold occurrences are distinguished by mineral composition diversity, types of mineralization hosting fold and fracture structures and the morphology of ore bodies.

The analysis of our geological research and review has shown that the Svaneti region is rather rich in gold occurrences. These occurrences are found in the Palaeozoic crystalline basement complex as well as in alpine intrusions and sedimentary cover. From our modern geological research data we can come to the conclusion that the “gold sands” mentioned in ancient Greek mythology and in historical sources were a geological reality.

Our work also shows that the gold content in the river sands of this region are sufficiently large to give grounds for the creation of the legend that describes Svaneti as a “country rich in this noble metal”. When our geological research is coupled with the use of modern implements and techniques that have ancient historical precedents for gold placer mining, we share the viewpoint of the Roman historian Apian Alexandrine, who believed that the myth about the expedition of the Argonauts and their quest for the Golden Fleece was based on reality. We contend that their trip to Colchis Kingdom was a real event, the main purpose of which was to obtain gold and gold-mining technology from those who were working the river sands of the Colchis Kingdom. According to our research, the phenomenon of the Golden Fleece was likely to have been connected with the sheepskin technique of gold mining from the rivers, the final result of which was a gold-impregnated sheepskin. The fanciful characterization of this actual process would have led to the romantic concept of the Golden Fleece.

Structural features and genesis of Khachkovi gold-ore occurrence: Adjara-Trialeti folded and trusted system, Georgia

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The Khachkovi gold-ore occurrence is located in the Tsalka region, on the South slope of Mount Arjevani. In the north, it is bounded by the Arjevan-Bakuriani subdivision regional overthrust and from the south with the Neogene-Quaternary lava flow. The endogenic structural control of the ore field is determined by the Arjevan-Bakuriani regional fault.

Khachkovi gold ore occurrence is represented by hydrothermal gold sulphide and pyritic types and is located in the top blocks of the abovementioned regional fault, localized on its parallel, steeply plunging down fracture zones.

Between middle Eocene tuffogenic rocks are located subdivision orientation mineralization zones of 0.5 km width, which creates an intensively mineralized zone along the Khachkovi river. It is represented by alteration rocks that are saturated with quartz-calcite-barite veins. They contain veins and impregnations of sulphide. The Quartz-baritization zone №1 is located in the source of the Khachkovi river gorge, on its right side. A total of 70 samples were obtained from this zone, from where 58 channel samples were analysed for gold, in 29 samples, the gold composition is more than 1 g/t.

The Pyritization Zone № 2 is located on the first left tributary of the Khachkovi river. It is represented by a 50–70 m mineralized and hydrothermally altered zone. Of 90 samples taken, 55 samples were
analysed for gold. Gold content varied from 11 g/t to 3.2 g/t.

The Pyritization Zone No 3 is located on the left tributary of the Khachkovi river. It is presented with irregular pyritization and hydrothermally altered Andesite rocks. From this zone, 50 samples were taken, 30 of them were analysed for gold. Gold composition varied from 0.8 g/t to 1.7 g/t.

On the basis of works conducted by us, a hypothesis on the genesis of Khachkovi ore occurrence is provided. It is said to represent an apical part of a magma system, where propylitic and gold-bearing seams are developed and impregnated with mineralization.

The influence of the Caucasus foothill local food chain development on the regional economy

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An increasing number of consumers are looking for alternative sources of food that is produced near their place of residence. The proliferation in recent years of new forms of food distribution organization called short food supply chains (SFSCs) may be due to the growing role of trust.

Indeed, the growing popularity of short supply chains must be attributed to a distribution model that allows consumers to support local agriculture by adding fresh foods to their diet.

In the past two decades, the topic of sustainability has shifted from border supply chain management research for the mainstream and is currently an area of significant research activities including, in particular, SFSCs. There are many different forms of SFSCs, but they have a common characteristic of reduced numbers of intermediaries between the farmer or food producer and the consumer.

The growing interest in SFSCs reflects consumer demand for quality and traceability. In this article, the authors single out the importance of SFSCs for Caucasian stakeholders’ sustainable economic development of the Caucasus Mountain region and modernity barriers to the creation of SFSCs.

SFSCs have the potential to increase farm value-added (profit sharing), promote sustainable farming systems’ production diversification and local economic development.

Poster Session

Dynamics of forest cover in Georgia according to the map by Alexander Javakhishvili

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Georgia has a high percentage of forestation (39.8%), higher than the average world ratio (30%). Forests in Georgia covered even larger areas at the beginning of the 20th century. Old cartographic sources are very important to explore this issue, which has virtually never been studied. “The General Map of Georgia” (scale 1:200,000) by Alexander Javakhishvili in 1931-1932 is a valuable source. This study is based on a geographic-cartometric analysis of the map, as well as a GIS-analysis comparing the forest cover in the 1930s and today in different regions of Georgia. While in the 1930s the forest cover occupied the largest areas in Abkhazia, followed by Kakheti and Imereti, the ratio...
has more or less changed today. In particular, in terms of forest cover, Abkhazia ranks first followed by Imereti and Kakheti, which means that particularly vast forest areas were destroyed in Kakheti. Plain forests were primarily those that have been destroyed in Georgia, particularly in the Kolkheti Lowlands. Floodplain forests in East Georgia have been almost completely destroyed, surviving only in fragments. The forests in the Greater and Lesser Caucasus are relatively better preserved.

Modelling of the climate change impact on alpine plant diversity of the central Greater Caucasus

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Global climate change will affect all ecosystems around the world, but the most rapid and sharp changes are expected in high mountain areas. The long-term monitoring programme Global Observation Research Initiative in Alpine Environments (GLORIA) supported by the European Union was established to monitor the alpine plant cover transformation. Plant cover, abundance, distribution and soil temperature were monitored in 64 permanent plots and four summits in the Central Greater Caucasus in 2001, 2008 and 2015 (according to GLORIA protocol). The average annual soil temperature did not increase during the monitoring periods. Growing degree days (GDD) changed in different years, but there was no significantly increasing trend. The thermic indicator (S) decreased on all summits during the monitoring period. The study has shown that grasses and sedges tend to get more benefit from local climate change. Their cover and abundance did not change as much as the indicator value of the indicator species. It was obvious that the endemic and cold-adapted species are not severely endangered and species immigration is not at play. The observed changes mostly reflect a filling process rather than succession and Central Greater Caucasus has faced no climate warming at this particular stage of the research.

Studying of dynamics and assessment of the current condition of relic landscapes in Azerbaijan

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The study of relic elements of natural complexes and their role in the genesis, structure, function, dynamics and evolution of landscapes is one of the most important issues in modern landscape science.

In this article, the historical dynamics of the relief landscape of Azerbaijan were extensively studied for the first time, as were the ecological problems that derive from them. It has been established that plain forests have been completely destroyed and transposed to anthropogenic complexes; the biodiversity of existing forest ecosystems has diminished; some species of trees and shrubs have been decimated; and the density of the forest has dropped below the ecological norm. The proposed environmental sustainability index is calculated by the formula $\Sigma_i = S_i/S_3$ for the studied region.

Located on the west coast of the Caspian Sea in the south of the Republic of Azerbaijan, the research area covered 6,069 km². The relief is located in the eastern part of the plain and in the west from the Talish, Pestasar and Burovar mountain ranges with an absolute height from 27 m to 2,493 m.
The relief elements of the landscape are divided into two categories: dynamic and static. Static relief elements include relief, lithological composition of rocks and dynamic relic elements related to fauna and flora. The research area region landscapes are mostly rich in dynamic relic elements.

The existing mountain forest ecosystems have diminished biodiversity, some species of trees have been severely impacted and the density of the forest has dropped from the ecological norm.

The environmental sustainability index was calculated by the formula $\Sigma = S1/S3$ and it was determined that the environmental sustainability index for the region was above the average country level and equalled 0.5 in the study area.

Radical changes in the regime of the Elbrus glaciers at the turn of the country (1982–2018)

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A long series of observations on the glaciers located on the southern slope of Mount Elbrus reflects the change of two climatic periods in the Caucasus high mountains. The first period (1982–1997) was relatively cold and snowy. During this time, a layer of ice with a thickness of 0.8 m w.e. accumulated on the surface of the glacier. The second period (1998–2018) was characterized by increases of summer air temperatures and catastrophic melting. Summer temperatures in the Elbrus region rose almost to the level of the 1950s—the hottest decade of the 20th century. The duration of the summer season increased on glaciers. Large firn areas in the main part of the accumulation area disappeared at altitudes of 3,800–4,000 m and open ice of the ablation zone appeared. The former areas of the temperate firn zone, where up to 35% of thawed water was retained in the 20-metre firn layer, were replaced by the firm-ice zone. Glacier runoff increased. The supply of the glacier is currently deteriorating, its tongue receding with increasing speed. New rocks and entire lava ridges appear from under the ice at different altitude levels. Ablation intensity determines interannual fluctuations of the glacier mass balance. Over 36 years of observations, the reduction of glacier mass led to a loss of 0.05 km³ of volume, 0.51 km² of area, and 11.4 m w.e. layer of ice.

This study is supported by the RFBR grant 18-05-00838 and the state assignment 0148-2018-0008 of the Russian Academy of Sciences.
Youth attitudes and awareness towards human-wildlife conflicts in the Alps: Promoting youth knowledge and dialogue to turn current conflicts into concrete opportunities

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Human-wildlife conflict is the manifestation of the negative interaction between human mountain activities and the wildlife population. In the framework of the ALPBIONET2030 project, Eurac wanted to point at the future of Alpine rural communities, surveying more than 1,000 high-school students throughout the Alpine arc to explore their current knowledge and attitudes towards wildlife presence and interactions with humans.

It is fundamental to question young people with an interdisciplinary approach in order to provide a comprehensive view of the current human-wildlife interactions that may account for environmental, economic and social processes.

Subsequently, in a series of meetings in the same high schools, we had the opportunity to discuss the results of the survey with the students, covering their knowledge and attitudes towards current conflicts, their lifestyles and relation with wildlife and to collect new and fresh ideas from them to enhance the coexistence between human activities and wildlife species in their areas.

The poster hereby presented aims to show some of the main results of the survey and to highlight the importance of involving the young generations of society to create the basis for new forms of coexistence with wildlife and for regional development.

Socio-economic development of urban and rural populations in the north-western region of the Azerbaijan Republic: A case study of the Guba-Khachkar economic-geographic region

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The economic-geographical region of Guba-Khachmaz of Azerbaijan Republic and its social-economic development in urban and rural settlements were the subject of our research. Five regions make up the economic-geographical region of Guba-Khachmaz, located in the northeast of Azerbaijan (Guba, Khachmaz, Gusar, Shabran and Siazan). Oil and natural gas resources, the suitable economic-geographical position, grain, fruit and vegetable cultivation, development of cattle-breeding and food processing take place in farming areas.

To assure that there is enough work and sustainable new jobs, the socio-economic development of a region creates conditions for development of demographic service sectors to meet the demand of the population. But serious problems have arisen relating to difficulties of the transition period in urban and rural settlements in the economic-geographical region of Guba-Khachmaz. The economic reforms began from the first years of independence to solve problems, now that process is continuing by the government and is showing positive results. Industry and agriculture were encouraged with diversification based on the natural potential of the economic region. However, the current potential cannot ensure that the increasing population will have work and people are not satisfied with the modern social services in cities that are expanding. Socio-economic development should be sustainable to ensure the processing of agricultural products and the level of social services for the population to meet increased need through more extensive new networks. These measures will provide regulation of social-economic development in the urban and rural settlements of region.
Intergenerational practice: A potential way of tackling rural mountain area depopulation in the North Caucasus region

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Rural mountainous areas of the North Caucasus region are known for their cultural diversity and traditional heritage. However, they face countless problems such as a clear lack of educational institutions (i.e. no school education is available beyond the 5th grade) and social services. Furthermore, there is often no possibility of economic development, leading to depopulation (i.e. Uchkulan, Karachay-Cherkessia). The outflow of younger people, in particular, aggravates the problems of rural mountainous regions and leads to the risks of loss of traditional heritage, degradation of natural ecosystems and cultural landscapes and even the loss of historical examples of the adaptation of land use and livelihood systems to the complex natural and climatic conditions of the local mountains.

Several EU initiatives targeting rural areas include intergenerational research (bringing older and younger generations together through meaningful and mutually beneficial activities), which has been gaining in popularity in Europe. One of the existing initiatives is called “Big Foot”, a project successfully applied in three European rural mountainous areas, focusing on transmitting the experiences and traditions of older generations to youth through the organization of community consultations and trainings in order to preserve traditional heritage and revitalize the region’s sustainable socio-economic development. The purpose of this paper is to examine the potential of the application of such an initiative and intergenerational practice in general in the mountain villages of North Caucasus.

Power and composition of the forest litter of beech forests of various altitudes in Armenia

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Only a third of the Earth’s surface is covered by forests. In addition to providing food and shelter, they play an important role in combating climate change. Forest ecosystem services are diverse and highly important to maintaining the environment, human wellbeing and health balances.

Evaluation of the economic value of forest ecosystem services indicates that two reverse processes form the main value in terms of revenue: (a) obtaining organic matter through photosynthesis and carbon sequestration (accumulation) and (b) timber consumption.

Identification and calculation of the thickness and structure of forest litter at different altitudes is a very important step to evaluating carbon sequestration by forests.

Studies have shown that the content of the leaf fraction is the most stable indicator in the total litter mass and specific weight if tree bark and squama of buds are the most variable.

Summarizing the above, it can be stated that forest litter reserves are closely related to the type of beech forest and fullness of forest stands. The largest amount of litter accumulates in high-fullness dead-cover and fern types of beech forest where figures are 91.25 and 88.84 c/ha.

Niche distribution of sympatric species (Darevskia dahli and Darevskia portschinskii) in Kojori, Georgia

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We compared niche distribution and ecological requirements of unisexual species Darevskia dahli and bisexual species Darevskia portschinskii in a shared location in Kojori, Georgia. We divided the
study area into 108 squares measuring 10 m x 10 m and measured surface humidity and temperature twice a day for each square. We separated the microhabitats into four types and recorded activity periods for each species.

According to our study, *D. dahli* prefers rocky habitats with scarce bushes, close to the brook side and near the forest (5–7 m), while *D. portschinskii* individuals prefer small, rocky hillocks covered by grass near the forest. Neither of these species can be found far from the forest. Optimal surface temperature for *D. dahli* is around 20 °C, while for *D. portschinskii* it varies around 25 °C.

Competition between sympatric *D. dahli* and *D. portschinskii* results in habitat utilization and habitat shaping. Unisexual *D. dahli* tends to overcompete its paternal *D. portschinskii* in Kojori, which is in line with the general observation that *D. dahli* occupies a wider range of the microhabitats in sympathy with *D. portschinskii* (Tarkhnishvili et al., 2010, 2012). Our study suggests that on a finer geographic scale, the parthenogen also uses a broader range of microhabitats and prefers lower temperatures and higher surface humidity.

**Chalaati Glacier survey using UAV photogrammetry**

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Glacial retreat is a major problem in the Caucasus, especially over the past 50 years. In the course of work performed in Georgia in 2018–2019, for the first time, a remote-sensing methodology at close distances has been used for glacier study that benefits from aerial photography of glaciers and their periglacial zones using unmanned aerial vehicles (UAVs). Photogrammetric and geo-information (ArcGIS, Agisoft, Pix4D) programmes have been used for data processing.

The objective of this study is to evaluate the potential of commercial UAV platforms to detect the evolution of the surface topography and morphology of an alpine glacier over a short time scale through the repeated acquisition of high-resolution photogrammetric data. Two high-resolution UAV surveys were performed on the ablation region of the Chalaati Glacier (Georgia, Caucasus) in June 2018–2019. First, structure-from-motion (SfM) techniques were applied to create orthophotos and digital surface models (DSMs) of the glacial surface from multi-view UAV acquisitions. The geometric accuracy of DSMs and orthophotos was checked using differential global positioning system (dGPS) ground measurements, and an accuracy of approximately 10 cm was achieved for both models. High-resolution orthophotos and DSMs made it possible to provide a detailed characterization of rapidly changing glacial environments.

**The effect of anthropogenic factors on desertification-process intensity in soils of the Ajinohur Lowland, Azerbaijan**

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Desertification is the reduction or depletion of the biological potential of the Earth as a result of the effects of anthropogenic factors and global climate change. The excessive amount of CO$_2$, CO, NH$_3$, SO$_3$ in the atmosphere causes excessive heat in the climate. This contributes to the acceleration of the desertification process. In addition, human economic activity contributes to the deepening of the desertification process. In the modern era, this influence is increasing.

The lower mountainous area of Ajinohur is situated in the north-western part of the Republic of Azerbaijan which has arid climatic conditions. Compared to previous years, together with the aridity of the climate, the increase of anthropogenic impact in the research area has been one of the main factors intensifying the process of desertification. Based on the analysis of satellite images and the
results of field research, the anthropogenic factors that influence desertification in the study area are as follows:

1. Degradation of plant cover due to unsystematic and intensive grazing;
2. Degradation of lands as a result of cutting of tree and shrub vegetation and intensive agriculture; and
3. Replacement of the natural landscape with anthropogenic landscapes in arid and semiarid conditions.

In addition, while using lands in arid climatic conditions, the almost total lack of irrigation systems has caused the deterioration of the physicochemical properties of the soil, the reduction of humus and nutrients, and the collapse and the consolidation in the upper fertile layer. It also has a negative impact on the recovery nature of soil vegetation afterwards.

According to our research, up to 70% of deserted areas are subject to weak and moderate desertification, and 30% of areas are subjected to strong desertification. Depending on the slopes’ gradient and exposure, the southern slopes have strong desertification, and the northern slopes are subjected to weak desertification.

Identifying the factors influencing the achievement of sustainable development in local communities: The case study of the Uramanat Mountains, Iran

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A sustainable development movement in local communities can respond to global issues by communicating to local communities about global destructive impacts. This movement indicates that the most important global environmental issues are rooted in local communities. Thus, in order to achieve sustainable development, efforts should be targeted at the local community, the smallest urban unit. Therefore, achieving sustainable development depends on empowerment and the contribution of local communities to the sustainable use of land and natural resources.

This study has been conducted in the Uramanat region of Kurdistan, which has become a prominent region in the Middle East due to its nature-friendly lifestyle. The research was based on information from a questionnaire and extraction of the most important factors influencing sustainable development. Based on the results of the importance of each community group to achieve sustainable development, local communities, women, and NGOs have the highest role, respectively, with weights of 0.25, 0.20, and 0.15, respectively. Ecotourism with the score of 0.28 is also most effective for the sustainable development process within each local community.

Future distribution of Caucasian Salamander, Mertensiella Caucasia (Waga,1876), under different climate scenarios

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Amphibians are strongly affected by climate change, as are many vertebrate animals. To address this situation, we examined the potential effect of climate change on the distribution of Mertensiella
caucasica (Waga, 1876) that is the best-known species in the Caucasus hotspot using future distribution modelling (averages for 2041–2060 and 2061–2080) under RCP 4.5 and RCP 8.5 emission scenarios. According to our model, the future distribution showed a remarkable expansion towards the northwest part of the Greater Caucasus, whereas it indicated a regression from the west of the West Lesser Caucasus up to the Greater Caucasus. Our results indicated that most habitat loss seems to occur in the West Lesser Caucasus including the northeast of Turkey and the East Lesser Caucasus. Moreover, habitat suitability for M. caucasica showed trends towards local extinction in the future. In the Caucasus hotspot, the expected distribution range of M. caucasica will decrease with the risk of local extinction. Therefore, we recommend that its status in IUCN Red List should be reconsidered.

Return migrants and economic activities in tourism development in high mountain regions of Georgia: The case of Svaneti and Kazbegi

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During the last decades, compulsory and voluntary migration from mountain regions to the plains has always occurred in Georgia, largely driven by factors such as socio-economic situations, natural disasters and forced collectivism. After the collapse of the Soviet Union, in Georgia as well as in all post-Soviet countries, significant changes in economic structures began and many mountain regions faced depopulation and economic decline. Due to the lack of proper living conditions and employment in the highlands, seasonal labour migration became widespread in Georgia. However, in parallel with tourism development, the return of migrants has been noticeable over the last decades. Our fieldwork revealed that tourism has a significant impact on migrant return. The aim and the major objective of the study was to shed light on the nexus of tourism development and the return of domestic migrants to high mountain regions of Georgia. The research methods comprised document analysis and in-depth interviews with locals. Data obtained from the survey were transcribed and worked out in MAXQDA (qualitative data analysis software). The paper aims to explore the linkages between migration and the tourism sector, studying the motives of migrants and identifying economic activities carried out after their return.

Tourism and potential opportunities in Azerbaijan

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Natural resources and the rich historical and cultural heritage of our country are the foundations of tourism development. The favourable climate in Azerbaijan is another major factor in the country’s tourism potential. Our territory is ancient and our historical monuments have been preserved to date. Rich forest resources and hydrological resources have also contributed to turning Azerbaijan into one of the tourism centres of the region.

Tourists traveling on the Baku-Absheron route have the opportunity to see historic and ethnographic museum preservation complexes such as the Gobustan Rocks, mud volcanoes, Ateshgah Temple, Maiden Tower and the Palace of Shirvanshahs. Most of the country’s natural tourism resources are concentrated in the Greater Caucasus Mountains. Tufandag and Shahdag are available for tourists at any time of the year. The historic areas of Shaki and the Shaki Khan Palace have been included on the UNESCO World Heritage List, which thus increased tourism in the country in the ensuing years.

In the southern part of the country, mineral springs, the exotic nature of different species of relic and endemic trees and hot springs in Masalli make the area more attractive.
Closing Session

Moderator: Prof. Dr. Mehmet Somuncu

The first part of this last plenary session was dedicated to Poster Awards and the second to the approval of the Regional Research Agenda.

Poster Awards

Prof. Dr. Jörg Balsiger thanked the authors for the amazing posters and noted that the choice is always difficult because there is so much good research and many solid presentations.

An evaluation commission was comprised of Jörg Balisger, Director of Environmental Governance and the Territorial Development Hub, University of Geneva, and Chair of Mountain Research Initiative; Ceran Sekeryapan, representative of Zonguldak Bulent Ecevit University; Mamuka Gvilava, representative of GeoGraphic; and Robert Atkinson, Board member of Sustainable Caucasus. These members were guided by the following three criteria in their evaluations: a) organization, structure and logic; b) scientific content; and c) research value.

Three posters were recognized and the authors were awarded certificates and symbolic souvenirs.

First place: Yusuf KÜMLUTAS, Çetin ILGAZ, Serkan GÜL, “Future distribution of Caucasian Salamander under different climate scenarios”

Second place: Fillipo FARELLI, Isidoro DE BORTOLI, “Youth attitudes and awareness towards human wildlife conflicts in the Alps: Promoting youth knowledge and dialogues to turn current conflict into concrete opportunities”

Third place: Khatuna GIGAURI, “Modeling the climate change impact on alpine plant diversity of the central Greater Caucasus”

Approval of Caucasus Regional Research Agenda

Joseph SALUKVADZE, Ivane Javakhishvili Tbilisi State University, Georgia

In the opening meeting, we presented topics that we had identified as the main topics for the next few decades of intense research. We had different scores that were quite close and the points, averaged from your votes. Out of 10 points, eight points were given to climate change. Then four topics had 7.7 points: forestry conservation and forest development; water resources and management; land use and land cover change; and socio-economic development and planning. Next were natural hazards; tourism and recreation; biodiversity; water; and mountain cryosphere all with scores of 6.9. All topics thus had more than 70% support from participants and this is quite a good sign for us. First of all, we think that participants reconfirmed that all topics were correctly identified from the very beginning. Secondly, this shows us that we are on the right track and that all topics are interconnected — we cannot think about one of them without the others. This is quite good evidence that the participants approved the Caucasus Regional Research Agenda (C-RRA).

Further discussions were devoted to outcomes and feedback from the participants on the way forward. The main focus was given to issues like: Which target audience should be prioritized? How can priority target audiences best be reached? How can international awareness of the C-RRA be raised? How can funding for basic and applied research on C-RRA topics be promoted? How can the alignment of new knowledge with the C-RRA chapters be ensured? What mechanisms for dialogue between research and practice should be fostered?

Prof. Dr. Jörg Balsiger and Nina Shatberashvili presented the activities already planned and also
talked about contacts and international perspectives on the way forward. Moderator Prof. Dr. Mehmet Somuncu thanked all the participants and key partners, SNC-mt, University of Geneva, Swiss National Science Foundation, Swiss Agency for Development and Cooperation, United Nations Environment Programme, Caucasus Network for Sustainable Development in Mountain Regions, and Ankara University for their support and announced that the next Caucasus Mountain Forum would be held in Georgia in 2021.

Detailed programme and presentations for Caucasus Mountain Forum 2019 can be found here.