TRAINING PROGRAMS IN THE DOCTORAL SCHOOL OF EARTH SCIENCES

(In effect from 1st September 2016)

1. LANDSCAPE PROTECTION AND CLIMATE PROGRAM

Program leader: **Attila Kerényi**, DSc.

General aim of the program

Based on the close relationship between landscape and climate research the doctoral program aims to expand the scientific basis of landscape protection and extent the range of basic and applied research associated with it. Academic and research staff of the Department of Landscape Protection and Environmental Geography and the Department of Meteorology work together in the program. The sub-program, Sustainable energetics studies the relationship between the built and the natural environment with an engineering orientation.

Research fields associated with the program: climatology, environmental protection, environmental energetics, landscape protection.

Key-points of the program in landscape protection and in climatology

The co-operating two departments have already carried out a wide range of landscape geographical – landscape protectional and climatological research: landscape structure analyses and landscape evaluations were completed with landscape climatological studies in the form of medium- and micro-scale climatological measurements.

The primary focus of research is determined by the effects of anthropogenic activities on the natural environment together with issues of the environmentally sound utilization of landscape potential. Renewable energy resources are part of this potential and research studying the availability and utilization potentials of solar and wind energy in Hungary forms an integral part of the program. Another research focus has been added to the program recently: studying the regional effects of global environmental processes.

Key-points of the program in landscape protection

Humans inevitably modify their natural environment as a result of economic activities. The volume of the change depends on the strength of the effect and the conditions of the natural environment. This natural environment has a specific

structure: landscapes are connected to each other to form a complex system in which certain elements (landscapes) react in different ways to human interference. Production results in smallest destruction-pollution effects if the utilization of the environment is adjusted to landscape conditions.

- Studying *the processes in a landscape* (soil erosion, water supply of soils and sediments, soil-plant interaction) helps to better understand the operation of a landscape. Results of such research can be used in multiple ways regarding landscape protection.
- Research focusing on the relationship of *landscape structure and utilization* is promising to yield direct results for the transition of agriculture that has been ongoing since the regime change.
  Apart from the natural conditions of lowland and mountain study areas, different social conditions also influence significantly the spatial extent and method of utilization. Our studies focus on exploring such nature-society interactions.
- Studying *contamination* effects still has an immense pool of research possibilities for young scientists due to the variability of human actions. Exploration and mapping of various anthropogenic pollution sources in different landscapes, studying the primary route of pollutant movement and their spatial distribution, creating vulnerability maps are important applied science research tasks.
- Studying the conditions of waste management and waste disposal from the aspect of geography.
- Studying *tourism and its environmental* effects is made important by – apart from traditions in the institute – the fact that tourism is the most dynamically developing industrial branch not only in Hungary but in the world as well therefore its environmental effects are also increasing. Research fields include ecotourism, exploration of conflicts and co-operation possibilities between tourism and environment/nature protection, and the theory and practice of sustainable tourism.

Key-points of the program in climatology

- *Landscape climatology*: research exploring natural environmental values is part of analyses studying generation and production values and potential, and is a special meteorological analysis grounding the study of the human related environmental protectional effects of environmental planning in landscapes and settlements. Based on the results, for example, the climatological districts of a landscape can be identified that could be important from landscape utilization point of view (tourism, recreation, etc.).
- *Climate change*: Nowadays it seems doubtless that the near-surface temperature of the Earth-atmosphere system increases. The reason of this is thought to be the increase of the concentration of greenhouse gases as a result primarily of anthropogenic activities. Global warming contributes to the modification of the rest

of the climatic elements as well. This, however, could be different regionally. At the same time the increasing concentration of atmospheric aerosols – as a result again of human activities – result in cooling and increased precipitation, the intensity of which, however, is much smaller than the effects of greenhouse gases. The joint effects of the above two processes are global warming and the regional-scale modification of the rest of the climatic elements. New scientific findings related to the above recent climatic change emerge every now and then. The vast majority of those are found by the science of climatology contributing to economic and social conclusions. As a result, greater emphasis is placed on the joint study of impact assessment and greenhouse gas emission reduction issues in the doctoral program based primarily on the revision of certain climatological terms and quantitative description methods.

– *Renewable energy resources*: There are two important reasons of the fact that the attention of humankind turned (again) towards renewable energy resources in the last third of the 20th century. One of the reasons is that certain fossil energy resources are running out. The other – that can be proved easier – is that the burning of the fossil energy resources increases the concentration of certain greenhouse gases contributing to the generation of the climate change process. Other reasons include the protection of the environment in another aspect that can be ensured with the exploration of the utilization possibilities of the atmospheric sources (solar, wind and water energy) and the rest of the energy sources. The task can be solved only in the relationship of the landscape and the climate since the potential quantity of these energy resources depend on the climatic conditions of the area. Apart from developing methods for determining the potential quantity of atmospheric energy resources great emphasis is placed on the social acceptance of renewable energy resources together with their effects on landscape structure and land use.

– *Urban climatology*: In built-up areas the modified composition of the atmosphere and the different land cover compared to natural surfaces result in the modification of climatic elements and eventually in the development of urban climate. As urbanization advances around half of the population of the planted and almost two thirds of the population of Hungary live in cities exposed to the disadvantageous effects of urban climate. The research focuses on studying the heat island phenomenon developed in Debrecen and in the surrounding towns due to different weather conditions using the data of mobile measurements carried out in Debrecen and in the surrounding settlements in order to work out an empirical heat island intensity prediction model. Associated with it is the formation of an urban climate measurement station network in Debrecen. The third area includes studying urban human comfort, front sensitivity and air quality.

Sustainable energetics sub-program

Aims of the sub-program:
In the “Sustainable energetic” sub-program of the Earth Sciences Doctoral School scientists study the possibilities of reducing the energy consumption of buildings taking into account the physical properties of the structures and building materials of

the building, the increase of the efficiency of building engineering equipment, the determination of optimum operational parameters, the application and optimal integration of renewable energy resources, the modelling of the above system elements and systems, the relationship of the building, the built and the natural environment. Research also aims to handle energy efficiency, the built and the natural environment in a united system and to expose the possibilities of energy supply of settlements based on environmental friendly resources and of reducing environmental load.

The training opens space for innovative, complex environmental, architectural and building engineering solutions and also for working out establishment and settlement models, and city operation strategies with minimum energy usage adjustable for various climatic parameters. Besides life-cycle analyses the establishment of new, hierarchic systems are also important in the field of establishment energetic in order to develop and standardize traditional and modern structures, equipment and material.

Program courses

- Climate change, effects, responses (János Mika)
- Urban climatology (Sándor Szegedi)
- Statistics (Szilárd Szabó)
- Agrometeorology (Károly Tar)
- Environmental effects of social activities (Attila Kerényi)
- Landscape research and landscape protection (Tibor Novák)
- Ecological landscape structure research (Péter Csorba)
- Cultural landscapes (Péter Csorba)
- Energy management – energy policy (István Fazekas)
- Environmental policy of the European Union (István Fazekas)
- Landscape metrics in landscape protection (Szilárd Szabó)
- Environmental condition survey, revision (Szilárd Szabó)
- Soil deterioration and protection (Tibor Novák)
- Environmental protection of neighbouring countries (György Szabó)
- Urban environmental protection (György Szabó)
- Urban ecology (Péter Csorba)
- Protection of abiotic natural values (Tibor Novák)
- Landscape planning (Péter Csima)
- Environmental effects of tourism (Lóránt Dávid)
- Establishment energetics (Ferenc Kalmár)
- Comfort conditions of a closed environment (Ferenc Kalmár)
- Environmentally sound buildings (Imre Csáky)

2. NATURAL AND ANTHROPOGENIC PROCESSES OF THE LITHOSPHERE AND HYDROSPHERE PROGRAM

Program leader: **Dr. József Lóki**, DSc

General aims of the program

Our aim is to preserve the intellectual heritage of the outstanding scientists and to support the application of recent research trends and methods in the departments of the University of Debrecen, namely the Department of Mineralogy and Geology and the Department of Physical Geography and Geoinformatics. Another aims is to meet the social requirements of recent years, the EU directives and to transfer modern, internationally high standard knowledge.

Research fields in the program: physical geography, geology, hydrogeology, geophysics, geoinformatics.

Key-points of the program in geology

- On the basis of its specific views, diverse analysis methods and close relationships with a wide range of natural sciences, geology is suitable for modelling the long-term and short-term processes, exposing the development trends, protecting the values of our planet and environment that increasingly lose their equilibrium regarding.
- It is a basic task to apply and integrate the results achieved in plate tectonics, palaeoecology, geochemistry, geothermics and environmental geology into education with the help of up-to-date theoretical and analytical apparatus. The program can be divided into several topic groups that are based on each other.
- Up-to-date informatics and geoinformatic methods are essential for the solution of the above tasks that are fundamental for both database construction and modelling.
- National and international and also institutional co-operation possibilities are important for focusing on interdisciplinary fields (morphotectonics, energetic, protection of environmental values, avoidance and prevention of damage to values) just as reviving the methods of exploring essential raw-material.

Key-points of the program in Geomorphology

- On the one hand, recent processes may cause concrete risk or damage to the society and on the other hand, their thorough knowledge may help exposing their utilizable characteristics.

- It has been revealed in recent decades that the surface is formed to an increasing extent by the society to create a new environment for itself (nature – society interaction). The activity of the society triggers new processes forming the surface and at the same time it can modify significantly the effects of active natural processes (action – reaction). As a result, recent surface forming processes become more and more anthropogenic and their study gets the studying science even closer to the society. As a result, in changing geomorphology the basic characteristics of the traditional duality of geography strengthen (studying the spatial processes of nature on the one hand and the society on the other hand and thus expose their interaction in detail).
- Today, geomorphologic research must not remain at studying the shaping effects of natural and social processes but it has to be completed with evaluating the positive (advantageous) and negative (exposing threat) effects of these processes with exposing feedback mechanisms and modelling.
- New aspects and tasks in geomorphology today include the exact measurement of processes and landforms as conditions apart from the detailed genetic and qualitative mapping of the surface. Their successful utilization and even (justified) preservation is only possible based on the above results. Co-operation with engineering sciences in the field of applied geomorphology: creating useful information for sciences helpful for regional planning.

Key-points of the program in geoinformatics

The spreading of personal computers in Hungary and professional software packages in earth sciences over the last two decades enabled new possibilities in almost all fields of research considering data storage, processing and interpretation.

- Geoinformatic and geostatistical processing of geological and geomorphological taking utilization aims into account.
- Applying and developing geoinformatic modelling in research fields associated with our doctoral program.
- Remote sensing possibilities in geological, geomorphological, hydrological and hydrographical research based on aerial (satellite, airplane, drone) and land (GPS, measurement station, land photogrammetry) survey data.
- Development of geoinformatic methods, and the study of the accuracy of measurements, data and methods.
- Analysis of digital elevation models using geomorphometric methods for object identification.
- Solving urban geomorphological research tasks with the joint application of geomorphology and geoinformatics.

Recommended and highly supported topics in the doctoral program

- Studying rapid climate change and associated changes in the environment and the biosphere in the Mesozoic.
- Studying the noble gas isotope ratio (He, Ne, Ar, Kr, Xe) of rocks and fluid inclusions in minerals in order to determine the origin of the rock or that of fluid movements in rocks (crust or mantle).
- Hydrodynamic and contamination flow modelling of subsurface waters. Interaction of subsurface waters. Studying filtration in the three phase zone of soils.
- Up-to-date geodynamic, micro-tectonic and morphotectonic studies and sequence stratigraphy based basin analysis supported with geophysics and geoinformatics, characterization of raw material resources (water, coal, geothermal energy), resource calculation, optimization of mining methods and effective exploitation of resources.
- Volcanological research integrated with regional tectonics and mega-structural reconstructions covering areas that lacking data (e.g. Tardona Hills, Mecsek) and also regions over the border (e.g. Transcarpathia, Northern Transylvania).
- Complex geological, technological, environmental geological, etc. research of mineral raw materials and their environmental friendly utilization.
- Research of the material and origin of archaeological tools, archaeometric study of the material and technology of building material and ceramics, palaeoenvironmental reconstruction of archaeological expositions.
- Research of the morphological issues of natural landscape evolution present in today's natural environment, especially in the lowlands, hills and mountains of NE Hungary. Special focus is directed on fluvial, aeolian processes and mass movements.
- Characteristics and modifications of landscape development due to anthropogenic activities. Geomorphological risk and hazard analyses, equilibrium problems in river floodplains, wind-blown sand areas and in valley systems in hills and mountains.
- Geomorphological natural value survey and protection especially in landscape types sensitive to natural equilibrium. Development of the theoretical basis and practical system of geomorphological value protection in Hungary.
- Geomorphological modelling – modelling experiments, theoretical models.
- Exposing the geomorphological characteristics of highly dangerous – either directly or in their long-term effects – anthropogenic activities (mining, industry, infrastructure development, intensive agriculture), prognosticating their consequences and reduction of their threat.
- Analysing the geomorphological relations of landscape planning and reclaim of mined areas, integration of the role of geomorphology in landscape protection. Analysis of the natural bases of regional development.
- Quantitative study of the characteristics of the earth surface (relief), integration of the results in geographical information systems (GIS), theoretical-methodological

issues of the application of informatics in geological, geomorphological, hydrological, etc. research, geomorphological possibilities and tasks in digital thematic mapping.

- Application of remote sensing methods in analysing and interpreting surface changes.

Program courses

- Interpretation of geochemical data (Gábor Dobosi)
- Environmental geochemistry (Gábor Dobosi)
- Igneous petrogenesis (Gábor Dobosi)
- Advanced analytical methods in geochemistry (Gábor Dobosi)
- Building stones in history (Péter Rózsa)
- Selected Chapters in Mineralogy and Petrology (Péter Rózsa)
- Environmental Geology (Miklós Kozák)
- Hydrodynamic modelling (Tamás Buday)
- Applications of thermal analysis (Árpád Csámer)
- Structural geology and morphotectonics (Richard William McIntosh)
- Clay minerals (István Viczián)
- Petrology of formations (István Viczián)
- Radiometric age determination (Zsolt Benkó)
- Volcanology (János Szepesi)
- Key events in the history of the biosphere (Gábor Pálfy József)
- Landscape Metrics (Szilárd Szabó)
- Research Planning and Publishing (Szilárd Szabó)
- Geosciences of Statistics (Szilárd Szabó)
- Geomorphological problems of the Great Hungarian Plains (József Lóki)
- Anthropogenic Geomorphology (Csaba Tóth)
- Geological application of photogrammetry (Gergely Szabó)
- Applied cartography (Gergely Szabó)
- Static and dynamic surface analysis and evaluation (Gábor Négyesi)
- Geo-heritage - anthropogenic form - tourism?! (László Sütő)

3. SOCIAL GEOGRAPHY AND REGIONAL DEVELOPMENT PROGRAM

Program leader: **Dr. Gábor Kozma**, DSc

Aims of the program

Development of research meeting the new challenges of social geography (human geography) together with preserving the valuable traditions. Maintaining and further developing the research orientations of modern regional development with following continuously the new research methods.

Research fields associated with the program: social geography, regional development, tourism.

Role of already performed research in the program

Research of the teachers associated with the PhD program is wide ranging considering both geographical, regional development disciplines and the selected geographical regions. Regarding the selection of geographical regions, although it is focused on Northeast Hungary it still covers the entire country and in many respects it extends to Europe and even other continents. Three lines are markedly separated in the thematic diversity. One of them focuses on traditional social and economic geographical research with up-to-date content and methods (demography and settlement geography, village geography, lifestyle studies, regional relations of industry, regional effects of tourism); the other opens towards completely new social geographical sub-disciplines (geopolicy, cross-border relations, labour market studies); while the third contributes to the scientific grounding of regional and settlement development. Considering the methods, apart from using the officially collected statistical data (e.g. Regional Information System, company information databases) “soft” study techniques (questionnaire survey, interviews) taken from social sciences are applied increasingly. Geoinformatic and modern data processing methods also gain focus increasingly in the analyses.

Research areas of the teachers in the PhD program cover the following fields:

- Interethnic research in the NE part of the Carpathian Basin;
- Euroregions as successful participants of international co-operation;
- Transformation of village space in the northeastern regions of the Carpathian Basin;
- Research grounding the regional and settlement development of East Hungary;

– International migration and minorities;
– Employment policy issues in Hajdú-Bihar county;
– Studying the marketing policy of local governments in Hajdú-Bihar county
– Recent research directions in political geography; geopolitics in Central Europe;
– Human resources in East and Northeast Hungary;
– Regional characteristics of the transformation of the industrial structure;
– Specifics of today's urbanization;
– Inequalities in social-economic spatial processes;
– Foreign trade characteristics of Eastern-Central countries;
– Studying the spatial effects of tourism.

Topic groups of the program

The scientific activity of the PhD program since 1990 can be grouped into the following topics.

1. Focusing on the regional and settlement development of different regional levels is justified by Hungary joining the European Union. Colleagues of the Department regularly participate and give lectures at Alföld Congresses. Research at the department significantly contributed to the documentation of the intensifying economic-social changes and also to the development of the methodology of delineating underdeveloped regions. The success of the work of the Department is indicated by that the colleagues were involved in creating several county regional development concepts and programmes and settlement development concepts and also in working out documents steering the transformation of villages into towns.

2. The detailed study of Debrecen, the second city of Hungary, the regional centre of the Tiszántúl and the scientific analysis of the changes in the last decades are included among the tasks in the program. Associated research results were presented at several scientific meetings and were published in three volumes entitled „Studies on the urban geography of Debrecen". The lecturers at the Department have been honoured to take part in working out several documents founding the development of Debrecen and its wider environment (e.g. Integrated Urban Development Strategy, Integrated Settlement Development Strategy).

3. The third major field of scientific study at the Department is research of crossborder relationship and the possible ways of co-operation. This includes both direct relationship and co-operation in joint research programs with other universities abroad. Colleagues of the Department worked in several INTERREG projects and aim to become an important scientific base for the main priority of the Regional Co-operation of the EU.

4. Human resources present a very important basis for recent development therefore – co-operating with the Institute of Education at the Faculty of Arts – great emphasis

is given to expose the regional differences in the education level of the population and associated with it the employment conditions with special regards to the Roma population.

5. The fifth focus point of the Department is closely associated with the recent industrialisation of the Eastern-Central European region started after 2000. The appearance of global value chains in Hungary, the development of the sub-contractor system and the regional consequences of solutions associated with the „Industry 4.0” programme have been studied.

Program courses

- Methodology of social geographical research (Károly Teperics)
- Data collection in social geography (Károly Teperics)
- Human resources and regional development (Károly Teperics)
- Geographical diffusion of innovation (Gábor Kozma)
- Social and economic decline of Eastern Hungary (Gábor Kozma)
- Migration and Hungary – Migration (Mrs Pál Eke)
- Geopolitics (Zsolt Radics)
- Regional processes (Ernő Molnár)
- Methodology of studying urban functions from regional planning point of view (Zoltán Bujdosó)
- Regional development inequalities (János Pénzes)
- Development possibilities in borderside regions (Klára Szilágyi-Czimre)
- Urban planning (György Csomós)

Appendix 1

Doctoral School of Earth Sciences, University of Debrecen

Subjects for the theory part of complex exam

Main subjects:

1. Physical geography
2. Landscape protection
3. Environmental protection
4. Social geography
5. Economic geography
6. Climatology
7. Palaeontology
8. Geology
9. Petrology
10. Energetics of establishments
11. Environmentally conscious buildings
12. Curriculum theory (in the case of PhD in education methods)

Side subjects:

1. Geomorphology
2. Landscape geography
3. Regional environmental protection
4. Agrometeorology
5. Regional economics
6. Regional policy
7. Social geography
8. Geology of Hungary
9. Environmental geology
10. Hydrogeology
11. Geochamistry
12. Geophysics
13. Mineralogy
14. Structural geology
15. Palaeoecology
16. Applied and engineering geology
17. Agrogeology
18. Historical climatology
19. Environmental climatology
20. Remote sensing
21. Geoinformatics
22. Comfort conditions of a closed environment
23. Studying natural and non-natural based insulation and building materials
24. Application of solar energy in the energy supply of establishments

Appendix 2

Competence to be obtained in doctoral training

1 knowledge

- is highly aware of the most important trends in the landscape and environment research, their development, the associated scientists and the differences in their view
- has all the knowledge that includes general characteristics of the lithosphere and hydrosphere, key findings of scientists in the fields of geological, geomorphological and geoinformatic research
- has knowledge of the most important characteristics of social geography sectors, with the most important achievements of the work of scientists in each sector
- is highly informed about the theoretical issues of processes in the natural and artificial landscape and in the atmosphere, the systems based on them and the links between them
- knows the models related to processes in the lithosphere and hydrosphere, the link between the phenomena and their impact on society
- understands theories in the field of social geography and regional development, is well informed about the possibilities for exploring the impact of the processes on each other
- knows the methods to be applied in landscape and environmental protection research
- is aware of all the practical knowledge required for high-level research into natural and anthropogenic processes in the lithosphere and hydrosphere
- has practical knowledge that is essential for learning about the spatial functioning of the society, for a high level of analysis of the problems encountered in the field of regional and urban development

2. abilities

- able to organise and successfully conduct field data collection and questionnaire surveys
- has the ability to analyse statistical data on the spatial functioning of the society using mathematical and statistical methods and thereby identify links and differences between sub-phenomena
- capable of processing information obtained through aerial photography and remote sensing, scientifically demanding explanation of the differences between the results and the real situation
- able to test the field samples collected by himself/herself in laboratories
- has the ability to use the research infrastructure of the doctoral school in a high-quality and reliable manner

- capable of detecting causal links between natural and social geographical processes, geological and meteorological phenomena
- is able to compile a presentation on his/her research results of the field of earth sciences and to communicate it in Hungarian and also in foreign languages, and to answer questions about them
- is able to summarize research results in a scientific publication and to manage successfully the publication process

3. attitude

- reveals openness to further develop existing knowledge and new models when learning about natural and social geographical processes, geological and meteorological phenomena
- seeks to protect natural resources of community values in the context of field research
- respects fundamental moral and community values when carrying out a questionnaire survey

4. autonomy and responsibility

- seeks to solve less complex tasks independently in his/her research, relying on existing knowledge
- asks the supervisor for advice to address more complex problems
- assesses and avoids the risks involved in field surveys and questionnaire surveys
- treats and responsibly manages the information that is made known to him/her during data collection
- seeks to justify the obtained results from several aspects