



INNOVATIVE SOLUTIONS FOR SUSTAINABLE GROUNDWATER RESOURCE MANAGEMENT

UNIVERSITY OF MISKOLC

the
Water
WiseWay



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MISKOLCI EGYETEM
MŰSZAKI FÖLDTUDOMÁNYI KAR

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INTRODUCTION

Busy days are behind us! A unique opportunity was granted to the researchers of the University of Miskolc, Faculty of Earth Science and Engineering when our proposal titled: "Innovative solutions for sustainable groundwater resource management" (short form: WaterWiseWays) was funded by the GINOP 2.3.2 R&D excellence program in 2017.

The project is a follow up of our former groundwater management research program of similar scope. This project however had a strong emphasis on improving excellence in R&D, thus we were privileged to be selected for funding.

The project goals were formulated to work out and test novel engineering solutions in the field of water management, hydrogeology and soil protection. The achieved results are expected to contribute remarkably to sustainable water management practices in groundwater source protection, water utility activities and agricultural soil protection.

Besides striving for innovative solutions equally important aspect was to achieve socially and economically beneficial project results in relatively short term. It is widely known that such ambitious goals demand not only academic excellence and engineering skills, but also partnering with industrial partners and following or even forecasting business trends.

There are three main driving factors that motivate researchers to develop new measurement and data management techniques in water management.

The first one is the widely observed climate change and increased frequency of extreme precipitation events that directly impact the recharge intensity. The second factor is the globally increasing population growth and consumer trends that dramatically increase water demand especially at highly populated areas. The third aspect is the present trends in digitalization, sensor technology which opened unprecedented possibilities during the past decade in data collection, that necessitate the use of latest data management techniques including Big Data and artificial intelligence techniques.

In the present booklet we want to introduce the results we achieved during the last four years by the researchers of the Institute of Environmental Management, Institute of Geography and Geoinformatics and Institute of Geophysics and Spatial Information Systems. The results are briefly highlighted as structured to three research modules, however more detailed technical information can be accessed via QR codes. On the last pages of the booklet we list relevant publications authored by project contributors. I trust that this booklet will raise your interest and shall open door for new technical collaborations

*Prof Dr. Péter Szűcs
full professor, project technical chair*



RESEARCH MODULE 1

Extreme weather conditions and their impact on water resources cannot be neglected. This is especially true in Hungary where our drinking water sources depend on the quantity and quality of groundwater resources almost exclusively. Our investigations were based on several field measurement stations in the Great Hungarian Plain and the Bükk mountains. The data collections were aiming the better understanding of hydrogeological processes, detecting its dynamics and ultimately to better understand the intensity of infiltration (groundwater recharge). The data generated were assessed with modern data management data interpretation routines.

*Prof. Dr. Péter Szűcs,
vice rector, full professor*



RESEARCH MODULE 2

Hungary's agricultural land and soil is globally known for its high quality and fertility. Beyond its natural features numerous anthropogenic phenomena such as way of cultivation and irrigation have significant impact on how the soil quality will change in the future. A group of researchers of the Institute of Geography and Geoinformatics has a strong commitment to better understand these processes and educate farmers, professionals and the wider public. The purposeful linking of our hydrogeological and soil science competences and the related intense field work provided a number of remarkable results. A database was generated based on a few hundred soil profile excavations, measurement points and numerous on-site consultations, workshops drawn the attention of experts and farmers on the threat of intense soil compaction, fragmentation, erosion and other unfavorable phenomena related to water.

*Endre Dobos Endre, head of
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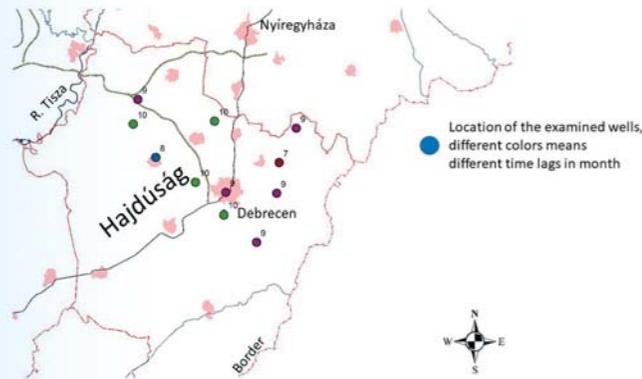
RESEARCH MODULE 3

A challenge of 21st century water management frontiers is the water security of highly urbanized regions, such as the aging water utility networks, sewage system operational challenges or even cleaning up groundwater pollution. Our research team tested the applicability of a novel remote sensing-based technique to locate drinking water pipe failures. In an integrated GIS environment, we evaluated the risk factors that lead to pipe failures. Based on our soil mechanics and geotechnical laboratories and field activities, we developed new concepts to better understand pipe failure vulnerability, specific features of soil contamination phenomenon and the features of agricultural lands. For more details of our research, please refer to the contact information and QR codes found in this booklet.

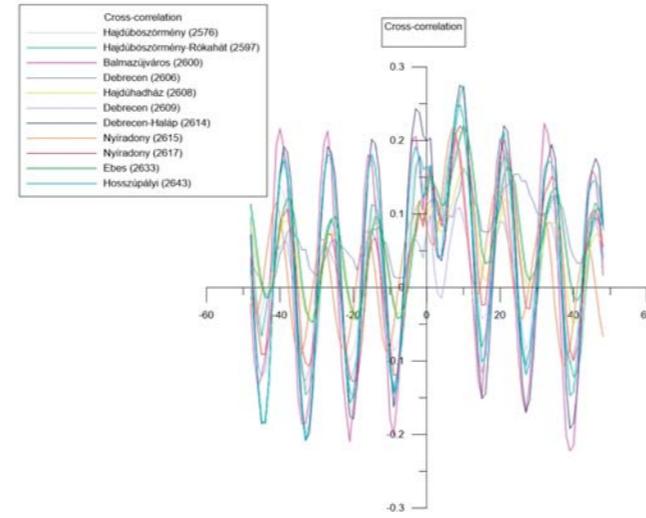
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PRECIPITATION AND GROUNDWATER RECHARGE INVESTIGATION AND ITS RELATIONSHIP BY ISOTOPE MEASUREMENTS AND STATISTICAL SURVEYS

Precipitation and groundwater systems feeding on it have been studied in many ways before. As part of our work, on the one hand, we determined the concentration of isotopes and their proportions on groundwater samples taken from several depths, from areas ranging from Nyírség, Hajdúság and the Danube-Tisza Interfluve. This way, the age and velocity of the downward infiltration are measured using water ageing.



- The location of the wells involved in the study in the Nyírség and Hajdúság region, the time lags between the precipitation and water levels, in months



- Cross-correlation analysis of data series

Another major area of our research was the analysis of related time series. In the course of this, comparative studies were performed to quantify the hydrological relationship and to determine the delay times using long-term water level data from a set of several observation wells in the Hajdúság area and the measured precipitation amounts. Using advanced mathematical methods, we searched for cycles with different periods of times



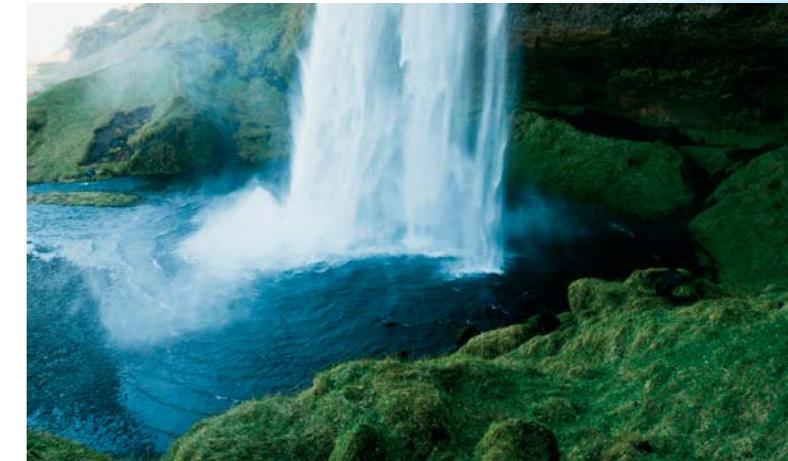
- Shallow groundwater wells in the Nyírség region

in the data series, examining them first separately and then together. Knowing the results, we quantified the relationship on a daily and monthly basis, and we were able to show the regularities by searching for the hydrological cycles in the data series.

INNOVATIVENESS & EXPLOITABILITY

Studies in the sample areas will help to understand the dynamics of the water cycle in line with current international research trends on climate change and the Earth water cycle. Our research contributes to the understanding of the relationships and regularities inherent in the cycle, while on the basis of the results forecasts can be given for specific areas, thus the negative effects of extreme weather conditions can be mitigated. The results show the closeness of the relationship between

the amount of precipitation and the groundwater level, which may seem random at times, however, our studies unfolded several cycles that can be explained by natural processes. Knowledge of the results helps local decision-makers in the implementation of sustainable water management and supports the avoidance of emergency situations by making forecasts and by more precisely defining the GW supply.



RESEARCHERS

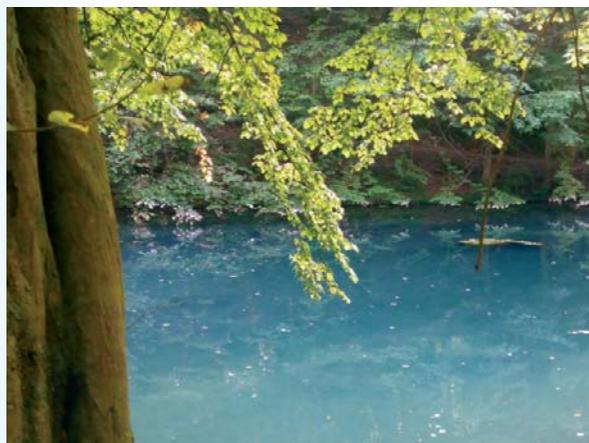
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- Prof. Dr. Péter Szűcs, full professor
- Dr. Márton Tóth, assistant professor

CONTACT

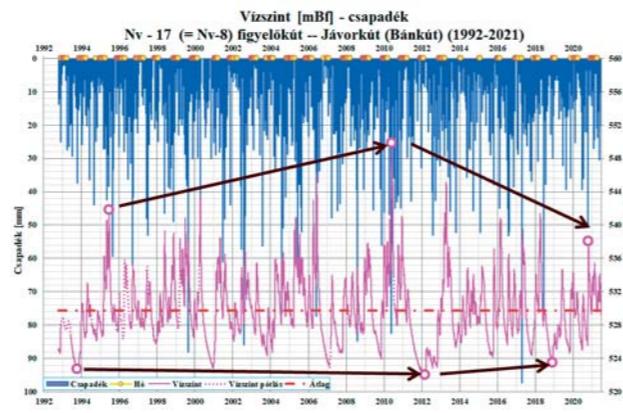
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NEW CHAPTER IN THE HISTORY OF THE BÜKK KARST WATER LEVEL MONITORING SYSTEM

In the frame of the project device development and monitoring point enlargement on the Bükk Karst Water Level Monitoring System (BKWLMS), operating for more than 30 years, were carried out. Continuous quantitative monitoring activities were completed, accompanied with qualitative measurements (eg. water chemistry, environmental isotopes).

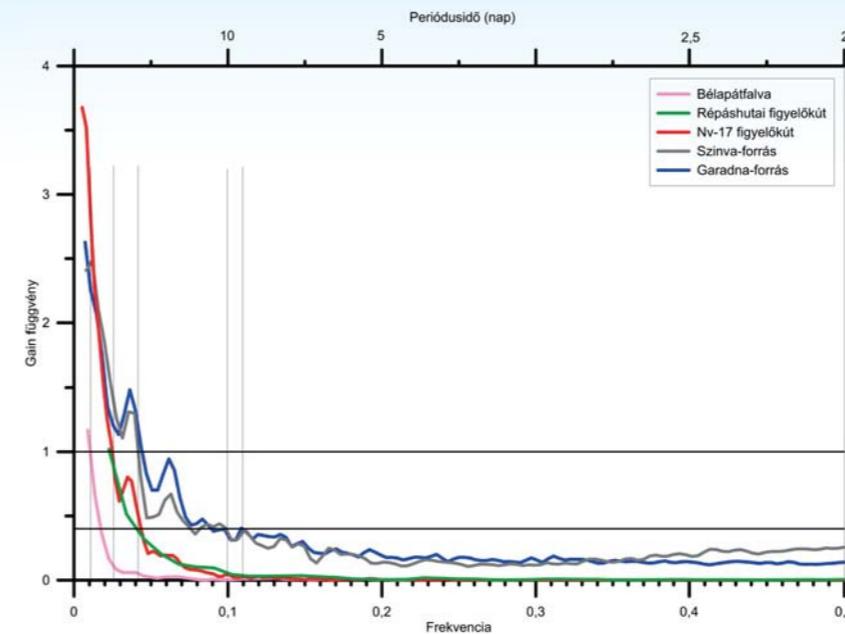


The long-term data series of the BKWLMS are unique at European level, too. These datasets were subject to science-based, new generation statistical analyses and their complex interpretation. Tests and investigations covered both the cold and the thermal karst system in the Bükk mountains. We proved the hydraulic intercon-



- Water relief prepared from mean water levels

nectedness of these karst systems. As part of our research, a momentary water budget estimation method was developed based on BKWLMS datasets, geological features and karst water level relief map. Using different kinds of methods several comparative test was carried out. As a result, examined geological formations of the Bükk Mountains can be ranked in line of hydraulic conductivity features and storage characteristics. Researches also covered examination and presentation of thermal features and conditions of the thermal karst system. Complex results greatly promote the best possible knowledge of the Bükk karst system.



- Gain function is to determine duration of flow types

INNOVATIVE CONTENT AND USABILITY

As multipurpose karst water production (drinking water, balneological, energetical and heating purposes) is being carried out in the Bükk Mountains, getting knowledge of special karst aquifers as thoroughly as possible is of strategic importance for sustainable water management of the region. A very important achievement in this field is the mathematical verification of the existence of the hydraulic connection between a cold and a thermal karst system. The karst water level relief model we created, as well as determined technical borders (slowly and quickly recharged dynamic, and thermal karst

water), enable to perform momentary water budget estimation and infiltration examinations. According to the model, the waterworks can plan their daily production and can prepare for water exploitation from alternative sources if it is needed. Based on the karst water level relief map made from measured data, the typical karst water flow directions in the mountain can be determined such as the expected potential values at any point. All these remarkably simplify water well design, water flow tracking, as well as contamination propagation modeling. Time series analyses performed with modern mathematical methods led to a better understanding of the Bükk karst system, its karst water flow system features and other characteristics.



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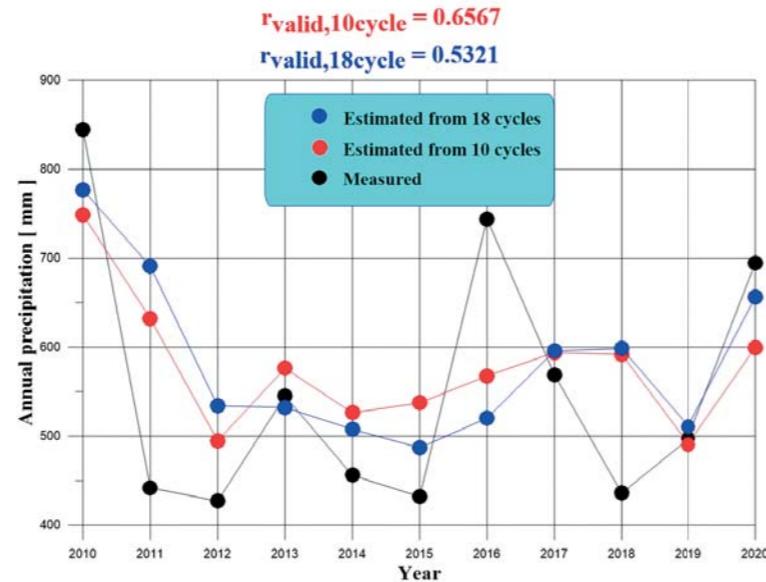
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DEVELOPMENT OF SPECTRAL DATA PROCESSING METHODS FOR THE ANALYSIS OF EXTREME WEATHER CONDITIONS

To understand the dynamics of the ever-changing Earth climate, it is particularly important to identify the patterns inherent in the processes. For this goal, we performed calculations using advanced mathematical methods on a number of long-term data sets (110-year precipitation, 50-60-year-long water levels). The purpose of the methods used is to look for regularities in precipitation amounts that are thought to be stochastic. By using spectral analysis, we were able to detect several periods from the annual, monthly and daily precipitation amounts, then we used the Wavelet analysis methodology to examine the strength of these periods in the 110 years timeframe. We also examined the effect of different global climate phenomena on the amount of precipitation in the Carpathian Basin, and the periodicity in them. In addition to the most famous El Nino, we have studied the effects of several other climate oscillations and have shown that they can have a small but also influential effect on the climate in Central Europe.

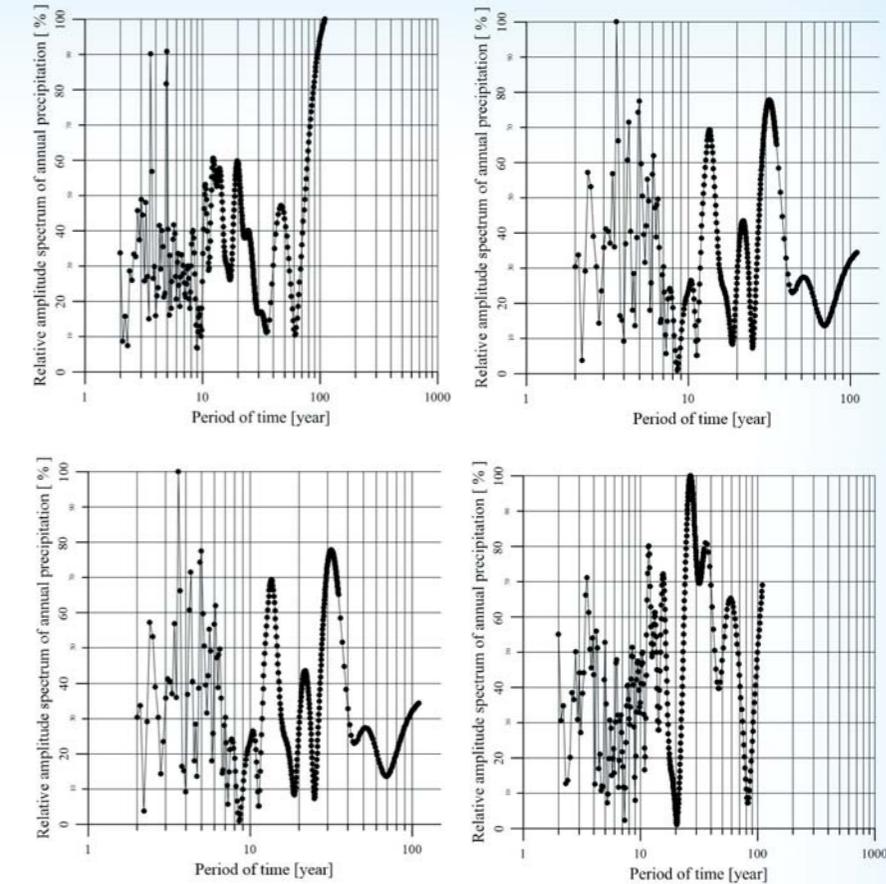
INNOVATIVENESS & EXPLOITABILITY

In the course of the research, the temporal development of the precipitation in the Carpathian Basin became better known. The methodology of spectral analysis is



- Estimation of annual precipitation amounts for the period 2010-2020, together with precipitation amounts measured since then

rarely used for such studies, as it requires long-term measurements for the reliability of the result. Fortunately, such data sets have been available for more than 100 years now, so we were able to calculate nationally occurring rainfall cycles from annual, monthly and daily data for the entire 20th century, and with the help of forecasting we were able to create a deterministic estimate of expected rainfall amounts for the future. The search for such periods and its relationships is especially important for the implementation of sustainable water management and adaptation to the changing climate, as our groundwater feeds on the infiltration of fallen rainfall, so any change in it will affect the whole process.



- Amplitude spectrum of annual precipitation amounts for Budapest (upper left), Debrecen (upper right), Pécs (lower left) and Szombathely (lower right)



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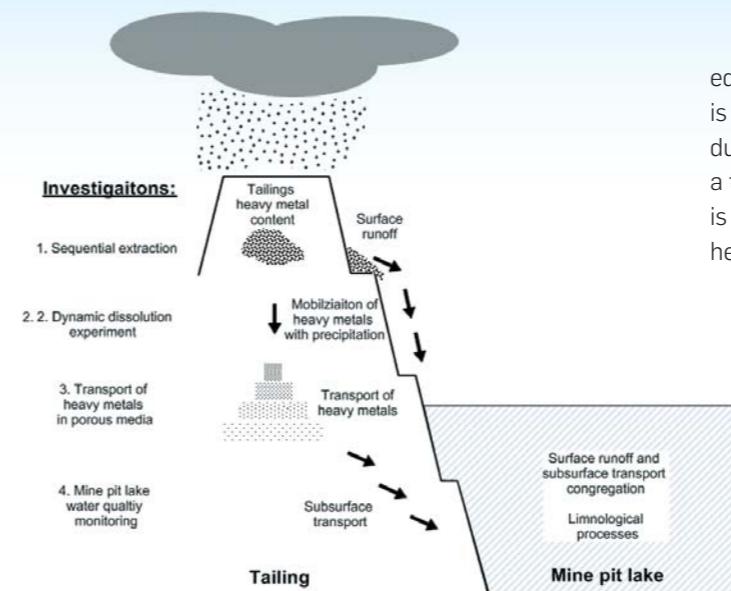
INVESTIGATION OF HEAVY METAL MOBILIZATION CONDITIONS AND ENVIRONMENTAL IMPACT OF ABANDONED MINING AREAS



The aim of the research work was to get to know the abandoned mine site of Rudabánya with a focus on its environmental conditions. Heavy metals leached out from waste dumps threaten the clarity of surface water bodies and subsurface ones. This process is very complex and require extensive laboratory and field investigations. The first research task was aimed at determining the leachability of different heavy metals from waste dump material, and was focused on its quantitative aspect. In the subsequent step, the modeling of the leaching process occurred. As a third step, the properties of subsurface transport of heavy metals were investigated. The closing task of research work was aimed at investigating surface water bodies affected by heavy metal leaching. According to our research work, the unique geological situation of Rudabánya with its high volume of carbonate rocks inhibits the transport of heavy metals from the waste dumps, although they have significant heavy metal content in some cases. This way, the easily leachable heavy metal content of the waste dumps does not threaten the clarity of surface and subsurface waters.

INNOVATIVENESS & EXPLOITABILITY

The main result of the research work is the output of parameter sensitivity analysis of 1D transport



equations. The experimental result of the research is the proof that the heavy metal content of waste dumps of abandoned mine sites does not always mean a threat to water resources. The geological condition is key to judge what we can expect in the transport of heavy metals.



RESEARCHERS

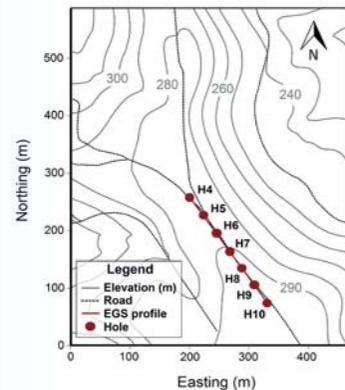
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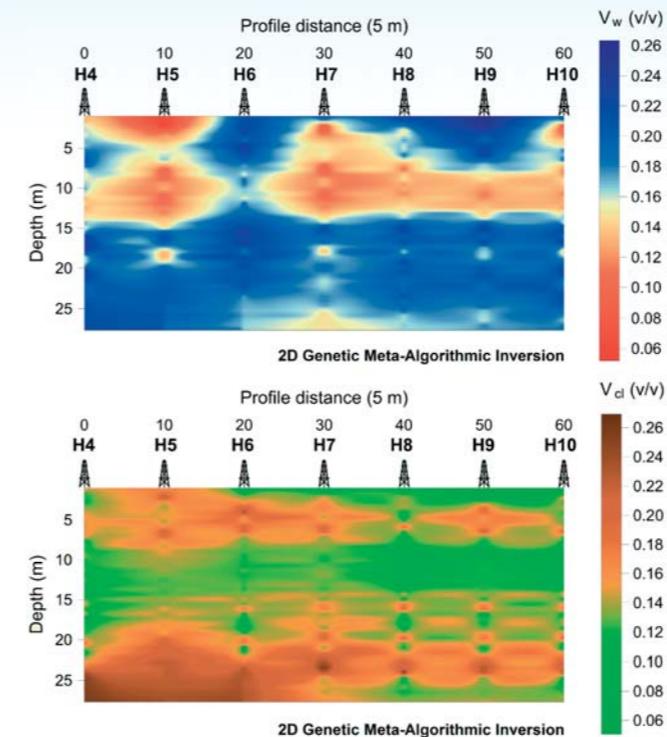


DEVELOPMENT OF HYDROGEOPHYSICAL DATA PROCESSING METHODS FOR STUDYING AQUIFERS



By jointly processing the data collected with borehole geophysical probes, the void ratio, water saturation, clay content of soil layers/rocks and the amount and composition of the minerals forming the solid rock frame and their estimation error were determined. The interpreta-

tion was performed using computer-controlled data processing (so-called inversion) methods developed by us. Using the toolbox of artificial intelligence, we developed an evaluation method based on the principle of natural selection, which was tested on engineering geophysical sounding data. The mineral composition, pore content and volumetric parameters of the near-surface unsaturated sedimentary formations and soils were determined jointly, which allows for a significant reduction of laboratory measurement costs. The method was successfully applied to characterize aquifers seated deeper than the above exploration range. The physical properties of aquifers were determined on the basis of borehole geophysical measurements carried out in water exploration wells the results of which were confirmed by pumping tests. The determination of the thickness, petrophysical and hydraulic characteristics of the layers and their log-like determination were performed in several Hungarian test areas.



INNOVATIVENESS & EXPLOITABILITY

We developed new, innovative computer-controlled (automated) hydrogeophysical log interpretation procedures. We applied the mathematical toolbox of artificial intelligence to a new field of hydrogeology. The data processing method supported by the genetic algorithm provides an accurate and reliable solution even in the absence of preliminary geological information, which increases the efficiency of processing and significant-

ly reduces the role of costly laboratory data during interpretation. The method development covers the physical characterization of the near-surface unsaturated range and deep thermal reservoirs. By evaluating the measurements, we can group the geological formations more accurately and reliably, as well as calculate their petrophysical properties. The usefulness of the developed methods is demonstrated in the estimation of water resources, their more efficient production and water quality protection. The results of the method development were presented in Q1 / Q2 ranked scientific publications. With the borehole geophysical instrument equipped with modern water exploration probes acquired within the framework of the project, a complex instrument park was created at the Department of Geophysics at the University of Miskolc, which is suitable for solving hydrogeological and environmental tasks using field geophysical measurements.



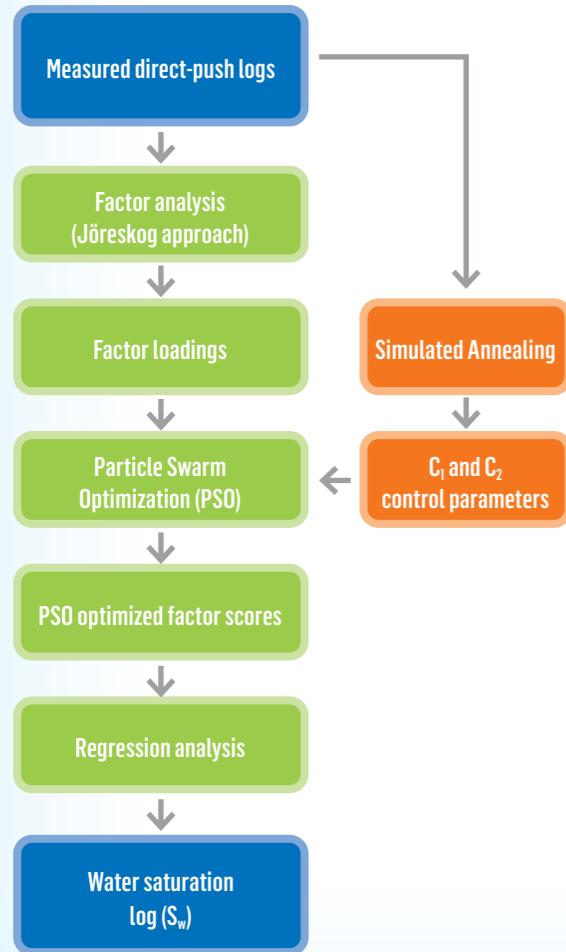
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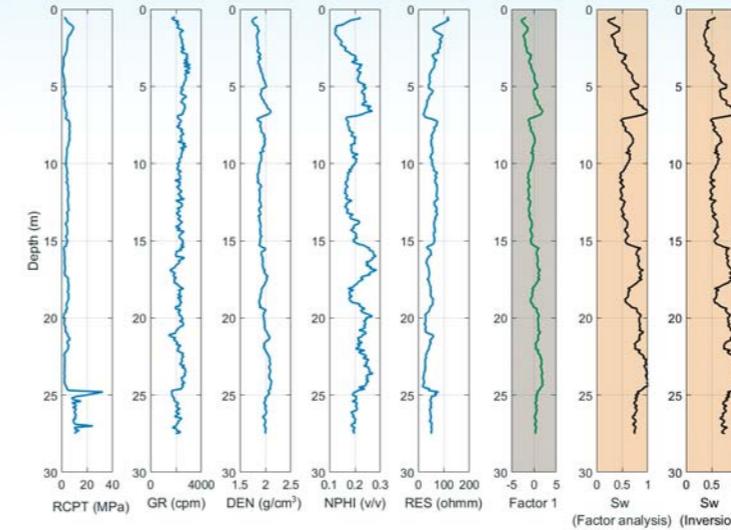
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GLOBAL OPTIMIZATION BASED DATA PROCESSING METHODS



Based on the PSO algorithm that models the movement of animals, we developed new well log interpretation procedures. Because traditional data processing methods are sensitive to the choice of the starting model, we made the evaluation procedure independent of it. The deviation between the data calculated on the estimated model and the measured data was significantly reduced, which made it possible to determine a more accurate and reliable hydrogeological model. The control parameters of the PSO procedure were determined objectively by a two-step algorithm. We introduced such a dimensional reduction procedure that facilitated the easier interpretation of measured variables. The relationship between the derived statistical variables and the petrophysical and hydrogeological pa-



rameters of the aquifers was effectively explored. In our studies, the clay content and hydraulic conductivity of the rocks were determined along the entire length of the boreholes and in the region between the boreholes. The measured geophysical parameters were compared with the results of laboratory tests on core samples, and the new data processing methods were successfully applied in the field as well. The clay content and hydraulic conductivity of clayey sand thermal water formations were determined, and the petrophysical parameters of near-surface unsaturated layers were also determined by the PSO-based inversion method.

INNOVATIVENESS & EXPLOITABILITY

We developed new evaluation methods for the efficient processing of borehole geophysical data. The developed

methods are suitable for the determination of the petrophysical parameters (water content, air content, clay content, rock composition, hydraulic conductivity) of different aquifers. The developed factor analysis based methods can provide an independent, accurate and reliable estimate of the clay content and hydraulic conductivity distribution of sedimentary layers, which are of key importance in determining the water storage capacity of rocks and water production. The generation of the learning parameters of the PSO procedure by hyperparameter estimation is a unique result in terms of the mathematical algorithm of the method. The results of the research may significantly contribute to the exploration of Hungarian porous aquifers in the future. The final result of the research is a PhD dissertation describing the method development results and a Q1 ranked scientific paper.



RESEARCHERS

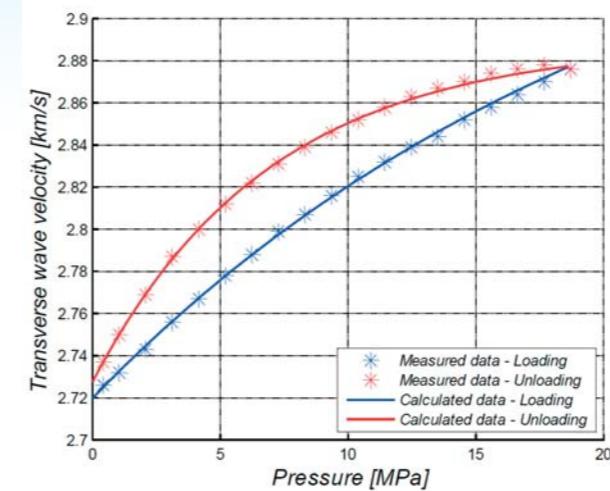
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PETROPHYSICAL STUDY OF THE ACOUSTIC RELAXATION PROCESS

The propagation characteristics of acoustic waves propagating in rocks play an important role in applied geophysical research. The advantage of laboratory ultrasonic measurements is that the effect of different physical conditions (pressure, temperature, pore-filling) can be modelled under supervised conditions. Based on acoustic laboratory experiments, we performed model and method development for the study of the acoustic relaxation process in petrophysics. To describe the pressure dependence of the acoustic wave propagation velocity and absorption, we set up a new petrophysical model, based on which the calculated data are in good agreement with the measurements. Calibration and test measurements were performed in the petrophysical laboratory of the Department of Geophysics to measure longitudinal and transverse wave propagation velocities under varying pressure. We have created a mathematical model to describe the velocity-pressure relationship under the loading and unloading of the rock sample. Based on the velocity of compression and shear waves we may deduce the porosity and permeability of rocks. The results of laboratory tests can be extended to determine the physical properties of subsurface rock formations. The results are of practical use in under-



standing the physical parameters required in water exploration and in the spatial extension of information from core measurements.

INNOVATIVENESS & EXPLOITABILITY

We developed an analytical model to describe the acoustic wave propagation characteristics and the relaxation processes of rocks. In the laboratory examination of the rock samples we dealt with the pressure dependence of the physical properties, which serves to extend and calibrate the information obtained from boreholes. The phenomenon of acoustic hysteresis (during which the pressurized rock does not return to its pre-load state when



the load is removed) is explained in a unique way by the model, in which new petrophysical parameters were introduced and determined by an inversion method. As more than two internal mechanisms can occur simultaneously when the pressure on the rocks changes (closure of the pore space or micro cracks, friction on the surface of the particles / cracks), therefore the combination of these elemental changes has an effect on the studied acoustic absorption characteristics. To explain the above phenomenon, we created a model with which the combined effect of any number of internal mechanisms could be described and predicted. From the research results, a PhD dissertation were prepared and defended as well as international conference papers were published.



RESEARCHERS

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- Prof. Dr. Mihály Dobróka, professor emeritus

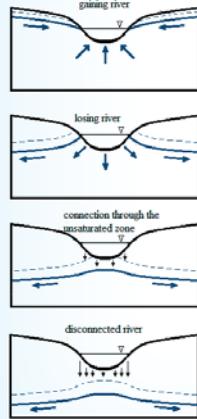
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NOVEL FINDINGS AND CORRELATIONS REGARDING THE SPACE AND TIME CHANGING RELATIONSHIP BETWEEN RIVER AND GROUNDWATER

There can be a close connection between rivers and groundwater. Rivers can tap or feed the aquifers and depending on the strength of connection also determine the groundwater flow system. The hydraulic impact of a river is complex, and not only the narrow riverbank is influenced.

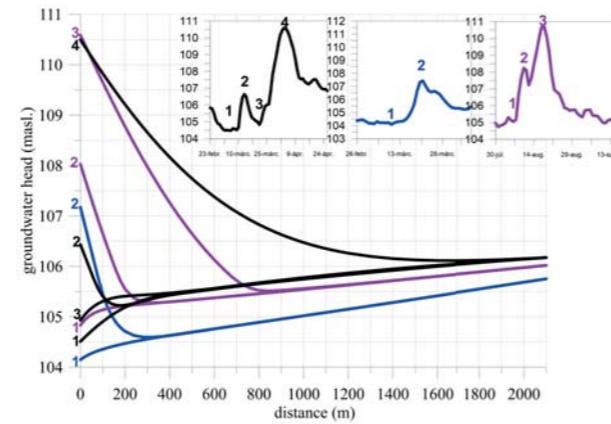
As a result of the research, three hydraulically effective distances were established: (1) the distance which the entering water particles reach in the aquifer during the rising river stage, (2) the distance in which the groundwater flow direction is reversed during rising river stage, the flow is towards the aquifer from the river, (3) the distance in which the river influences the groundwater flow velocity and the groundwater head.



entering water particles reach in the aquifer during the rising river stage, (2) the distance in which the groundwater flow direction is reversed during rising river stage, the flow is towards the aquifer from the river, (3) the distance in which the river influences the groundwater flow velocity and the groundwater head.

- Possible hydraulic connection between surface- and groundwater

The distances vary over time and space. As a result of the river's flood wave, the water flow in the aquifer also changes day by day, and the recharge and discharge process of the aquifer do not take place at the same pace.



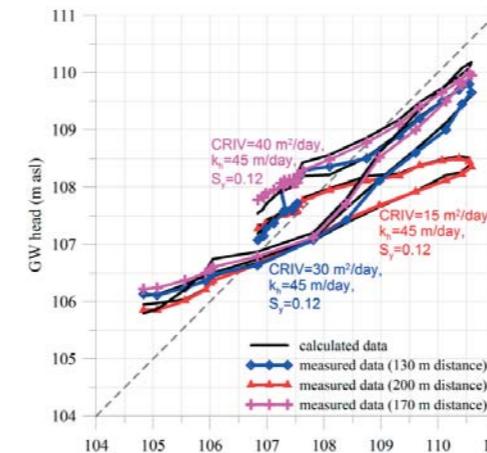
- Calculated groundwater heads as a function of distance in response to different river floods



- Groundwater sampling from an observation well



Research has shown that the effect of a river should not be approximated mathematically as a constant over time to perform certain design tasks. At the same time, a constant mathematical model approaching the river is able to describe and study phenomena with less and less accuracy, such as e.g. the catchment zones of wells, flow direction, speed, spatial extent and concentrations of dissolved contaminant plumes, and shape and spatial extent of the protection zones.



- Hysteresis between river stage and groundwater head, fit the calculated and measured data using different model parameters

INNOVATIVENESS & EXPLOITABILITY

A detailed study of the river's hydraulic effects, and its relationship to the aquifer help protect our bank-filtered aquifers and groundwater resources associated with the river by performing field measurements, data processing, and performing numerical modeling. In Hungary, the daily water demand of 40% of the population are covered by riverbank-filtered water resources, most of which are located along the Danube.

75% of our long-term drinking water resources are bank-filtered, which means that they will also play a major role in future water resource management. A better understanding of the mass transport processes taking place in the contact zone of surface and groundwater also requires a better understanding of the groundwater flow processes there. A large part of our industrial areas are located near surface water bodies, where potential or existing pollution of groundwater may come into contact with surface water.



- Datalogger installed in monitoring well



RESEARCHER

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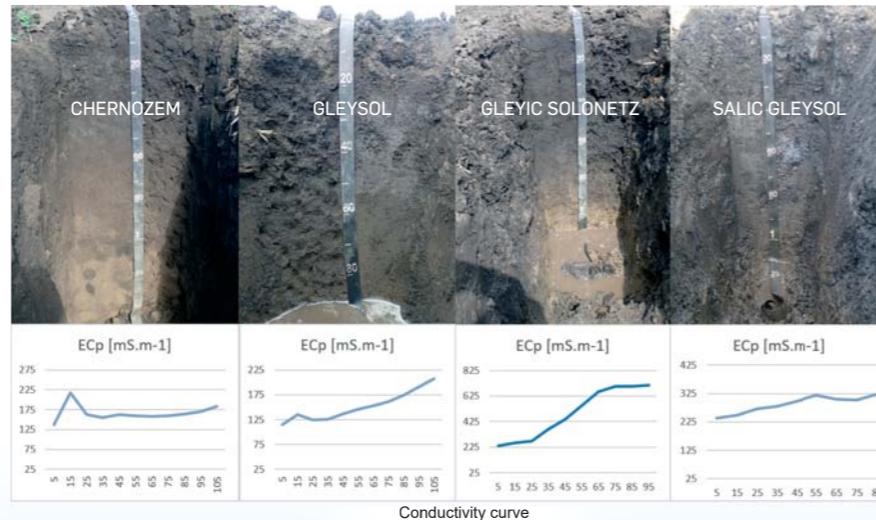
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DEVELOPING A SET OF ON-FIELD SOIL EXAMINING METHODS



field profile morphology, and through fitting RTK topography models and yield maps. The elements of the method are not new in themselves, yet we rarely encounter such a rich database developed considering the support of precision cultivation systems and also the establishment of the cultivation zone system.

The aim of the project was to reintegrate soil genetics and morphology knowledge into the applied agronomy, with a special focus on the day-to-day applicability of soil genetics. More than 300 soil profiles were exposed, sampled and interpreted in various parts of the country. The field soil data were calibrated and interpreted using laboratory analysis of soil samples, field moisture and conductivity curves,



to display these soil morphological characteristics and soil genetic processes in an understandable form for farmers, in order to be able to determine further steps and tasks knowing all this. Feedback on the results of conscious land use is not only an EU expectation, but a priority research direction worldwide.



RESEARCHERS

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INNOVATIVENESS & EXPLOITABILITY

One of the most pressing problems in today's agriculture is the dissemination of soil-quality improving cultivation systems. The decision has already been taken within the Union and is slowly prevailing in the Common Agricultural Policy support system. The support is based on soil protecting cultivation and its positive, provable effect, which the profession links to indicators. Some of these indicators are difficult to generalize, in a measurable and objective way, while the professional community knows and sees these processes and the morphological characteristics that indicate the processes. In the project, we tried



METHODOLOGICAL DEVELOPMENT OF SOIL MOISTURE MONITORING

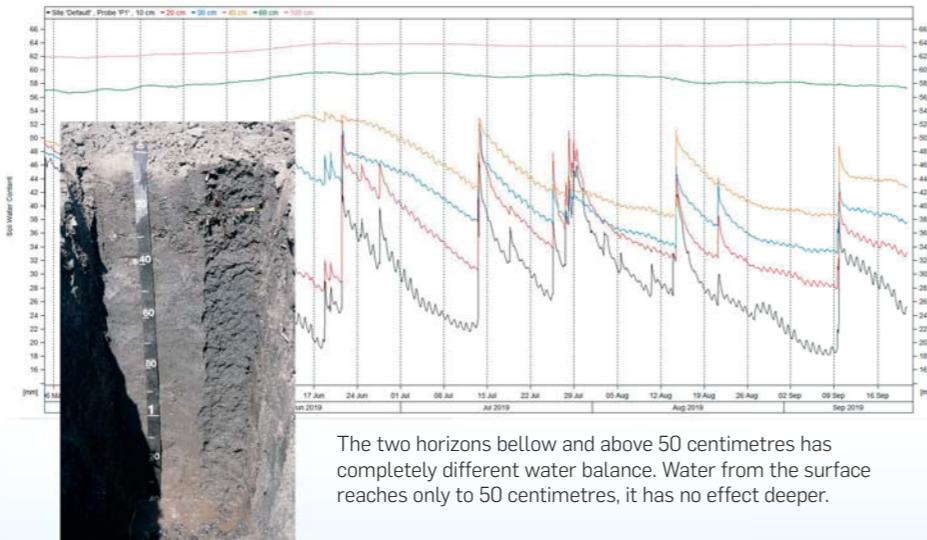


that meet scientific goals, but are expensive, therefore installed at low densities. In addition to efficiency, we aimed to investigate feasibility and also possibilities of use without scientific support. Our results show that a network of a large number of inexpensive sensors provide at least as much estimation accuracy as the expensive sensors arranged in an experimental network. The latter are present in a much smaller number under real conditions than in experimental cases, so their effectiveness is also presumably weaker. Combined lab and field calibration gave the best results during sensor calibration.

INNOVATIVENESS & EXPLOITABILITY

Data based systems of precision and “smart” agricultural solutions require the collection of soil moisture data. Soil moisture sensors estimate the amount of water

One of the main objectives of the project was to compare alternative solutions for soil moisture monitoring and to carry out comparative studies planned and performed with scientific thoroughness. In our work, we examined the efficiency of cheap and poorly calibrated measurement networks, with sensors used by “black box” civilian researchers (citizen science), as well as sensor systems



The two horizons below and above 50 centimetres has completely different water balance. Water from the surface reaches only to 50 centimetres, it has no effect deeper.



used for operating systems. In addition to “high tech” sensors, we also tested the efficiency of systems compiled from low-cost sensors.



based on the electro-physical properties of soils, as there is a very significant difference between water and solid particles of soil. However, the relationship not only depends on moisture content, but also on many other soil characteristics, therefore proper calibration is indispensable. At present, there is no calibration method that can be performed during installation and does not change the physical properties of the immediate – measured – environment of the sensors. In the framework of the project we compared the existing calibration methods and proposed a calibration procedure to be



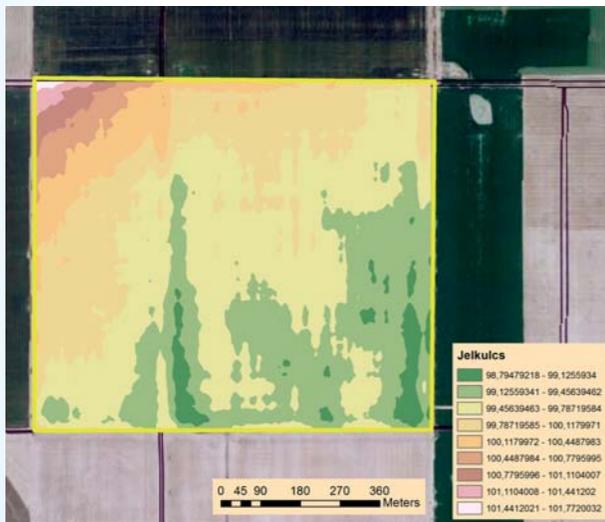
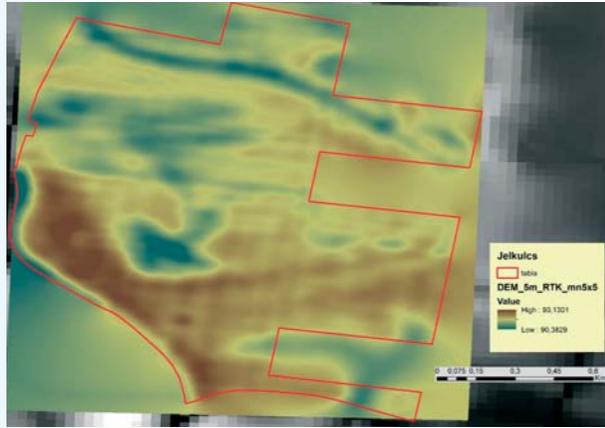
RESEARCHERS

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- András Dobos, MSc student

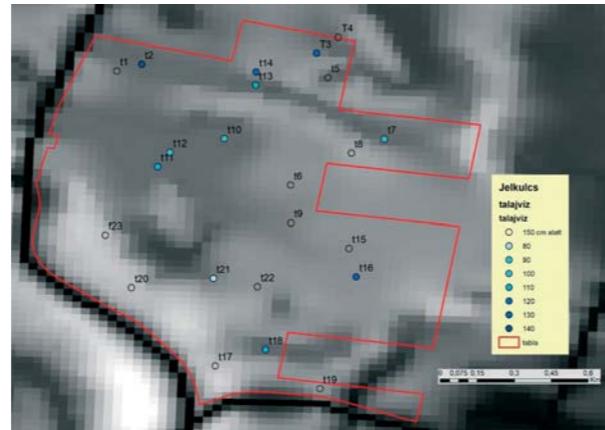
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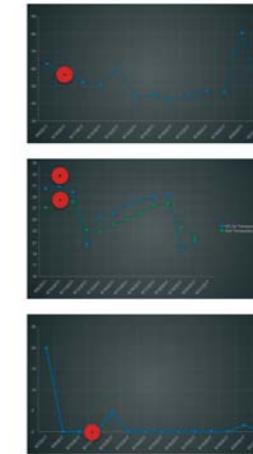
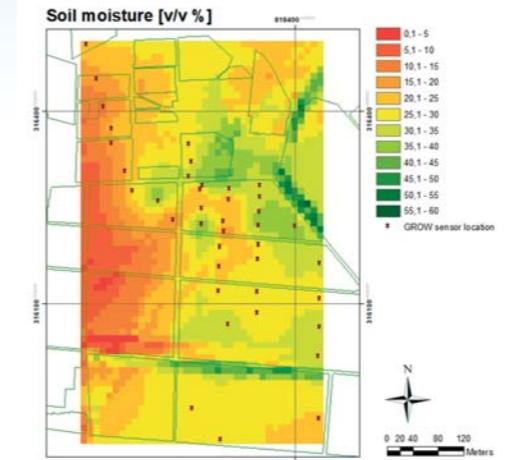
INNOVATIVE MAPPING AND SPATIAL EXTENSION USING GIS AND REMOTE SENSING METHODS



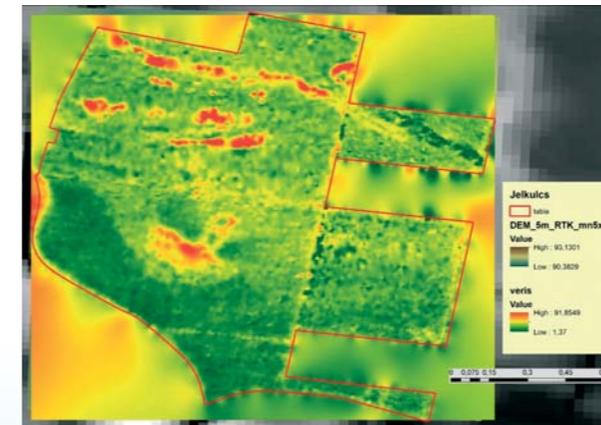
One of the main goals of the project, in addition to characterizing soil moisture regime, was to develop geoinformatic methods for estimating soil moisture. During the research, we compared different approaches that help the spatial extension of data measured in the framework



of the soil moisture monitoring procedures described previously. Remote sensing and topography-based variables were collected and derived, which explain the spatial distribution of soil moisture, therefore can be a suitable for statistical and geostatistical estimation processes. The model we developed uses partly topographic variables and partly data from the Sentinel-1 radar satellite. Based on the estimating variables and the measured data of the monitoring system, we estimated



the soil moisture with a regression function. Then, in the second step, the error (which is the lack of soil properties) was corrected by a geostatistical method, i.e. the regression-cropping method often used in digital soil mapping.



INNOVATIVENESS & EXPLOITABILITY

Knowing the current moisture content of soils is essential for climate science and agriculture. Due to the development of remote sensing technologies, environmental data and resolutions have become available in such high amounts that were previously unimaginable; however, interpretation and transformation of these data to be used as support to farming means a daily challenge. One of the fastest and most dynamically developing area is the estimation and mapping of soil

moisture. In this regard, satellites working in the radar / microwave range, such as Sentinel-1 satellite of the European Space Agency, are seen to have an increasing role. Our staff joined this process and developed methods for mapping soil moisture and inland water cover.



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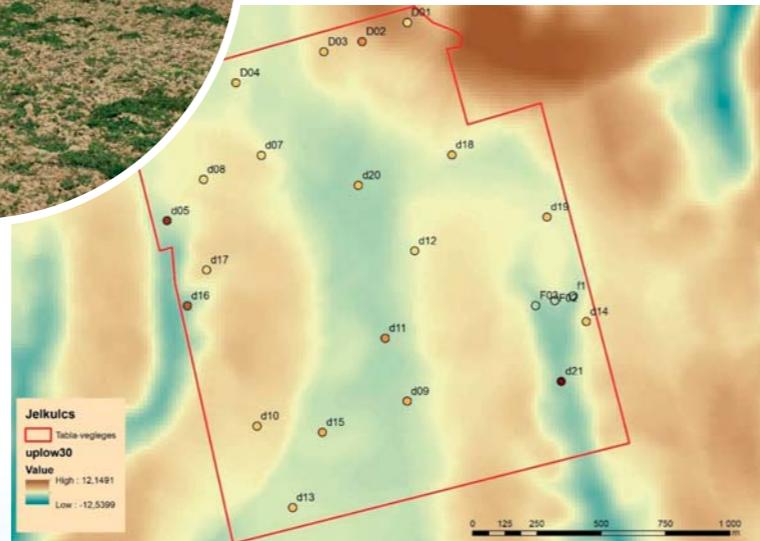
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METHODOLOGICAL DEVELOPMENT OF DIGITAL SOIL MAPPING



In the framework of the project a digital mapping methodology was developed for delineating soils exposed to inland water and stagnic soils. We worked out a complex methodology with remote sensing and topography modelling elements, which is suitable for mapping wetland areas and soil moisture content. Data from Sentinel-1 satellite, which operates in the radar wavelength range, is known to be sensitive to surface waters, so can be used well for mapping. Radar data from March 2021 were calibrated with data from Sentinel-2 satellite images taken at the same time in the visible and near-infrared range, which indicate the

presence of surface waters with very high reliability. Using patches from wetlands, we derived data from digital elevation models to characterize surface topography elements often covered by water, and determined typical surface landforms supporting the formation of water patches, also compared the appearance of patches with the theoretical groundwater levels in order to separate stagnic water and rising groundwater. The method is also suitable for detecting micro-depressions within the field in case of available RTK, high-resolution relief models.



INNOVATIVENESS & EXPLOITABILITY

The use of remote sensing in environmental monitoring has gone through an extreme rapid development. It is also the most commonly used toolkit for separating areas covered by inland water. Inland water causes many problems for farmers of course, but its management is currently not solved. Areas characterized by high groundwater are high importance agricultural areas in Hungary, which is characterized by continental prone to drought summer weather. High clay content and degraded structure show similar, inland water-like symptoms; therefore, these two processes are often confused. Unfortunately, while gleysoils mean advan-

tage, stagnic soils require extreme water management. The aim of the project was to clearly understand and separate these two phenomena, this way helping farmers to develop the right problem-solving solutions.



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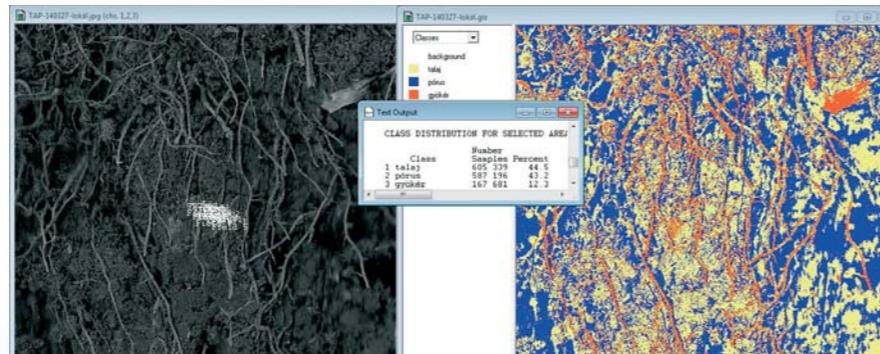


NOVEL METHODS IN DETERMINING WATER REGIME OF AGRICULTURAL SOILS



for methods suitable for the characterization of water balance within the profile. As a part of this, we examined optical properties of soils with the help of scanners dug into the soil, which are used to determine the thickness of the wet, water-saturated layers. A geophysical method for the determination of the plough pan has been developed, which can be used to detect the presence of layers that inhibit water infiltration within the soil. Examining the causes of water saturation, a heavy-isotopic method was developed to separate excess water due to poor infiltration and also rising groundwater saturation, which is still a very important issue for farmer due to its significance in influencing the profitability of their farming activities. The separation of these two types is also decisive from the point of view of soil genetics and soil classification: the separation of groundwater and

The two extremes of soil water management problems are drought and over-wetting. They often appear intertwined, at the same time during a vegetation period, which indicates well that the source of the problem is not only the weather but also soil physical properties and differences between physical characteristics of soil layers. We were looking



stagnic water – gleysol and stagnosol – which in the short term can help the further development of our renewable soil classification system.

INNOVATIVENESS & EXPLOITABILITY

Hungary is economically highly exposed to the effects of climate change due to the dominant role of agriculture in the country. In Hungary, the problem is not the change in the amount of precipitation, but its increasingly extreme distribution. Increasing amounts of rain are expected in the winter-spring months, while the amount of summer precipitation is less but with more intense rainfall.

In such an environmental system, the basis of climate adaptation is to increase the amount of stored water during periods of rainfall as well as to strengthen infiltration in the summer period characterized by heavy rainfall. From a pedological point of view, these two goals require an increase in total porosity and field water capacity as well as an improvement in the permeability of the gravity pore system that helps infiltration. Our research team



developed methods, which make it easy for farmers to recognize and signal the negative soil effects of over-wetting caused by reduced porosity, thereby helping to identify the problem and the need for change.



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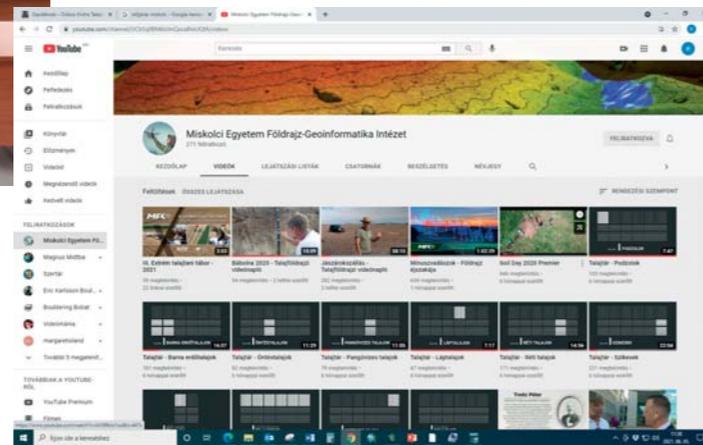
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EDUCATIONAL PLATFORM DEVELOPMENT FOR THE DISSEMINATION OF SOIL SCIENCE KNOWLEDGE

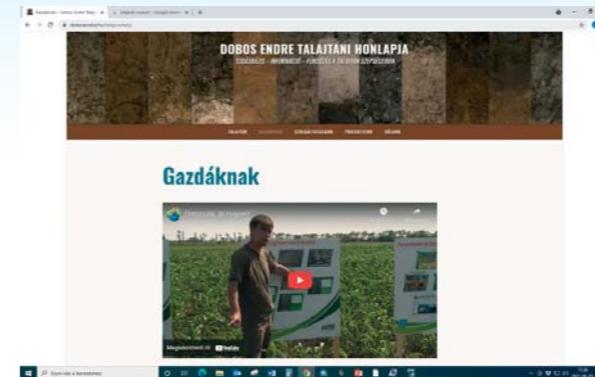


As part of the Soil Science Knowledge Base, established at the University of Miskolc, we created the Péter Treitz Soil Lecture Room located in the C/2 building, room 106. Here we exhibited 160 monoliths out of 200 monoliths collected over more than 25 years, mostly showing the soil diversity of the Carpathian Basin, including pieces from 10 countries of 3 continents. The origin of each monolith and the classification of the samples – according to Hungarian and WRB – are included in our catalog; some of them also have laboratory data by genetic levels, so our constantly expanding collection is suitable to cover geographical and soil type diversity as well as to present new thematic connections, such as agricultural, environmental, archeological ones. Opened

on World Soil Day 2020, the Room is primarily designed to support university education, but is also open to all interested groups, outsourced elementary and high school geography classes, students, faculty and students from other universities, and interested soil science professionals. The comprehensive presentation of the



collection was also published in the form of 10-15 minute-long, freely accessible videos, this way expanding the content offer of our online soil knowledge database "KNOWLEDGE BASE – INFORMATION – RESEARCH IN THE BEAUTIES OF SOIL" for educational purposes. As part of this knowledge base – on the Youtube channel of the Institute of Geography and Geoinformatics – soil



geography video diaries and video notes containing university lectures on our field work are also available (both in Hungarian and in English). Our activities aim to draw public awareness on the importance soil sciences, which include regularly organized professional days, professional competitions, soil science camps, radio informative programs. These can contribute to the direct use of research results by farmers, and strengthen the role of soil science, being one of the most important national disciplines, both in public consciousness and in production.

INNOVATIVENESS & EXPLOITABILITY

Presenting soil diversity in a unified form is perhaps the most difficult part of education, as profiles can only be presented in their undisturbed, original form, mostly on field, in form of digged soil profiles, where, however, it is difficult to illustrate soil diversity as there is only one type of soil at one place. Our collection is a solution for this, which is unique in Hungary, but perhaps also in Central-Europe, as well as the relevant part of our online knowledge base. The project also confirmed

that farmers mostly lack authentic, science-based soil knowledge and information that help them make the right decisions. By developing our knowledge base, we primarily would like to promote the soil science knowledge of farmers, experts and university students by providing a wide range of information necessary for getting to know and using the soils correctly. Among our most popular shared contents, we now have a professional video material with over half a million views.



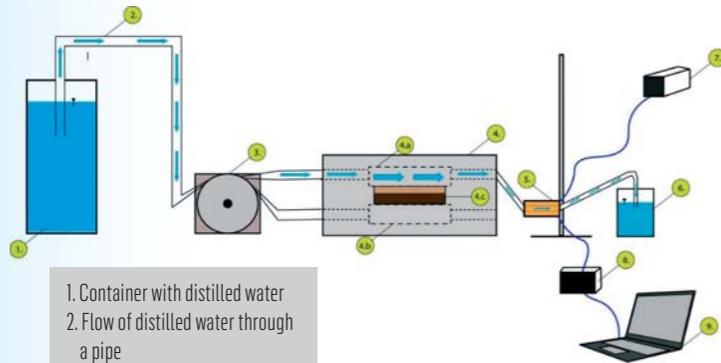
RESEARCHERS

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DEVELOPMENT OF INSTRUMENTS AND LABORATORY TESTS TO BETTER UNDERSTAND THE SIGNIFICANCE OF REDIFFUSION



1. Container with distilled water
2. Flow of distilled water through a pipe
3. Peristaltic pump
4. DKS-permeameter
- 4.a Upper flow plate (active)
- 4.b Lower flow plate (inactive)
- 4.c Soil sample cell
5. Cuvette
6. Contaminated water storage unit
7. Radiation source
8. Spectrometer
9. PC

• *Measurement arrangement*

In many parts of the world, including Hungary, underground hydrocarbon pollution is a big problem, which sometimes endangers the environment for decades.

Remediation procedures cleaning of porous layers is usually a routine task, but the pollution remaining in the aquiclude layers often diffuse back into the already cleaned layers.

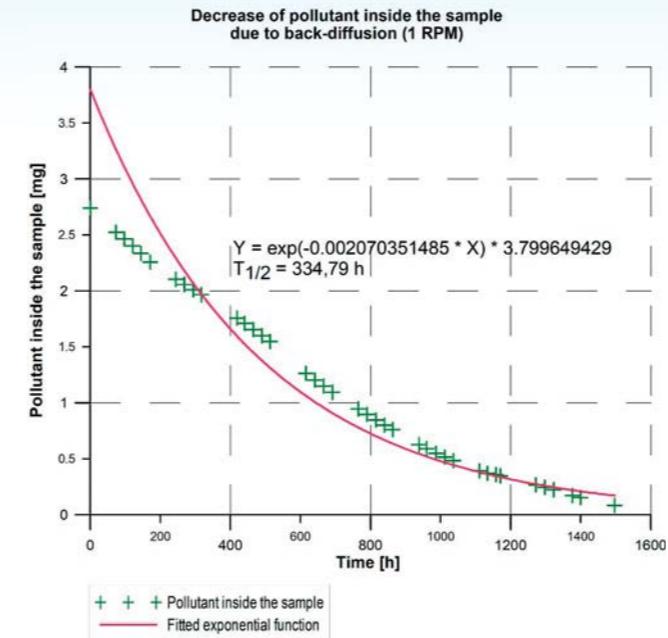
To determine the parameters influencing the process (flow rate, concentration gradient, temperature, porosity), a laboratory measurement protocol was developed. As part of this, (previously developed for landfill liner

insulation systems) the DKS-permeameter was used in a measurement set-up suitable for modeling hydrocarbon-contaminated heterogeneous subsurface systems.

During the measurement protocol, the concentration of the pollutant leaving the contaminated soil sample incorporated in the DKS-permeameter was measured using a flow-through type spectrometer to determine the concentration of hydrocarbon entering the porous layer by back-diffusion. In the permeameter and the flow-through type spectrometer, the movement of the solutions is



• *Laboratory measurement of back-diffusion*



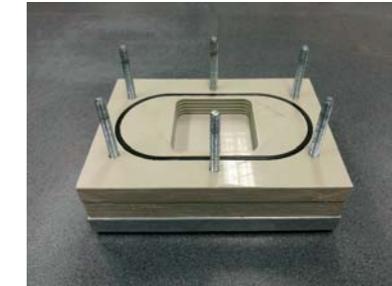
• *Decrease of the contaminant in the sample*

provided by a peristaltic pump with adjustable speed, which allowed to study the back-diffusion process affected by different flow rates.

INNOVATIVENESS & EXPLOITABILITY

The conventional pump and treat remediation procedure for underground hydrocarbon contaminants often surprises the professionals due to the back-diffusion phenomenon from lower permeability layers. With the help of the measurement protocol developed in

the laboratory of the Institute of Environmental Management, the back-diffusion phenomenon that often occurs in heterogeneously structured subsurface systems can be modeled in a laboratory environment. During the measurements, a more accurate description of the effect of the parameters influencing the phenomenon, such as subsurface flow rate, porosity, concentration gradient and temperature, were provided making it pos-



• *Measuring cell of the DKS-permeameter*

sible to determine the parameters required for pollutant transport modeling more precisely. In connection with the field of research, several award-winning student competition essays, thesis and dissertation were written during the project.



KUTATÓ

- Székely István, tudományos segédmunkatárs
- Szász Noémi, PhD hallgató
- Dr. Madarász Tamás, egyetemi docens

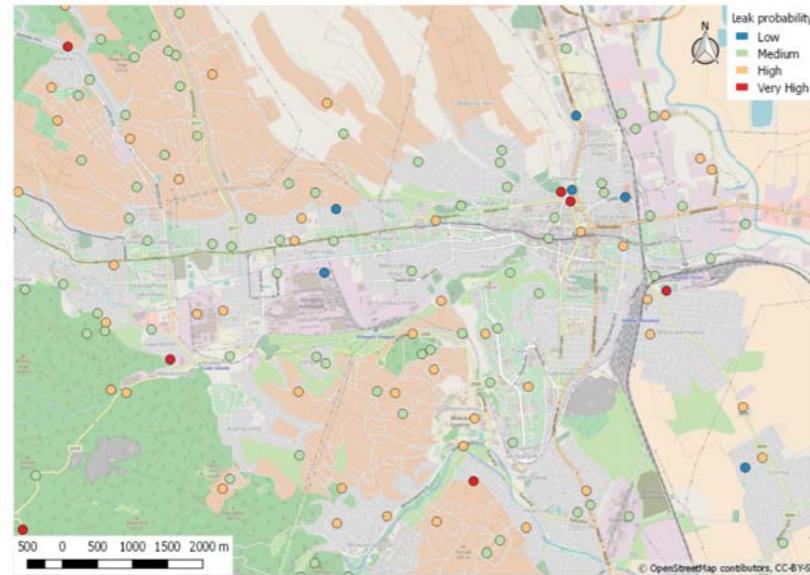
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VALIDATION OF SATELLITE-BASED LEAKAGE DETECTION METHOD FOR DRINKING WATER DISTRIBUTION NETWORK



In many major cities around the world, the destruction of aging distribution networks, in the form of hidden water leaks or spectacular pipe breaks, is a serious technical and operational problem. Mains water loss due to corrosion, changes in operational conditions and environmental impacts often



does not exceed 25-30%. For the operator, any solutions that can significantly reduce this proportion will result in direct savings. Our partner, the Israeli-based start-up UTILIS, entered the market in 2016 with its satellite (SAR) data-based leak detection procedure, which won several interna-



tional water industry innovation awards in a row. In the framework of our project, we undertook the pilot testing of the pioneering procedure among the world leaders in 2017 in the field of water utility services in Miskolc and Budapest. The essence of the method is to evaluate the captured data of the sensors mounted on a special satellite to determine the soil moisture anomalies and the peculiarities of their origin, so that potential hidden leakage sites can be identified. The field leak detection team checks for suspected failures. The hit rate result based on satellite image is many times higher than the traditional, planned programme for leak detection.

INNOVATIVENESS & EXPLOITABILITY

Leak detection methods for distribution networks have not changed significantly in recent decades. The effectiveness of the acoustic field investigation according to the planned program is questionable. Lauren Guy, the founder of the UTILIS start-up company, developed and patented a method based on captured data from L-bandwidth SAR sensor and an evaluation data algorithm rested on research ideas for groundwater resources on Mars. The satellite image, covering an area of 50x70 km, is able to "see" below the ground

surface to the depth of 1.5-2 m, regardless of atmospheric conditions, and to identify potential water leakage failure locations. The evaluation and field validation of potential failure records made in Miskolc and Budapest in the summer of 2017 proved that the procedure could provide a modern and programmed leakage control and prevention tool for water utilities, which could significantly reduce the physical losses of drinking water networks.



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- Hoang Dinh Thien, research assistant
- Dr. Tamás Madarász, associate professor
- Our External Partners: UTILIS Corp.; Miskolc Holding Plc; MIVÍZ Ltd.; Budapest Waterworks Plc; AquAcust Ltd.

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APPLICATION OF INNOVATIVE MEASUREMENT METHODS IN GEOTECHNICS

Geotechnics is a multidisciplinary field of science that is constantly evolving and renewing today. Connective topics include soil mechanics, agricultural sciences, hydrogeology, hydrology, and increasingly mechanical sciences and informatics. Innovations inherited from the



- Large scale, unique shear box

development of other disciplines help the development of the laboratory, field, and theoretical background of geotechnics opening new avenues for solving increasingly complex problems.

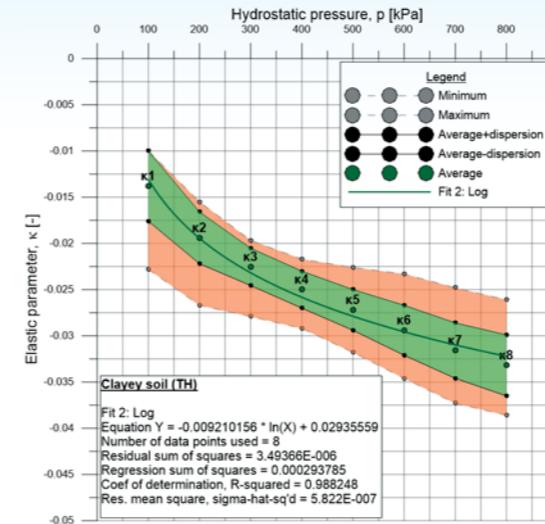
The research area is focused on the border of soil mechanics and agrogeotechnics. A characteristic problem in agrogeotechnics is the characterization of agricultural soils from the point of view of soil mechanics, the meas-



- Modified triaxial loading frame

urement of soil parameters that facilitate the modelling of the expected behaviour of soils.

Soils under agricultural cultivation undergo loosening and compaction during cultivation processes, and their condition is constantly changing. However, they are characterized by the fact that they are most often loose in structure, low in load-bearing capacity and cannot be fully consolidated, while their water balance is highly dependent on weather conditions and groundwater flow. The doctoral dissertation directly related to this research presents the methodology as well as the development of tools, which are suitable for solving the above-mentioned problems and may help future researchers on the topic.

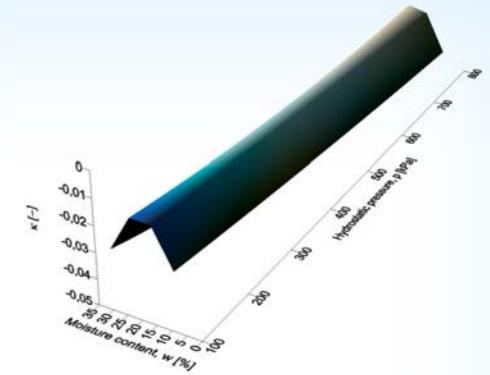


- Change of elastic behaviour of clayey soil

INNOVATIVENESS & EXPLOITABILITY

The practical benefit of the research, is to better understand the interactions between cultivating agricultural machinery and the soil; with systematic method development, the results can help to understand the behaviour of other loose, low-consolidation materials (waste, fly ash, agricultural crops, etc.).

Sensory measurement technology, the transformation of the triaxial system (large-scale volumetric and sensor technology), the large shear device, and the oedometer measuring device with tension meters all contributed to a more accurate determination of the soil properties of loose soils. These innovative measuring devices could



- Water content dependency of elastic behaviour of silty soil

also be part of soil research in the coming years. The investigated pressure sensor measurement technique can provide insight into the processes taking place inside the soils and help to better understand the mechanical flow inside the soils.

Our results can help the development of soil-friendly farming, the development of soil-friendly tires, and the long-term protection of our soils. The results of the research are summarized in the PhD dissertation defended at the Samuel Mikovinyi Doctoral School.



RESEARCHERS

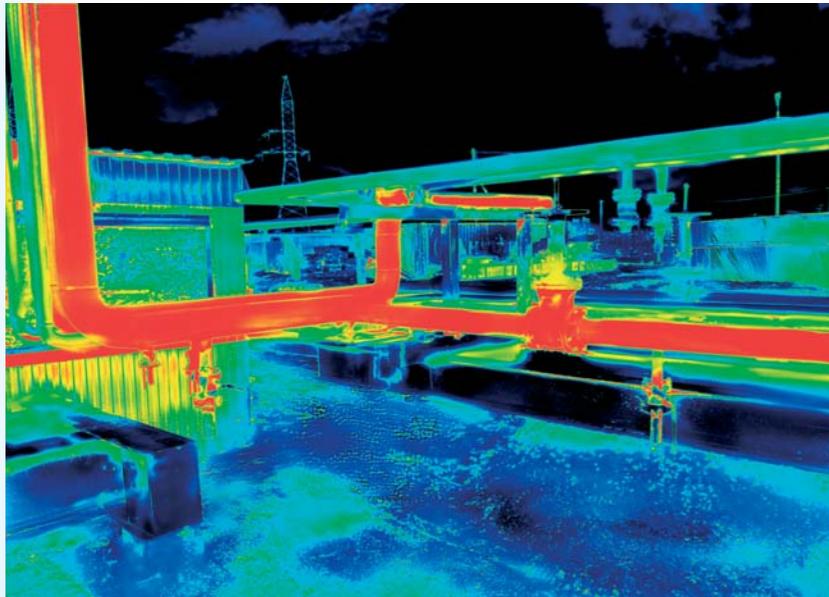
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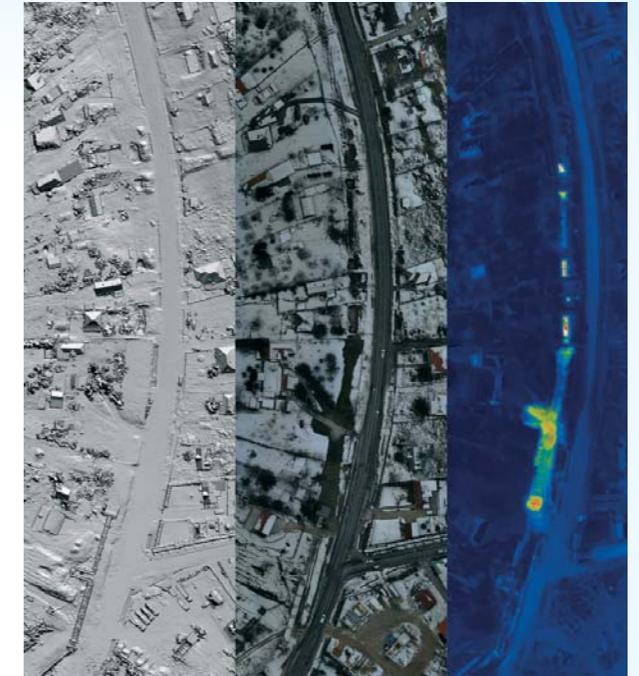
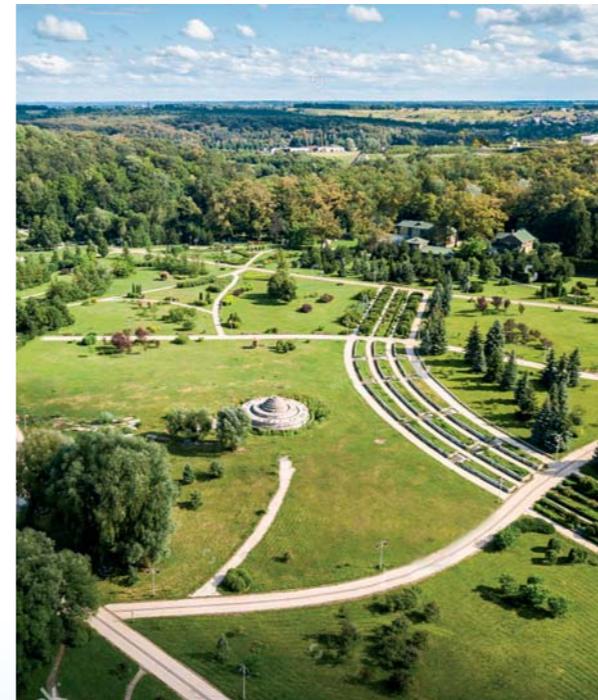
APPLICATION OF DRONES (UAV) FOR THE INVESTIGATION OF NATURAL AND ANTHROPOGENIC ENVIRONMENTAL PROCESSES



The main goal of the task was to apply thermal imaging to investigate soil moisture related phenomena. Image processing may be a cumbersome task, but since photogrammetry has seen a huge development a lot of suitable methods are available. In order to process thermal IR images, some additional steps had to be involved: DEM data was acquired from visible light photogrammetry, thermal images had to be rescaled and reprojected in which an optimization step was necessary. Finally, a thermal photo mosaic may be generated.

INNOVATIVENESS & EXPLOITABILITY

The use of UAVs (Unmanned Aerial Vehicle) in engineering practice has increased significantly during the last decade. At the Faculty of Earth Science and Engineering drone based remote sensing has been effectively used in data gathering for the purpose of city management, agricultural and water management. An advantage of the approach is that a widely available and accessible drone is being used (DJI Mavic 2 Enterprise Dual) which may be operated without any further infrastructural development. Our scope was to develop a method to ob-



tain a projection corrected thermal mosaic image, which may be useful in identifying underground infrastructural issues as well as natural anomalies.



RESEARCHERS

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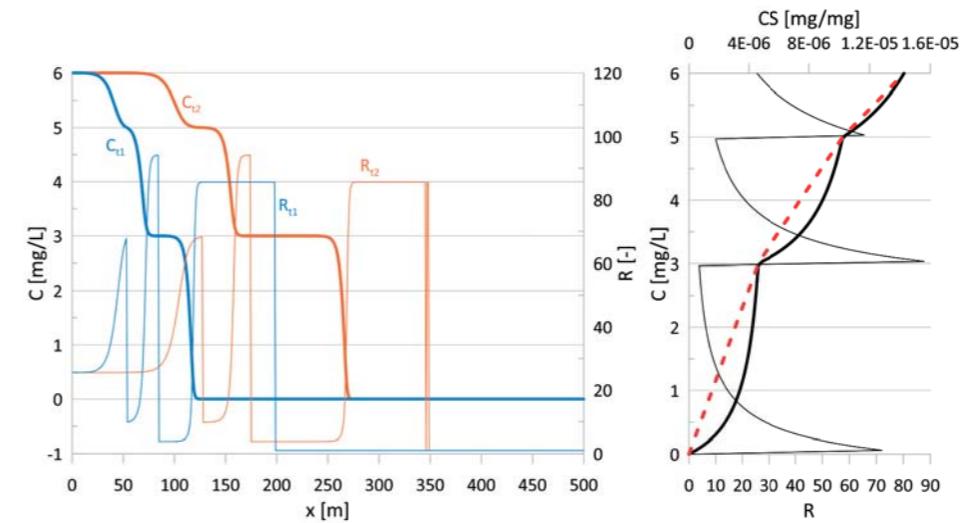
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INVESTIGATION OF THE EFFECT OF MULTI-STAGE ISOTHERMES ON THE TRANSPORT OF SOLVED MATERIAL



Contaminant transport is a major field in hydrogeology. One of the fundamental transport processes is the adsorption on solid surfaces. Along the flow velocity of the groundwater, the speed of transport is determined by the nature of adsorption, which in case of highly adsorptive materials may decrease the speed of transport – this is called retardation. In many cases the amount of retardation depends not only on environmental conditions, type of contaminant and of the porous material, but also on the dissolved concentrations. One possibility is that at low concentrations the contaminant transport is slow but speeds up with increasing concentrations. The contrary is also possible: contaminant transport is



• Többlépcsős izoterma tipikus képe

faster at low concentrations and slows down at increasing concentrations. In some particular cases the relationship may become more complicated, and several



concentration ranges may cause an increased retardation (slower transport). This is due to the fact that the slope of the isotherm function is not monotonic.

INNOVATIVENESS & EXPLOITABILITY

The effect of these multistep isotherms was first investigated with numerical methods, then their analytical description was prepared. The results may gain application

in diverse fields such as optimization of pollution remediation tasks, water treatment and material separation processes. A unique trait of the phenomena is that it caused by a relationship which locally is concave, but the overall bend is convex.



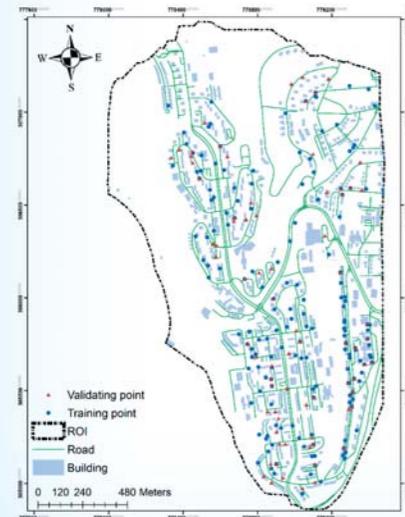
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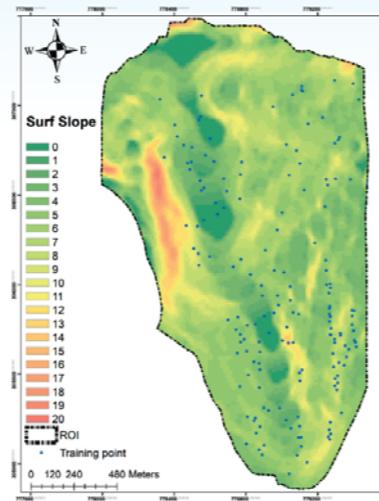


INVESTIGATION OF RISK FACTORS AFFECTING THE INTEGRITY OF UNDERGROUND NETWORKS

Our research aimed to better understand the factors influencing the destruction of groundwater aquifers. It is well known that due to the aging of distribution networks, service providers are facing an increasing amount of water loss, which not only increases the operator's

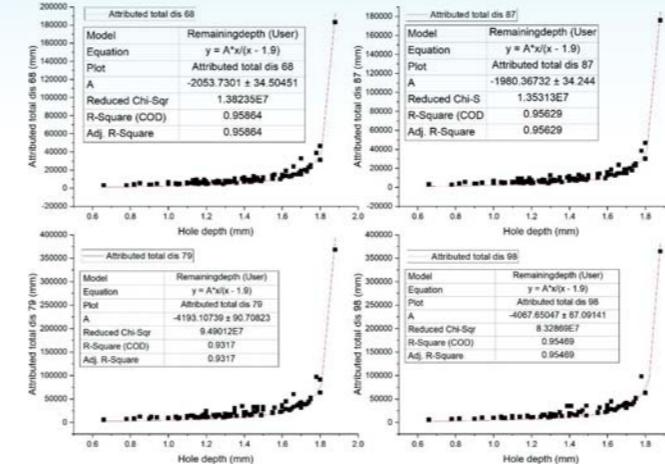


- *Universal failure inventory in the study area*



- *Pannonian vertical segmentation of the study area*

loss but can also cause other additional damage, not to mention wastage of drinking water as a resource. In each service area, general and site-specific factors (line age, line material, diameter, installation depth, technology, slope conditions, geological structure, load, etc.) that play roles in network failure can be identified. Based on the fault location database received from the local utility company MIVÍZ Ltd., the analysis tools integrated in the unified GIS system can be utilized to determine whether the statistical relationship between



- *Some result derived from corroded pipe samples*



the individual risk factors and the failure sites exists or not. Furthermore, it can also be used to identify whether there is a prominent factor or factors influ-

encing the failure in a given area. With this in mind, leak detection and network rehabilitation activities can also become consciously planned. Some issues of the methodological analysis, especially the better understanding of the failure of metal pipes, were verified by laboratory

tests. In the laboratory, the induced failure of steel pipes was derived by artificially accelerated corrosion processes, and then the impaired magnitude of the specimens was evaluated by bending tests.

INNOVATIVENESS & EXPLOITABILITY

The methodology summarized in the PhD dissertation examined the pipeline sections of the Avás residential area in Miskolc, building on previous extensive engineering and scientific works, expert opinions and the vectorised Geological Atlas of the City of Miskolc, as well as the inclinometer monitoring network of the Avás housing estate, etc. Through processing the results of these input data as well as the service provider's fault location database, we built a modern susceptibility assessment system the methodological correctness of which was verified in the specific area, so the procedure can be applied in other areas with minor modifications. The methodology combines and offers traditional engineering knowledge, databases, field experience and state-of-the-art leakage control procedures as a decision support tool for municipalities and water utility service providers.



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LIST OF PHD DISSERTATIONS, HABILITATION ESSAYS SUPPORTED BY THE PROJECT

Darabos Enikő, (2017): Vízkészlet számítás és idősorok elemzése karsztosodottsági jellemzők meghatározása céljából a Bükk Karsztvízszint Észlelő Rendszer adatai alapján, Tudományos vezető: Dr. Lénárt László

Kolencsikné Tóth Andrea (2017): Folyó és talajvíz kapcsolatának vizsgálta, Tudományos vezetők: Prof. Dr. Szűcs Péter, Dr. Kovács Balázs

Tóth Márton, (2018): A rudabányai bányaterület nehézfém-mobilizációs viszonyainak és környezeti hatásának vizsgálata, Tudományos vezetők: Dr. Kovács Balázs, Dr. Czinkota Imre

Kiss Anett, (2018): Akusztikus relaxációs jelenségek közzefizikai vizsgálata, Tudományos vezető: Prof. Dr. Dobróka Mihály

Kántor Tamás, (2019): Innovatív mérési megoldások alkalmazásainak vizsgálata a geotechnikában, Tudományos vezető: Dr. Kovács Balázs

Abordán Armand, (2020): Global optimization-based data processing methods for advanced well logging applications (Globális optimalizáción alapuló korszerű fúrólukgeofizikai adatfeldolgozási eljárások), Tudományos vezető: Prof. Dr. Szabó Norbert Péter

Miklós Rita, (2021): A bükk karsztrendszer hidrogeotermikus jellemzése komplex karszthidrogeológiai vizsgálatokkal*, Tudományos vezetők: Prof. Dr. Szűcs Péter, Dr. Lénárt László

Daniel Kibirige, (2021): Estimation of soil moisture using environmental covariates and remote sensing imagery with the aid of capacitance probes*, Tudományos vezető: Dr. Dobos Endre

Hoang Dinh Thien, (2021): Investigation of risk factors affecting the integrity of underground utilities, with special emphasis on drinking water pipe networks*, Tudományos vezetők: Dr. Madarász Tamás, Dr. Kovács Balázs

Dr. Dobos Endre, (2021): Small-scale digital soil mapping (DSM) methodological developments (Kis-méretarányú digitális talajtérképezési módszertan fejlesztése); habilitációs dolgozat

*Benyújtott, még nem megvédett értekezés

LIST OF MSC THESIS SUPPORTED BY THE PROJECT

Kovács Virág, (2018): Investigation and quantification of parameters influencing back-diffusion, Témavezető: Székely István, Madarász Tamás

Demián Szabolcs, (2019): Laboratory testing of rediffusion from contaminated double porosity layers, Témavezető: Székely István, Madarász Tamás

Poczek Noémi, (2020): Laboratory investigation of back-diffusion and sorption properties of contaminants, Témavezető: Székely István, Madarász Tamás

Sara Almeida, (2020): Evaluation of the Sajókaza municipal solid waste site using surface geophysical methods and geotechnical modeling, Témavezető: Dr. Kántor Tamás, Madarász Tamás

LIST OF BSC THESIS SUPPORTED BY THE PROJECT

Gál Gitta, (2020): Természetes utánpótlódás vizsgálata izotópos mérésekkel, Témavezetők: Prof. Dr. Szűcs Péter, Ilyés Csaba

LIST OF STUDENT RESEARCH ESSAYS SUPPORTED BY THE PROJECT

Kovács Virág, (2018): Effektív diffúzió mérésére alkalmas laboratóriumi protokoll kidolgozása és teszteredményeinek értékelése, Témavezető: Székely István, Madarász Tamás

Hadobás Ádám, (2019): Talajtani és vegetációs információk összehasonlítása precíziós gazdálkodásból származó térinformatikai adatokkal, Témavezető: Dr. Dobos Endre

Eslam Mohamed Hemid Mohamed, (2020): Complex engineering geological investigation of Avas hill, Miskolc, Hungary, Témavezető: Dr. Kántor Tamás

Poczek Noémi, (2020): Vízrekesztő rétegből történő szennyeződések rediffúziós jelenségének laboratóriumi vizsgálata, Témavezető: Székely István, Madarász Tamás

LIST OF SCIENTIFIC PUBLICATIONS SUPPORTED BY THE PROJECT

Abordán A., Szabó N.P. (2018): Particle swarm optimization assisted factor analysis for shale volume estimation in groundwater formations.; GEOSCIENCES AND ENGINEERING: A PUBLICATION OF THE UNIVERSITY OF MISKOLC 6, pp. 87-97. 2018.

Abordán A., Szabó N.P. (2019): Particle swarm optimization based interval inversion of direct push logging data.; In: Kékesi, Tamás (szerk.) MultiScience - XXXIII. microCAD International Multidisciplinary Scientific Conference Miskolc-Egyetemváros, Magyarország: Miskolci Egyetem, (2019) pp. 1-10.

Abordán A., Szabó N.P. (2019): Selecting control parameters for the particle swarm optimization based factor analysis.; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 88 : 1 pp. 134-140. 2019,

Abordán A., Szabó N.P. (2020): Uncertainty reduction of interval inversion estimation results using a factor analysis approach 11, Article number: 11; International Journal on Geomathematics, ISSN: 1869-2680

Demián Sz., Székely I. (2019): Dimetil-szulfóiddal szennyezett vízrekesztő rétegből történő szennyezőanyag visszaoldódás jelenségének vizsgálata dks-permeabiméterrel; Műszaki Tudomány az Észak-kelet Magyarországi Régióban Konferencia kiadvány pp.69-72; 2019

Dobos E. (2017): Hagyományos és digitális talajtérképezési eljárások ötvözése a precíziós mezőgazdaságban.; XIX Nemzetközi Bányászati, Kohászati és Földtani Konferencia. Kolozsvár, 2017. március 30 – április 2

Dobos E., Gál-Szabó L. (2017): Mezőgazdasági területek talajtani paramétereinek vizsgálata.; XIX Nemzetközi Bányászati, Kohászati és Földtani Konferencia. Kolozsvár, 2017. március 30 – április 2.

Dobos E., Kovács K., Dobos A., Vadnai P., Kibirige D. (2018): A Principális-völgy talajainak általános jellemzése a Zalaszentbalázs, Lóbánya tábla alapján.; XX Nemzetközi Bányászati, Kohászati és Földtani Konferencia. Gyulafehérvár 2018. április 5–8.

Dobos E., Kovács K., Gál Szabó L., Dobos A. (xxxx): Field scale soil variability mapping to support precision agriculture.; 21st World Congress of Soil Science. Augusztus 12-17, Rio de Janeiro, Brazília

Dobos E., Kovács K., Gál Szabó L., Dobos A., Hadobás Á. (2018): Field scale soil variability mapping to support precision agriculture.; European Geosciences Union General Assembly 2018, Bécs Ausztria, 2018. Április 8-13

Dobos E., Kovács K., Gál Szabó L., Dobos A., Hadobás Á. (2018): Soil structural degradation due to intensive soil tillage and its impact on soil moisture regime.; European Geosciences Union General Assembly 2018, Bécs Ausztria, 2018. április 8-13

Dobos E., Kovács K., Vadnai P., Gál-Szabó L., Dobos A. (2017): Field identification of soil structural degradation and its impact on soil moisture regime.; FAMU EnergyWaterFoodNexus International Summit 2017. Orlando FL, USA, 2017, október 19-20.

Dobos E., Kovács K.Z., Vadnai P., Gál-Szabó L., Dobos A., Daniel K., Juhász I., Hadobás Á., Michéli E., Sulyok D., Fórián T. (2018): Talajdiagnosztikai szemlélet alkalmazása a precíziós gazdálkodás zónarendszerének kialakításában; Talajtani Vándorgyűlés, Pécs. 2018. Augusztus 29–szeptember 1.

Dobos E., Kriston A., Juhász A., Dobos A., Kriston S. (xxxx): An in-situ soil methodology for characterizing soil porosity changes through the vegetation period; 21st World Congress of Soil Science. Augusztus 12-17, Rio de Janeiro, Brazília

Dobos E., Micheli E., Pásztor L., Vadnai P. (2018): Bridging the centuries: 1918-2017; GEOPHYSICAL RESEARCH ABSTRACTS 20 Paper: EGU2018-19628 (2018)

Dobos E., Vadnai P., Kovács K.Z., Láng V., Fuchs M., Michéli E. (2019): A novel approach for mapping WRB soil units – A methodology for a global SOTER coverage; HUNGARIAN GEOGRAPHICAL BULLETIN (2009-) 68 : 2 pp. 157-175., 19 p. (2019)

Dobos E., Vadnai P., Kovács K.Z., Micheli E. (2019): RS Based Soil Diagnostics Mapping and Use for Soil Property Estimation; World Soils User Consultation Meeting ESA-ESRIN 2019 2019-07-02 [Frascati, Olaszország],

Dobróka M., D.O.B. Nuamah, Somogyi Molnár J., Ormos T. (2018): A robust inversion-based Fourier Transformation algorithm used in the interpretation of non-equidistantly measured magnetic data; 9th ICCM, 6th-10th August 2018, Rome, Italy, ISSN 2374-3948 (online), pp. 903-907.

Endre Dobos, Károly Zoltán Kovács, Drew Hemment, Mel Woods, Naomi K. van der Velden, Angelika Xaver, Luca Zappa, Victoria J. Burton, Natalie L. Garrett, Rianne H. Giesen, Camille Pelloquin, Rastislav Skalsky (2019): Citizen Observatory based Soil Moisture Monitoring ; World Soils User Consultation Meeting ESA-ES-RIN 2019 2019-07-02 [Frascati, Olaszország],

Eteraf H., Mosallaei A., Kovács B., Mikita V. (2021): Effect of sewage sludge ash on collapsible soil; Research Developments in Geotechnics, Geo-Informatics and Remote Sensing: Proceedings of the 2nd Springer Conference of the Arabian Journal of Geoscience(Advance in Science, Technology & Innovation) 1st ed. 2021 Edition, ISBN 978-3-030-72896-1

Eteraf H., Mosallaei A., Kovács B., Mikita V. (2021): Effect of water content on consolidation parameters ; Research Developments in Geotechnics, Geo-Informatics and Remote Sensing: Proceedings of the 2nd Springer Conference of the Arabian Journal of Geoscience(Advance in Science, Technology & Innovation) 1st ed. 2021 Edition, ISBN 978-3-030-72896-0

Fejes Z., Szűcs P., Turai E., Zákányi B., Szabó N.P. (2021): Regional hydrogeology of the Tokaj Mountains world heritage site, North-East Hungary; Acta Montanistica Slovaca, Volume 26 (1), 18-34 DOI: <https://doi.org/10.46544/AMS.v26i1.02>

Gál Szabó L., Dobos E. (2018): Mezőgazdasági területek talajnedvességének vizsgálata.; XX Nemzetközi Bányászati, Kohászati és Földtani Konferencia. Gyulafehérvár 2018. április 5–8.

Hoang D.T. ; Madarász T., Molnár J. (2017): Investigation methods for pipe line tracing and leakage detecting in water utility networks; ADVANCES IN ENVIRONMENTAL SCIENCES: INTERNATIONAL JOURNAL OF THE BIOFLUX SOCIETY 9 : 3 pp. 193-206., 14 p. (2017)

Hoang D.T., Kovács B., Madarász T. (2019): Utilization of Antennas and Propagation for Pipeline tracking and Leakage detecting in Water reticulation; International Conference on Architecture & Civil Engineering 2019 (ICACE 2019) „Education, Integration & Sustainable Development”

Hoang D.T., Kovács B., Madarász T. (2020): A short discussion on some influencing factors of an artificial corrosion system and obtained metallic pipe samples; 1st International Conference on Engineering Solutions for sustainable Development, Ebook ISBN 978-0-367-82403-7, Print ISBN 978-0-367-42425-1 DOI: <http://doi.org/10.1201/9780367824037>, London, United Kingdom / England: CRC Press (2020) 394 p. pp. 371-377., 8 p.

Hoang D.T., Kovács B., Madarász T., Czinkota I. (2019): A proposed controlled setting of artificial corrosion for adverse impact examination on metallic pipes located in oxygen-sufficient environment; 15th Carpathian Basin Conference for Environmental Sciences, Ábel Publishing House (2019) 303 p. pp. 136-143., 8 p.

Hoang D.T., Kovács B., Madarász T., Czinkota I. (2019): An artificial, controlled setting of corrosion for remaining strength examination on metallic pipes; International journal of energy water food nexus, Vol 1. Issue 1. Pp 18-25

Hoang D.T., Kovács B., Madarász T., Czinkota I. (2021): Changes in Mechanical Properties of Metallic Pipes Subjected to Accelerated Corrosion Test; Periodica Polytechnica Mechanical Engineering, Periodica Polytechnica, scientific journals of the Budapest University of Technology and Economics, Hungary (Q2), Page and Date: 65(1), pp. 63-75, 2021, Online ISSN: 1587-379X; Print ISSN : 0324-6051, DOI: <https://doi.org/10.3311/PPme.17110>, Online: <https://pp.bme.hu/me/article/view/17110>

Hoang D.T., Madarász T., Fekete Zs., Kovács B. (2019): Inspecting methods for conduits tracing and leak detection of water in utility reticulation pipes: case studies in Hungary; Malaga, Spanyolország : Asociación Internacional de Hidrogeólogos – Grupo Español, (2019) p. 789

Ilyés Cs., Turai E., Szűcs P. (2017): Examination of 110 year long Rainfall Data using Spectral and Wavelet Analysis; 20th Congress of Hungarian Geomathematicians and 9th Congress of Croatian and Hungarian Geomathematicians „Geomathematics in multidisciplinary science - The new frontier?” 2017. május 11-13. Pécs

Ilyés Cs., Turai E., Szűcs P., Ilyés T. (2019): Examination of Debrecen's 110-year rainfall data; GEOSCIENCES AND ENGINEERING: A PUBLICATION OF THE UNIVERSITY OF MISKOLC 6 : 9 pp. 118-126., 9 p. (2019)

Ilyés Cs., Szűcs P., Ilyés T. (2019): Talajvizes idősorok vizsgálata szezonális alapján; Szigyártó, I-L; Szikszai, A (szerk.) XV. Kárpát-medencei Környezettudományi Konferencia, Kolozsvár, Románia: Ábel Kiadó, (2019) pp. 106-111., 6 p.

„Ilyés Cs., Tóth M., Lénárt L., Szűcs P. (2021): Csapadékösszegek és talajvízszintek kapcsolatának vizsgálata Debrecen környékén; Cseresznyés, D; Király, Cs (szerk.) XVI. Kárpát-medencei Környezettudományi Konferencia = 16th Carpathian Basin Conference for Environmental Sciences : absztrakt kötet Budapest, Magyarország : ELTE Természettudományi Kar (2021) 239 p. pp. 134-139., 6 p.”

Ilyés Cs., Turai E., Szűcs P. (2017): 110 éves csapadékatatok vizsgálata spektrális analízissel és Wavelet-elemzéssel; Műszaki tudomány az Észak-Kelet Magyarországi Régióban, 2017. június 1. Nyíregyháza

Ilyés Cs., Turai E., Szűcs P. (2017): Spektrális elemzésen alapuló előrejelzés Debrecen térségére; XX. Tavasz Szél konferencián elhangzott előadás

Ilyés Cs., Turai E., Szűcs P. (2017): The Changes of the Hydrological Cycle inside the Carpathian-Basin; FAMU ENERGY-WATER-FOOD-NEXUS International Summit 2017 19-20 Oct. 2017 Orlando FL, USA

Ilyés Cs., Turai E., Szűcs P. (2018): Examination of rainfall data for 110 years using spectral and wavelet analysis; CENTRAL EUROPEAN GEOLOGY 61:(1) pp. 1–15.

Ilyés Cs., Turai E., Szűcs P. (2018): Examination of the Hydrologic Cycles with Spectral Analysis; pp. 7-15., 9 p. In: Tometz, L; Tometzova, D; Dirnerová, D - LECTURES of 14th International Scientific Conference on Mineral Waters of the Carpathian Basin, Košice, Szlovákia (2018) 122 p.

Ilyés Cs., Turai E., Szűcs P. (2019): Csapadékösszegek és talajvízszint idősorok spektrális elemzése; pp. 17-24., 8 p. In: Bíró, Tibor (szerk.) Országos Települési Csapadékvíz-gazdálkodási Konferencia Tanulmányai. Kézirat változat Budapest, Magyarország: Dialóg Campus Kiadó

Ilyés Cs., Turai E., Szűcs P. (2019): Examination of the hydrologic cycle with long-term precipitation and groundwater level data; J., Jaime Gómez Hernández; Bartolomé, Andreo Navarro - Groundwater management and governance. Coping with uncertainty, Malaga, Spanyolország : Asociación Internacional de Hidrogeólogos – Grupo Español, (2019) p. 179

Jakab G., Dobos E., Madarász B., Szalai Z., Szabó J. A. (2019): Spatial and temporal changes in infiltration and aggregate stability: a case study of a subhumid irrigated cropland; WATER 11 : 5 Paper: 876 (2019)

Kibirige D., Dobos E. (2020): Analysis of calibration equations for soil water content data using enviroscan sensors; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 90 : 1, 9 p. (2020)

Kibirige D., Dobos E. (2020): Estimation of soil moisture using sentinel 1 SAR imagery and citizen observatory data in winter wheat crop; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 89 : 1 pp. 93-99., 7 p. (2020)

Kibirige D., Dobos E. (2020): Evaluation of multiple linear regression technique for soil moisture mapping; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 89 : 1 pp. 100-106., 7 p. (2020)

Kibirige D., Dobos E. (2021): Estimation of surface soil moisture by integrating environmental data and remote-sensing satellites; MULTIDISZCIPLINÁRIS TUDOMÁNYOK: A MISKOLCI EGYETEM KÖZLEMÉNYE 11 : 1 (2021)

Kibirige D., Dobos E. (2020): Soil Moisture Estimation Using Citizen Observatory Data, Microwave Satellite Imagery, and Environmental Covariates; WATER 12 : 8 pp. 1-25. Paper: 2160, 25 p. (2020)

Kibirige D., Dobos E. (2021): Off-Site Calibration Approach of EnviroScan Capacitance Probe to Assist Operational Field Applications; WATER 13 : 6 p. 837 (2021)

Kibirige D., Dobos E., Kovács K.Z., Gál-Szabó L., Dobos A., Pinezits B., Drew H. (2018): Temporal soil moisture data estimation using citizen observatory data; In: Szabó, Norbert Péter; Papp, Richárd Zoltán (szerk.) Doktoranduszok Fóruma : Miskolc, 2018. november 22, 28.: Műszaki Földtudományi kar szekciókiadványa

Kibirige D., Dobos E., Kovács K.Z., Gál-Szabó L., Dobos A., Pinezits B., Drew H. (2019): Temporal soil moisture data estimation using citizen observatory data; In: Kékesi, Tamás (szerk.) MultiScience - XXXIII. microCAD International Multidisciplinary Scientific Conference, Miskolc-Egyetemváros, Magyarország : Miskolci Egyetem (2019) pp. 1-20., 20 p.

Kibirige D., Dobos E., Kovács K.Z., Gál-Szabó L., Dobos A., Pinezits B., Drew H. (2020): Soil moisture monitoring using Citizen Observatory data; Bloemfontein, Dél-Afrikai Köztársaság : Soil Science Society of South Africa (2020)

Kiss A., Dobróka M., Nuamah, O. B. D., Somogyi Molnár J. (2018): Noise suppression in reduction to pole of magnetic data; Saint Petersburg 2018 : 8th International Conference & Exhibition : Innovations in Geosciences - Time for Breakthrough, EAGE Publishing, (2018) Paper: 44430, 5 p.

Kiss A., Nuamah, O. B. D., Dobróka M. (2018): Improved Description of the Acoustic Wave Parameters – Pressure Relations with New Double Relaxation Models; 24th European Meeting of Environmental and Engineering Geophysics. 2018. Porto, Portugália, DOI: 10.3997/2214-4609.201802583, ISBN 978-94-6282-263-4

Kiss A., Somogyi Molnár J., Dobróka M., Ormos T. (2018): New rock physical model describing the pressure dependence and hysteresis of acoustic velocities; Saint Petersburg 2018 : 8th International Conference & Exhibition : Innovations in Geosciences - Time for Breakthrough, EAGE Publishing, (2018) Paper: 44456, 5 p.

Kolcsenik-Tóth A. (2019): Differences between steady-state and transient simulations of mass transport in a river-influenced shallow aquifer; Geosciences and engineering (7) 10 pp. 144-157

Kovács K.Z., Dobos E., Vadnai P., Bertóti D. (xxxx): Digital elevation based soil mapping method for hilly areas built up of unconsolidated sediment; 21st World Congress of Soil Science. Augusztus 12-17, Rio de Janeiro, Brazília

Kovács K.Z., Dobos E. (2020): Decision support soil moisture maps generated from low-cost sensor observations; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 89 : 1 pp. 71-77., 8 p. (2020)

Kovács K.Z., Dobos E. (2020): High-resolution, continuous soil moisture maps generated from citizen observatory dataset; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 89 : 1 pp. 78-86., 9 p. (2020)

Mikita V., Czinkota I., Eteraf H., Mosallaei A., Pinjung Zs., Kovács B. (2021): The investigation of the stress field evolution in soil samples during vertical loads ; Research Developments in Geotechnics, Geo-Informatics and Remote Sensing: Proceedings of the 2nd Springer Conference of the Arabian Journal of Geoscience(Advance in Science, Technology & Innovation) 1st ed. 2021 Edition, ISBN 978-3-030-72896-2

Miklós R., Lénárt L., Darabos E., Kovács A., Czesznak L., Pelczéder Á., Szűcs P. (2021): A Bükk hegység karsztvíz-készleteinek feltárása és hasznosítása; Hidrológiai Közlöny 101 (2) pp 31-43

Miklós R., Lénárt L., Szűcs P. (2019): Hydrogeological and geothermal sections of the Bükk Thermal Karst reservoir, Hungary; 46th IAH Congress, 2019. szeptember 22-27., Malaga, Spain

Miklós R., Lénárt L., Szűcs P. (2021): Geotermikus viszonyok modellezése Demjén környékén; XVI. Kárpát-medencei Környezettudományi Konferencia, 2021. március 30. - április 1., Budapest

Miklós R., Prohászka A., Lénárt L. (2019): Vízföldtani és geotermikus szelvények a Bükki termálkarsztról Eger-Egerszalók-Demjén környékén; Almássy Endre XXVI. Konferencia a Felszín Alatti Vizekről, 2019. március 26-27., Siófok

Miklós R., Prohászka A., Lénárt L. (2019): Vízföldtani és hőmérsékletszelvény Eger – Egerszalók – Demjén környékéről; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 88 : 1 pp. 64-70., 6 p. (2019)

Miklós R., Prohászka A., Lénárt L. (2019): Vízföldtani és hőmérsékletszelvény Eger-Egerszalók-Demjén környékéről; XV. Nemzetközi Tudományos Konferencia a Kárpát-medence Ásványvizeiről, 2019. augusztus 22-24., Miskolc

Molnár F., Dobos E. (2020): A talajok fejlődése a Szernye-mocsár területén az elmúlt száz év talajtérképezéseinek tükrében; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 89 : 1 pp. 107-117., 11 p. (2020)

Molnár F., Dobos E. (2020): Leccsapolt területek talajainak fizikai tulajdonságai és azok szerepe a talajok fejlődésében; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 90 : 1, 11 p. (2020)

Nádasi E., Turai E. (2017): Elektromágneses közetfizikai paraméterek vizsgálata a georadarmérések esetében; Magyar Geofizika, 58. évf. 4. szám, 253-258.

Nádasi E., Turai E. (2018): Increasing the accuracy of GPR measurements.; GEOSCIENCES AND ENGINEERING: A PUBLICATION OF THE UNIVERSITY OF MISKOLC Vol. 6. : N. 9. pp. 40-52. (2018)

Nádasi E.K., Turai E. (2018): A földradar (GPR) mérések pontosságának növelése.; Műszaki Tudomány az Észak-Kelet Magyarországi Régióban 2018 Konferencia, Nemzeti Közszolgálati Egyetem Hadtudományi és Honvédtisztképző Kar Katonai Repülő Intézet, Szolnok, 2018. május 31.

Nyiri G., Zákányi B. (2017): Az Ózdi szennyvíztisztító telep technológiai újításainak eredményei; XIII. Kárpát-medencei Környezettudományi Konferencia. Kolozsvár, Románia : Ábel Kiadó, (2017) pp. 331-338., 8 p.

Nyiri G., Zákányi B., Szűcs P. (2017): Árvízvédelmi töltések és völgyzáró gátak hidrodinamikai és állékonysági modellezése.; XIII. Kárpát-medencei Környezettudományi Konferencia. Kolozsvár, Románia : Ábel Kiadó, (2017) pp. 61-68., 8 p.

Nyiri G., Zákányi B., Szűcs P. (2018): Nyírószilárdsági paraméterek mérési bizonytalanságának rézsúállékonyságra gyakorolt hatása árvízvédelmi töltések esetében; XIV. Kárpát-medencei Környezettudományi Konferencia, Gödöllő, Magyarország : MAG Mezőgazdaságért Alapítvány, (2018) pp. 230-235., 6 p.

Pinezits B., Dobos E., Pecsmány P. (2020): Talajnedvesség-térképezést támogató becsülő változók vizsgálata egy tardi mintaterületen; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 89 : 1 pp. 118-124., 7 p. (2020)

Poczok N., Székely I., Madarász T. (2019): Vízrekesztő rétegből történő szennyeződések rediffúziós jelenségének laboratóriumi vizsgálata ; International Journal of Engineering and Management Sciences, 4(4), 232-238.2019

Szabó N.P. (2018): A genetic meta-algorithm-assisted inversion approach: hydrogeological study for the determination of volumetric rock properties and matrix and fluid parameters in unsaturated formations.; Hydrogeology Journal, Vol. 26, pp. 1935-1946. 2018. <https://doi.org/10.1007/s10040-018-1749-7>.

Szabó N.P., Balogh G.P., Stichel J. (2018): Most frequent value based factor analysis of direct-push logging data.; GEOPHYSICAL PROSPECTING 66:(3) pp. 530-548. 2018. (Q2)

Székely I., Kovács V., Madarász T. (2018): Szennyezőanyagok rediffúziójának laboratóriumi vizsgálata DKS- permeabilitással; International Journal of Engineering and Management Sciences, 3(1), 41-48.2018

Szilágyi J.E., Dobos E., Szűcs P. (2020): A tájszemléletű vízgazdálkodás hidrogeológiai, talajtani és jogi aspektusai - Felhívás a tájszemléletű vízgazdálkodás koncepció kimunkálásához; HIDROLÓGIAI KÖZLÖNY 100 : 1 pp. 41-53., 13 p. (2020)

Szilágyi J.E., Dobos E., Szűcs P. (2020): Az öntözéses gazdálkodásról szóló törvény a tájszemléletű vízgazdálkodás tükrében; PRO FUTURO - A JÖVŐ NEMZEDÉKEK JOGA 10 : 1 pp. 1-22., 22 p. (2020)

Szűcs P., Kiss-Tóth E., Ilyés Cs., Tóth M., Juhász E., Dojcsákné Kiss-Tóth É., Juhászné Szalai A., Rabóczky A., Suskó M. (2019): Balneológiai és gyógyvíztechnológiai vizsgálatok Parád-fürdőn; HIDROLÓGIAI KÖZLÖNY 99 : 3 pp. 14-22., 9 p. (2019)

Szűcs P., Szabó N.P., Zubair M., Szalai S. (2021): Innovative Hydrogeophysical Approaches as Aids to Assess Hungarian Groundwater Bodies; Applied Sciences. 2021; 11(5):2099. <https://doi.org/10.3390/app11052099>

Tóth M., Szűcs P., Kiss-Tóth E., Ilyés Cs., Juhász E., Dojcsákné Kiss-Tóth É., Juhászné Szalai A., Rabóczky A. (2019): A parádi gyógyvíz előállításához használt kőzet kioldási vizsgálata; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 88 : 1 pp. 71-78., 8 p. (2019)

Turai E. (2019): A felszíni geofizikai módszerek alkalmazási lehetőségei a vízbázisok kutatásában és állapotvizsgálatában.; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 88 : 1 pp. 121-133. (2019)

Turai E., Bucsi Szabó L. (2019): A felsőtelekesi meddőhányó állapotvizsgálata az IP módszer alkalmazásával.; Műszaki Tudomány az Észak-Kelet Magyarországi Régióban 2019 Konferencia kiadványa, ISBN 978-963-7064-38-8, 408-411. o.

Turai E., Nádasi E., Szilvási M. (2018): Felszín alatti objektumok és földtani szerkezetek kutatása geoelektromos tomográfiával; In: Dr. Bodzás Sándor és Dr. Antal Tamás (szerk.): Műszaki Tudomány az Észak-Kelet Magyarországi Régióban 2018. konferencia előadásai, DAB Műszaki Szakbizottsága, 2018, pp. 374-381, (ISBN: 978-963-7064-37-1)

Turai E., Szilvási M. (2017): Rekultivált hulladéklerakó szennyezettségének vizsgálata; Műszaki Földtudományi Közlemények, 86. kötet, 1. szám (2017), pp. 179-190.

Turai E., Szilvási M., Nádasi E., Abordán A. (2017): Rekultivált hulladéklerakó belső szerkezetének vizsgálata geoelektromos módszerekkel; Műszaki Tudomány az Észak-Kelet Magyarországi Régióban 2017 konferencia előadásai, Debreceni Akadémiai Bizottság Műszaki Szakbizottsága, 2017, pp. 586-593. (ISBN:978-963-7064-35-7)

Turtogtoh B., Turai E. (2019): A geofizikai módszerek alkalmazásának az eredményei egy mongóliai aranykutatásban.; Műszaki Tudomány az Észak-Kelet Magyarországi Régióban 2019 Konferencia kiadványa, ISBN 978-963-7064-38-8, 416-419. o.

Vadnai P., Dobos E., Kibirige D. (2020): Data collection and processing procedure to characterize the relationship between soil moisture dynamics measured with low-cost sensors and soil and topographic properties; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 89 : 1 pp. 167-172., 6 p. (2020)

Vadnai P., Dobos E., Csorba Á. (2020): An introduction of extracting diagnostic features from harmonized european national soil profile databases using the WRB approach; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 89 : 1 pp. 161-166., 6 p. (2020)

Vadnai P., Dobos E., Kibirige D. (2020): A talajnedvesség-dinamika és a fizikai féleség összefüggéseinek vizsgálata olcsó szenzoros közösségi alapú megfigyelés által szolgáltatott idősoros talajnedvesség-adatok alapján; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 89 : 1 pp. 156-160., 5 p. (2020)

Vadnai P., Dobos E., Kibirige D. (2020): Data collection and processing procedure to characterize the relationship between soil moisture dynamics measured with low-cost sensors and soil and topographic properties; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 89 : 1 pp. 167-172., 6 p. (2020)

Vágó J., Hegedűs A., Dobos E. (2018): Aszályveszélyesség vizsgálata standardizált csapadékindex (SPI) alapján a Kárpát-térségben az 1951-2050 közötti időszakra.; XX Nemzetközi Bányászati, Kohászati és Földtani Konferencia. Gyulafehérvár 2018. április 5-8.

Xaver A., Zappa L., Pfeil I., Oismüller M., Vreugdenhil M., Dobos E., Kovacs K., Hemment D. (2018): The potential of crowdsourced in situ soil moisture for environmental research; European Geosciences Union General Assembly 2018, Bécs Ausztria, 2018. Április 8-13

Zákányi B., Szűcs P., Kántor T., Székely I., Farkas G. (2017): Egy perlitbánya meddőhányójának megcsúszását kiváltó hidro(geo) lógiai okok vizsgálata; MŰSZAKI FÖLDTUDOMÁNYI KÖZLEMÉNYEK 86 : 1 pp. 69-79., 11 p. (2017)

Zákányi B., Székely I., Szűcs P., Bodzássy B. (2017): Különböző talajtípusok hormonrendszeret befolyásoló (EDC) anyagokkal szembeni visszatartó képességének vizsgálata laboratóriumban; XIII. Kárpát-medencei Környezettudományi Konferencia. Kolozsvár, Románia : Ábel Kiadó, (2017) pp. 69-76., 8 p.

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