

**XIII. CONGRESS OF HUNGARIAN
GEOMATHEMATICS AND THE II. CONGRESS OF
CROATIAN AND HUNGARIAN GEOMATHEMATICS**

**APPLICATIONS OF GEOSTATISTICS, GIS AND
REMOTE SENSING IN THE FIELDS OF GEOSCIENCES
AND ENVIRONMENTAL PROTECTION**

ABSTRACT BOOK

**2009
MÓRAHALOM**

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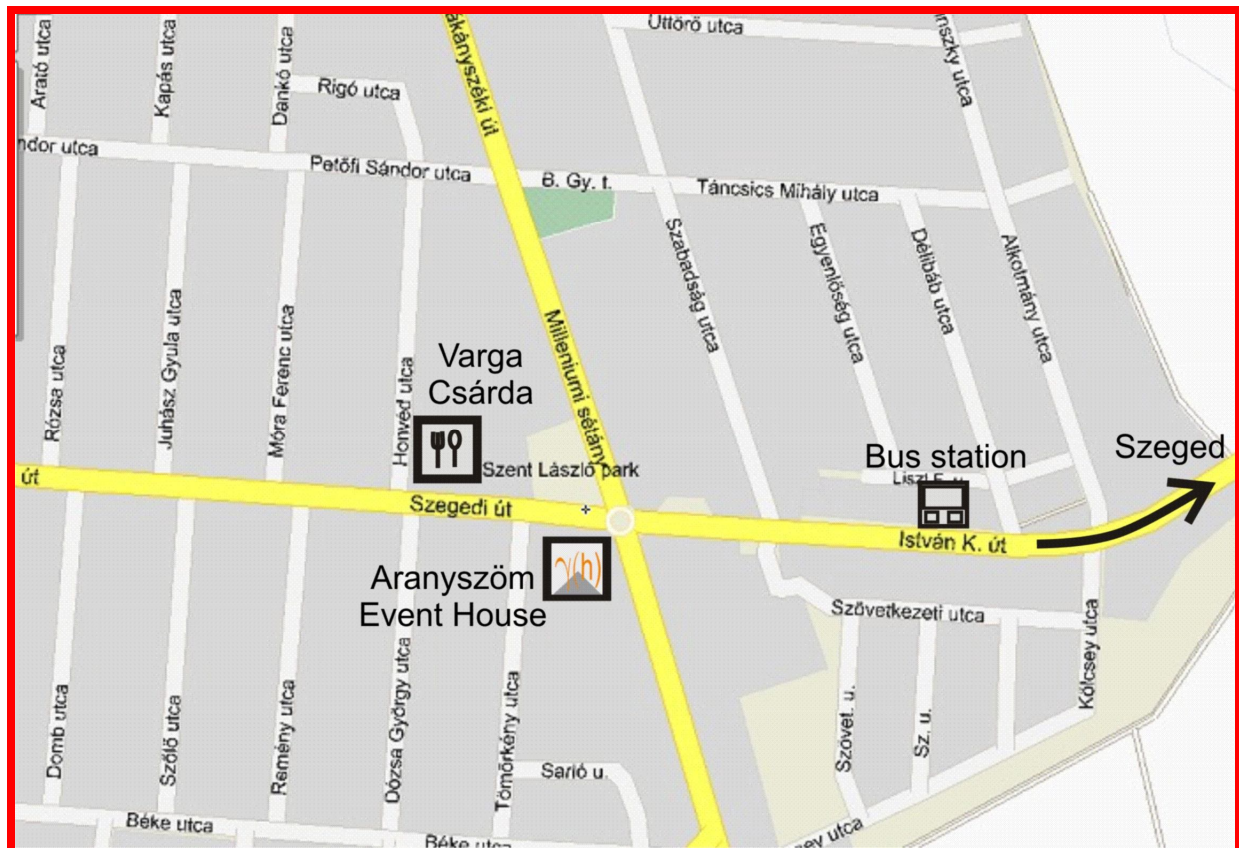
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CLOSING CEREMONY

FAREWELL LUNCH' VARGA CSÁRDA

Thickets are available only for those who will be at Closing Ceremony

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Application of stochastic approach in deterministic calculation of geological risk; Case study from Drava depression

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Keywords: geological risk, porosity, stochastic, Pannonian basin

There is well-established calculation procedure for geological risk (or Probability Of Success, abbr. POS) for any new or existing play or prospect in any petroleum province. This is already an old-fashion tool, but still applicable for practical calculation in many oil and gas companies or consulting firms. Modern approaches include several probabilities or probability curve expressed on different ways. One of them, based on geostatistical approach, is using of stochastic simulation through numerous realizations for obtaining several possible values for sampled area.

Deterministical POS is calculated as multiplication of more or less standard geological categories. Some of them (like value of porosities or reservoir quality) are usually expressed through the maps. Each such category (based on mapped data) can be observed through many possible and equiprobable realizations. This parameter is varied stochastically and finally selected like several (3, 5 or more) numerical values. It means that final POS could be expressed with several results; but the most often like minimal, median and maximal POS. Here is presented example of such calculation based on data from the Croatian part of Pannonian basin.

References:

Gaćeša, S., Futivić, I., Gyorgy, F. and Horvath, Z. (2001):] Barcs Nyugat - Stari Gradac field study, INA-Naftaplin & MOL KTD, Zagreb, unpublished company document.

Malvić, T. and Rusan, I. (2007): Potential hydrocarbon discoveries in Bjelovar subdepression, Croatia. Search and discovery article #10133, AAPG/Datapages Inc., Tulsa.

Rose, P. R. (2001): Risk analysis and management of petroleum exploration ventures. AAPG Methods in Exploration Series, 12, 164 p.

Smoljanović, S. and Malvić, T. (2005): Improvements in reservoir characterization applying geostatistical modelling (estimation & stochastic simulations vs. standard interpolation methods), Case study from Croatia. Nafta, 56, 2, 57-63, Zagreb.

White, D. A. (1992): Selecting and assessing plays. In: Steinmetz, R. (Ed.) AAPG Business of Petroleum Exploration: Treatise of Petroleum Geology, Chapter 8, AAPG, Tulsa, 87-94.

Handling uncertainty in geology

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Keywords: Uncertainty, Markov change, entropy, sequential Gaussian simulation, convergence.

The uncertainty belonging of geological phenomena can be characterized using several methods. Most of them relied on probability distribution but recently the theory of fuzzy sets also appeared in this topic. The traditional way to handle uncertainty is to derive such estimations which include somehow its effect (e.g. probability interval around means, standard deviations, and fuzzy numbers). However there are some possibilities by which the uncertainty can be connected to the geological evolution of the property analyzed. This paper presents how the uncertainty depends on depositional facieses and demonstrates that, in case of lateral extension, the entropy may be the function of the geometry of grid cells.

For the first problem Markov change analysis of some vertical lithological succession is addressed to the first problem. In this approach three types of entropies are calculated. Two of them pertain to every state: the first two are relevant to the Markov matrix expressing the upward and downward transitions, while the third coincide with the total depositional system. By calculating the second, third, etc. order Markov sequences (i.e. by powering the initial transitional probability matrix) and calculating the so called system entropy for each step an interesting convergence series of the corresponding entropies can be analyzed. This series converges to the entropy belonging to the limit of the series of transitional probability matrixes if power goes to infinite. By comparing entropy series belonging to two identical and one different depositional facieses it seems to be clear that the form of entropy series, the speed of their convergence, and the limits are the function of depositional facieses if the scales are the same.

In the case of lateral extension one-hundred grid-realizations of a lateral porosity set were generated by sequential Gaussian simulation. Then the average values, the width of their probability intervals and standard deviations are calculated for the first, first two, first three, and finally for the first 100 grids. The series of means obviously converges, and its limit is the theoretical expected value of the background population. However the limit of series formed from the width of probability intervals is not zero. It means that even in the limit there is a small amount of uncertainty belonging to the information gathered about the porosity. It open question whether this uncertainty varies with the depositional genetic, but it can be supposed to be the function of the grid geometry.

Successfulness of different neural network algorithms for missing well log data prediction – Example from the Sava Depression

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Keywords: Neural networks, well logs, Pannonian Basin

Intervals with missing well log data can be successfully amended with neural network predicted data (Sagaff and Nebrija, 2003). Process for completing well log data consists of training the neural network on the well with the complete set of curves and applying the neural network to predict the missing data. For this procedure well log curves, least dependent on mud properties, were chosen for better well to well to well prediction. Three wells with gamma ray, neutron porosity and acoustic well log curves were selected from Kloštar oil field. Three different neural network types were used: multi layer perceptron, radial basis function and generalized regression neural network. Program used for the neural network analysis was StatSoft STATISTICA 7. Well to well prediction was successfully achieved. Best results came from multi layer perceptron and generalized regression neural networks.

References:

Sagaff, M. M. and Nebrija, L. (2003): Estimation of missing logs by regularized neural networks. AAPG Bulletin, 87, 8, 1377-1389.

StatSoft, Inc. (2004): STATISTICA (data analysis software system), version 7. www.statsoft.com.

Probabilistic AVO interpretation of seismic data

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Keywords: seismic, AVO, Monte Carlo methods

Seismic attributes are generally used as direct hydrocarbon indicators (DHI) in the oil industry. One of the most popular DHI is the AVO processed seismic data. AVO processing results are commonly represented by intercept (P) and gradient (G) attributes. In this case study an interpretation method will be shown, which creates the possibility of the quantitative interpretation of the P and G AVO attributes. Multi case - multi realization AVO responses were calculated using 2-layered interface models by Monte Carlo simulation. Probability maps were generated to map the hydrocarbon indications using the results of the MC simulations.

Modelling of heat transfer process in low enthalpy geothermal systems

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Keywords: hydrogeology, open pit gravel, groundwater-model

Vertical U-tube ground heat exchangers are a key component in geothermal energy utilization systems like ground coupled heat pumps (GCHPs). In order to predict the long-term performance of these systems it is necessary to take into consideration the presence of groundwater flow. So we studied the heat transfer processes of heat exchangers in the Great Hungarian Plains.

First, a mass and heat transport model was developed to simulate the behavior of the aquifer and the water level dependence by surface rivers. Second, a large-scale system with several U-pipes was set up, and the temperatures were measured inside the borehole field. Third the performances of the U-tubes have been simulated using SHEMAT program.

The model uses finite difference method to mesh the cross-section domain of the borehole field, and consequently may retain the geometric structure in the borehole. To further improve the computational accuracy, the soil is divided into many layers in the vertical direction in order to account for the effect of changing fluid temperature with depth on the thermal process in the borefield. The inlet temperature of the ground heat exchanger (GHE) is used as a boundary condition and the inside and outside surfaces of the U-tube pipes are treated as the conjugated interfaces in the domain.

The models were used to investigate different operational schemes and maximize the heat extraction rate from the aquifer. The heat transfer around and in the borehole of a vertical U tube ground heat exchanger is a three-dimensional, transient, conjugated process. The conjugated process often refers on a thermally interacting process between the convective heat transfer of the fluid in the pipes and the conductive heat transfer of the surrounding medium (soil and grout). If the soil and grout partitioned by the borehole wall are treated as a whole domain, the conjugated interfaces of the heat transfer problem are the inside and outside surfaces of the U-tube pipes. Therefore, the whole borefield is divided into three subdomains.

As a validation of the model, in this study we only concern the entering water and exiting water temperatures of the GHE (the water flow rate of the GHE was kept constant during the entire period of operation). Of those the hourly entering water temperatures are as the input variable of the model, and the measured exiting water temperatures are compared to the model predictions. It is worthy to note that we also have to simulate the thermal process of the U-tube during the off-time since the experimental system was stopped at night. A comparison of the model predictions and experimental data shows that the models have good prediction accuracy.

Optimization schemes for allocating well doublets in a geothermal system

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Keywords: reinjection well, doublet system, simulation

There are about more than 1400 deep wells in Hungary discovering warm and hot thermal water, but only 950 are in production at present. A part of them are abandoned CH drillings but there are also boreholes and wells made for thermal water exploitation purposes. Around 220 wells are used for balneology and there are another 200 wells with water above 30 °C used for public water supply. There are also approximately 200 wells used for agricultural purposes and the temperature of the half of the produced water is higher than 70°C. Unfortunately there are only about 20 reinjection wells showing that the direct use of water without reinjection is the current standard. Due to the new legislation, a new system can only be established with reinjection scheme, and only water used for balneotherapy is allowed to lead into surface waters due to the high salinity.

There is an approx. 10 years tradition of reinjection into the Upper Pannonian sandstone in Hódmezővásárhely, where one of the first such wells was drilled and operated. In the last 6 years 75-80% of the produced thermal water was already reinjected. A new reinjection well was drilled in the surroundings of an existing one in 2007 that gave a possibility to evaluate the effect of the previous injections and to determine the hydraulic properties of the geothermal reservoir. During the pumping test several types of investigations were performed meanwhile the temperatures and pressures were measured both at the wellheads and in greater depth (in 1200 and 1450 m) depending on the well casing.

There are several interesting results of the measurements. It was clear that after 10 years of operation of the injection well there was only a non-observable decrease of temperature in such a small distance. This can also be because of the rather high hydraulic conductivity of the layer and therefore the big area of influence, but it is also surely determined by the high porosity of the aquifer. This fact assures the company doing the public services that this system is sustainable or at least it has a long lifetime until the temperature breakthrough can cause problems.

Using the test results a new hydrodynamic model was also built which can help to determine the optimal allocation of doublets (pumping well - reinjection well) in case of different hydrogeological conditions.

Acknowledgements: This project was supported by the Baross Gábor Program

Evaluation of loose, agricultural soil samples with computer tomography

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Keywords: loose agricultural soils, compaction, computer tomography

An innovative new tool, the computer tomography was introduced to investigate loose, agricultural soil's deformations without destruction of the sample. With the CT we can analyze special processes as development of failure planes (discontinuities) and the change of the moisture content and we can investigate what kind of stresses causing the destruction of the soil sample during the soil mechanical tests. This method is useful to know the deformation-distribution in the sample and to investigate the inhomogeneity of the material.

The CT's working principle is based upon different X-ray absorption capability of the soil components. The CT measurement results - the HU values - depend from the density of the soil skeleton and the pore liquids, so the measured values can be converted to porosity distribution which is related to the compaction of the soil. After the triaxial or oedometric test we performed CT measurement on consolidated soil samples. The consolidation was done using a special plastic tube or rubber membrane to avoid x-ray reflections.

There was a method developed to put markers (signs) into the soil samples that does not affects the deformations but which can visualize the time dependent deformation field caused by different external loads. The tests also performed let us determine the evolution of compaction and the deformation characteristics of the loose, agricultural soil samples.

A new image processing code is starting to developed. This starts from the bitmaps and derives the porosity with less accuracy from the CT pictures indirectly. There is an opportunity to determine the standard deviation of pixel tones, the RGB value distribution in ring shaped areas and along user defined lines, that possibly will get more information about special structures s.a. failure plain regions, compression cone regions, wall friction areas, etc.

The CT seems to be an aggressively growing application with wide range of using possibilities. The main problem nowadays is that the gaining of quantitative information form the CT pictures is not yet solved. It can be seen that the information is stored in the pictures but some innovative new mathematical and methodological methods has to be developed and applied.

The presentation summarizes the first measurements results but also focuses on the further applicability of CT in the other fields of agricultural engineering.

Evaluation of urban land use change using spectral mixture analysis

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Keywords: remote sensing, SMA, urban land use, medium resolution satellite image analysis.

The analysis of urban land use in Szeged (Hungary) using medium resolution images is difficult, because the size of urban patterns is mainly smaller than the size of image pixel, so these pixels can be characterized as spectrally mixed image elements. In spite of the difficulties of the processing of spectrally mixed images, because of the long term operational period of Landsat satellites, these kinds of images are indispensable sources of urban land use change analysis.

The linear spectral mixture analysis (LSMA) is one of the potential solution for measuring of the ratio of different land cover inside one image element (LSMA is also called as subpixel image analysis). Using LSMA method two satellite images (1986, 2006) were analysed and according to VIS model, the fractional images of Vegetation, Impervious surfaces and Soil were calculated after the endmember collection in ENVI.

Different land use categories were mapped according to the VIS model, which makes contact between the urban land cover and urban land use categories. The main processes of urban land use change in the last 20 years were statistically evaluated. The main focus was on the changes in the high density inner city, the housing estates and residential areas with detached houses. The inner city mostly consists of buildings build in the 1920s, these buildings largely remained unchanged until the end of the 20th century. This is reflected in very few changes in the values of fractional images and in the mean NDVI values, which were also calculates.

In the residential areas an overall decrease of vegetation can be observed due to the densification of build up areas. This is shown by the decreased mean NDVI values and the decreasing values on the fractional image of Vegetation in LSMA.

In the low density house estates areas, the mean vegetation cover increased. The land use largely remained unchanged, but the vegetation in gardens and parks evolved from small shrubs and trees to fully developed green areas.

Precipitation and temperature trends of Aggtelek karst between 1958 and 2008

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Keywords: Aggtelek karst, climate change, SPI drought index

On Feb. 2, 2007, the United Nations intergovernmental scientific panel studying climate change declared that the evidence of a warming trend is 'unequivocal', and that human activity has 'very likely' been the driving force behind that change over the last 50 years. As a consequence the debate now seems centred less over whether there is a change or whether human activity is the cause, rather over how to deal with its effects. However, efficient local adaptation and mitigation measures are only possible if the local trends and characteristics of the change are revealed.

Forest management is one of the most typical forms of land use in Hungarian karst regions although the site quality is usually poor and one of the most important factors in the species composition and health of the forests is the availability of water. In the interests of sustainable management in these areas it is important to examine the tendencies of local climate. Since it is widely accepted that the two most important climatic factors affecting vegetation are precipitation and air temperature we studied the possible changes of these two variables over the last 50 years in Aggtelek National Park, the biggest consistent karst area of Hungary.

We found a significant increase in temperature, with an apparent warming trend in both summer and winter. The rate of change seems faster in the winter. Based on the examined 50-year data series no significant change could be proved in the case of annual precipitation sums. The analysis of the duration and magnitude of dry periods based on a 3-month SPI drought index brought the result that the number of dry periods is decreasing while their length and magnitude are increasing.

XIII. CONGRESS OF HUNGARIAN GEOMATHEMATICS AND THE SECOND CONGRESS OF
CROATIAN AND HUNGARIAN GEOMATHEMATICS MÓRAHALOM, 21-23 MAY, 2009.

**WORKSHOP TOPIC
for the 21th May, 2009**

**„Fractal patterns in geology, and their application in mathematical
modelling of reservoir properties”**

Moderators:

**Tivadar M. Tóth (University of Szeged)
Tomislav Malvic (INA & University of Zagreb)**

Prepared by: Tivadar M. Tóth and Tomislav Malvic

Fractal patterns occur in many fields of geosciences. Some geological objects that concern reservoir properties and follow fractal pattern are 1) fracture and fault network of hard rocks, 2) grain size distribution in fault breccias, 3) fracture wall roughness, 4) grain surface roughness, 5) grain boundaries (sutures) in monomineralic rocks (e.g. quartz-quartz), 6) composition pattern of zoned cement minerals (e.g. carbonate) among many others. The common feature of all these geometrical objects is that although they appear as seemingly random, they are not. All fractal like patterns are scale independent and follow either self-similar or self-affine behaviour. From this aspect fractal patterns identified at any magnification can be used for prediction the same pattern at other scales. Understanding fractal-like geological objects and basic knowledge of the methods of fractal geometry can be used for better understand reservoir characteristics both along well trajectories and in the inter-well area. The most essential questions one can answer using fractal behaviour of diverse scale invariant objects are as follows. Fracture networks can be simulated at reservoir scale and can be used for computing hydrodynamic properties. Genetic characterisation and consequently reservoir properties of fault breccias are based on fractal geometry behaviour of size distribution and shape of grains. Zonation patterns of cement minerals are in direct relationship with paleohydrological activity of the veins and suggest flow velocity. These and many other important questions are to be discussed in the frame of the Workshop of the Conference.

Information Management Support in Complex Geophysical Prospecting Projects by Data Structures and Tools of the KINGA Portal

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Keywords: internet, geophysical data, service, standard, metadata, data model, GIS, download

The latest developments in productivity and methodology of the field geophysical data acquisition technology result much more measurement data in sense of amount and diversity as well. Such a large prospecting projects as for instance the investigation of radioactive waste deposition site in Bábaapáti, demands effective and distributed geophysical data management based on coherently standardised data structures. Except the professional ones the community of private geophysical data users is greatly increasing from such other areas of economic activity as environmental protection or geothermal utilisation which needs common IT solutions for data services.

Even though the large number of application software and mainly internet based IT are present to fulfil the requirements articulated by the recent geophysical data utilisation, there were no strong international results up till now in standardisation and integration of the complex geophysical data service management technology.

ELGI has participated in the GEOMIND (Geophysical Multilingual Internet-based Data Service) international, and in the KINGA ("Key for Internet-based Geophysical Data Access") inland project. Both of these two large projects aim the development of internet based geophysical data services in order to facilitate the satisfaction of the claims in an up-to date way. The efforts of the ELGI in this projects resulted significant achievements in development of the geophysical metadata profile and general data model compatible with existing international standard for metadata (ISO 19115) and European INSPIRE directive for geoscientific data. The general geophysical data structures developed by ELGI in the GEOMIND project become de facto transfer standard at 7 different European authorities participating in the project and dealing with service of the state owned geophysical data. (Last year in this conference László Sörös had an award winning presentation about the data structures developed and applied in GEOMIND and KINGA systems.)

The KINGA project had been initiated by ELGI and co-financed in 50% by GVOP for creation of public geophysical data service through the internet with restriction for inland usage. Implementation had been performed by ELGI in close co-operation with Intercomp Ltd. using

of the systematised knowledge and experience collected during the development activity in the GEOMIND project.

Internet environment in the client side of the KINGA portal provides a system of the functions for the users to search, select and download of information from entire repository of archive and new geophysical data of ELGI. At the same time the IT tools facilitating a convenient remote data preparation, upload and maintenance are also an integrated part of the KINGA system. (Due to the limited time these elements are out of the scope of the recent presentation.)

Metadata profile and general data model implemented in the KINGA system are the same with minor improvements as which had been developed for GEOMIND purposes. Practical applicability of these data structures is approved by that great number of different geophysical information types already seamlessly represented in these two service systems' databases. Moreover the data structures had been created to possess an inherent flexibility in adaptation to new data types even ones out of geophysics.

On the current level of the development the KINGA system supports GIS search and alphanumeric selection of information based on metadata attributes (Fig. 1) of the objects. The resulted selection set can be downloaded in many different formats for further processing or graphic/spatial presentation at the client side.

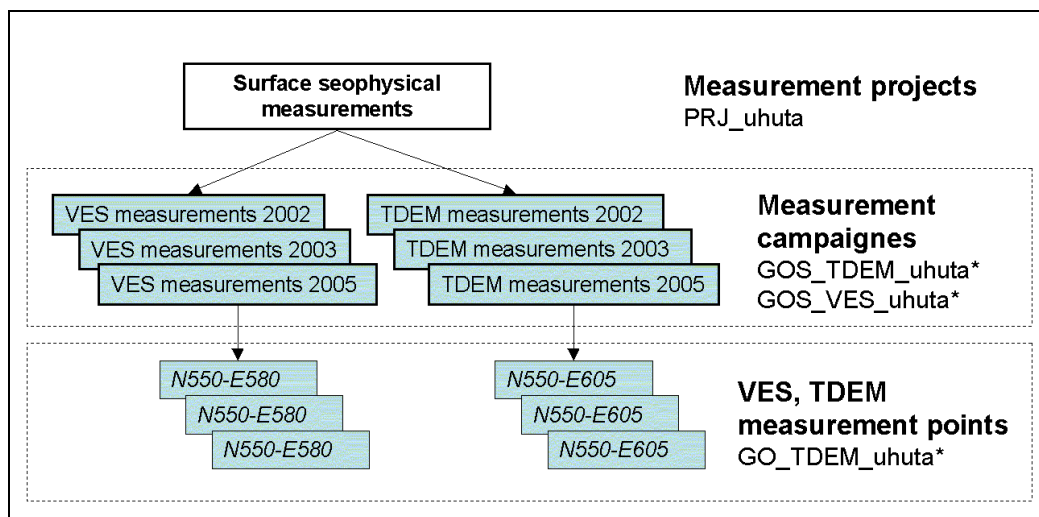


Fig.1: Applying the standard metadata structure to a complex geophysical survey

Recent presentation gives a brief overview of the typical user side operation of searching and graphical data imaging on the KINGA portal.

Besides running the service ELGI is also interested in the further enhancement of the system for which we are seeking financial support. The onward development aims the directions which are most important from viewpoint of more diverse utilisation. It is probably the integration of some geophysical data processing functionality into the system. Related to the latest achievements of this activity another paper from ELGI, the "Results of the Geophysical Inversions in the Bátaapáti Project Area" is going to be presented on this conference.

Estimation of Thermal Parameters Based on Porosity-follower Logs

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Keywords: mathematical model, petrophysics, well logging, heat conduction, density, porosity, permeability, bound water, clay content

There are two types of heat transportation in the rocks with penetrable pore space. They are heat conduction and heat convection. The first of them means the process of heat transmission between the stable particles of the rock and of the fluid molecules, while heat would be transported by moving fluid in the second case.

The resultant thermal conductivity of a rock depends on the conductivity of the rock matrix and the one of the fluid filling the pore space of that. It is independent from the size of the pores and the permeability of the rock.

The thermal conductivity of rock matrix requires some explanation because it's value ought to be higher than the real one considering the conductivity value of the single minerals, first of all the high quartz content of sediments.

The value of thermal conductivity used in the model, was chosen approximately the one of the feldspars since that is the most frequent mineral of the granitoid rocks and however of the earth's crust. So finally this value became 2,5 as the average conductivity of granite, syenite, granodiorite and of gabbro.

The thermal conductivity changes in reverse measure to the porosity because the conductivity value of water is only about a quarter of the rock matrix. The mechanical state of the rock is considered only in the measure of porosity because there is no change of structure but only direct heat transmission among the rock parts.

There were models created for the depth function of the geothermal gradient and the one of the temperature with a given heat flow and with different sand to clay ratio. The estimation of geothermal gradient and the temperature of the crystalline basement were made considering the theory for the basin sediments.

Estimation the change of heat conduction parameters with the depth requires the estimation of change the water filled total porosity according to depth. The changing of porosity is to be originated from the density changing by depth and it is in connection with the clay content.

Considering the global density–depth trend made for Hungarian basin sediments and also the expected chemical and physical transformation arising on compaction, two test functions were created. The first one shows the depth changes of clay and the second one the ones of the sand.

The function for depth – sand density became much steeper below 500 m and the derivative of depth – clay density function however has its maximal value at 1000 m.

In our model the depth – density functions were created from the two test functions' average according to the clay content. The total porosity–depth function is originated from the depth–density function. The total porosity of sand layers decreases to a negligible value below the depth of 2500 m.

The total porosity of the clay can't decrease below the adsorption water filled pore space and so it remains in the bigger depth too. This is important because of the presence of bound water referring the heat conduction and the specific heat capacity.

Heat conduction mainly depends on total porosity. It means all void space in a rock and matrix whether effective or non-effective. Total porosity includes that porosity in isolated pores, adsorbed water on grain or particle surfaces, and associated with clays. The total porosity can be calculated from density and acoustic logs.

Heat convection depends on rock permeability, because convection means the heat transport by the moving water. Permeability means the measure of the ability of a rock to conduct a fluid through its interconnected pores when that fluid is at 100% saturation. Permeability however is in an inverse proportion with the bound water content of the rock at given porosity. Most quantity of the bound water is adsorbed to clay minerals. That's why the computation of the clay content has an important role in estimation of thermal parameters too.

Geometric characteristics of the fault breccia of the Dorozsma basement reservoir

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Fault breccias are of key importance in hydrogeological processes in the brittle upper crust both concerning fluid flow and storage capacity. There, in the Pannonian Basin several hydrocarbon reservoirs occur in the fractured metamorphic basement, and several of them belong to wide breccia horizons. Here, fault rocks of the Dorozsma metamorphic high are to be studied.

Genetic classification of tectonites has been available for a long time, while nowadays significant effort has been made on constructing a geometric classification scheme of fault breccias. The main parameters, such a system may be founded are particle size distribution, surface roughness, clast roundness or even clast percentage of sample area. Parameters of the power-law size distribution can be correlated with the cataclastic mechanism, while typical fractal dimension of grain surface roughness may suggest the role of post-deformation fluid-rock interaction processes.

The samples studied represent the main breccia horizon of the Dorozsma basement reservoir. In four selected samples 300 clasts were evaluated one by one. Image analysis was used to explore geometric parameters. The breccias are monolithic with most clasts consisting of gneiss known from the undeformed portion of the studied well. Based on the proportion of large (> 2 mm), small clasts, matrix and cement, the studied rocks are chaotic breccia. This statement is confirmed by the small clast concentration (< 50%), and the high average clast rotation vaule (> 30 ϕ) too. By plotting a log-log plot of clast diameter against the number of clasts greater than that diameter, grain sizes follow power-law distribution with a fractal dimension of 1,628. All clasts exhibit distinctly corroded edges; the rough morphology of the grain surfaces can be characterized by a dimension of 1,262 as an average.

In case of the studied fault breccia samples, there is a clear evidence that tectonic fragmentation coincided with corrosive wear of the clasts. The studied horizon consists of chemical breccias, can be characterized by significant hydrodynamic activity.

Applied statistical methods in the modelling of the urban heat island pattern based on remotely sensed surface temperatures

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Keywords: urban air temperature pattern, urban surface temperature pattern, GIS, statistical modeling

The aim of this study is to develop a new – furthermore an easy to use – method for the early night-time near-surface air temperature pattern estimation based on surface temperature data in the urban area of Szeged. The surface temperature data have been collected by an airplane-based thermal infrared sensor at an altitude of 2000 m above ground level. The study area was covered by hundreds of images with a spatial resolution of about 2 m. The measured values were calibrated with data of in situ surface measurements in different land use types. Simultaneous air temperature measurement was carried out using a car-based temperature sensor along an almost 12 km long N-S urban transect. The measured points were located using GPS device.

Data were processed with GIS methods, with newly developed algorithms. In order to find the relationship between air and surface temperature a wider environment, the source area was taken into account, which determines the air temperature at a given point and time. Using a source area with a radius of 500 m, a strong relationship was detected between the two parameters. Namely, the temperatures of the surfaces found in the surroundings (weighted by the distance) determine the temperature of the air parcel located in a given point. The obtained regression equation was applied to extend our results in order to model the air temperature field in a larger urban area.

Characterization and changes in the state of the lakes in the field of Aggtelek and Slovak karst

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Keywords: karst, lakes, water quality

Karstic lakes belong to the natural values of karst. Some of these are very significant land elements, important as habitat as well as aesthetic attraction. Currently most of the lakes are strongly eutrophicated. That is mainly the result of changing traditional karstic land use to the intensive farm production and the sewage inflow. We monitored the quality of four lakes on the Aggtelek and Slovak karst: the Papverme-lake (Farárova jama), the Vörös-lake, the Aggteleki-lake and the Kender-lake. Our aim was to monitor the water quality and changes in the state of the lakes. In the analysis we determined the changes in the parameters and according to the operative hungarian standard we made a summarized water quality evaluation from the year 2008. We compared the lakes according to the evaluation.

After that we made the statistical processing of the data. We examined the spatial and temporal distribution of the data and their connection. We compared the lakes by the development stages and attended if they are similar to water quality evaluation groups.

Examination of the groundwater supply system of the Szigetköz using numeric modelling

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Keywords: Danube, Szigetköz, groundwater, dynamic factor analysis, numeric modeling, isotope-hydrology

Before the Danube was diverted, the Szigetköz's (in Hungary) shallow groundwater level oscillation was uniform. It depended mostly on the changes of the Danube's water level, which was limited by the hundreds of meters thick hydrogeologically homogeneous aquifer complex. After the Danube's diversion, the factors effecting the Upper-Szigetköz's groundwater-table-oscillation changed, and were modified again after the installation of the water supply system. In this new state instead of the Danube's main channel, the Dunacsún reservoir, the water flow arriving from the NW country border and least importantly the water supply system insures the water input for the groundwaters. In the Upper-Szigetköz the groundwater-table rose in the Rajka-Dunakiliti region. Under Dunakiliti, in the Middle-Szigetköz subsidence of the groundwater-table was noticed, because after the diversion the Danube drains the groundwater instead of supplying it. In the Lower-Szigetköz, under the mouth of the tailwater section, the groundwater level changes weren't considerable. In regard to this state is likely to be sustained, determining the factors by dynamic factor analysis, their loadings and providing numeric data regarding the groundwater supply is a very important task. Results of the studies concerning the changes in the groundwater supply system can only be used by integrating them into a numeric model. After calibrating the model, it can be regularly used to predict the outcome of the rehabilitation plans, including the different water sources and to simulate the adequate ecological water demand.

In the Szigetköz and its surroundings isotope-hydrological test were made in 1991, 1992, 1997 and 2001 to determine the supply of the ground waters, the discharges and the direction of the groundwater-flow. According to the tritium tests, in the NW region 500 m/year and in the Southern region 100m/year was the flow velocity. These tests were next preformed in 2006. Using these results and the information provided by the Geological Institute of Hungary we were able to verify the hydrodynamic model of the region.

Application of dynamic factor analysis for groundwater level changes of Northern Tiszántúl

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Keywords: background effect of the shallow groundwater, dynamic factor analysis

The basis of this study is a twenty-two years long time series of groundwater level in 122 observation wells in northern Tiszántúl (3.000 km²), in Hungary. The change of these groundwater levels - above the first aquitard formation - results from different cumulative effects, like water infiltration from precipitation, water extraction, etc. Our purpose was to know what kind of background effects drive the fluctuation of the subsurface water table.

The conventional tool to determine the background effects from observations is a factor analysis. Since factor analysis was elaborated for independent observations its direct application to time series vectors often produces unreliable or misleading results. To decompose the observed hydrogeological time series correctly in linear combination of the independent factor time series we applied dynamic factor analysis. These factor components can then be identified or regarded as the above mentioned effects (infiltration, evapotranspiration, etc.)

Three background effects have been determined and two of these have been identified, so far. The first factor fits well to the evapotranspiration, which was estimated with two methods. One of our determinations used the meteorological data, the other one the depth of the water table. We found correlations between water extraction and the precipitation from December to March, which model the infiltration of the precipitation. However, the water extractions increase the horizontal infiltration and the recharge. This process has been found as second factor. The two maps were produced from the loadings of the first and second factor. The information provided by the maps may be very useful because it indicates the vulnerability of an area for surface contamination.

Root cause analysis of land-subsidence near Medgyesbodzás

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Keywords: groundwater withdrawal, expansive clay, land-subsidence, hydrodynamic model,

The study area, Medgyesbodzás, is situated in the South-East part of the Great Hungarian Plain, 20 km from the capital of Békés county. Most of the area is built up by alluvial and fluvial deposits. The elevation of the study area ranges from 90 m up to 100 m. Building harms occurred on 11 settlements because of intensive land subsidence in 1992 in surroundings of the investigated area. From among these the most and the largest measure were the damages on Medgyesbodzás. More than half of the 638 buildings of the settlement realised splitting from building motion. Vertical, horizontal and diagonal splits took shape.

On the study area groundwater is used for drinking, and in a small proportion for irrigation. During the peak output, in 2007, from 14 wells the total water use was estimated to be approximately 3 million m³/year.

Five aquifers were identified in the Quarternary sediments based on the lithologic stratigraphic and hydraulic characteristics of the rock framework. The aquifers consist of unconsolidated sedimentary formations, predominantly sands, which are separated by clay and clayey sand aquitards. Near the surface there are 3-4 m thick clay lentils with fine sand under them.

The depth of the aquifers, the focus of the groundwater withdrawal, is from 30 m up to 120 m. This study is based on last century research data.

There are 4 main reasons, which may play a key role in the development of the surface motions:

- Hydrocarbon research related seismic blasts
- serious dry weather
- expansive clay
- groundwater production

Geophysical Research Institute blasts as a cause can be excluded as movements and splittings on the buildings have happened since these blasts finished.

The groundwater-level has decreased, resulting in clay lentils of cca.10 m diameter in the upper layers to dry. The clay lentils with the largest montmorillonite content have lost their natural water content and their total volume has reduced by 10-15%.

We simulated the effect of the water production onto the establishment of the groundwater-level, with Processing Modflow.

We have managed to prove that the exploitation carried out at the waterwork has a detectable role in the water level decrease at Medgyesbodzás surrounding. All this may be accompanied by a drier period in the weather.

According to our results continuous water production and serious dry weather are likely to be the direct cause of the building harms. These all induced the unequal vertical movement of clay under the buildings basement.

Advantages of Ordinary Kriging approach compared by Simple Kriging applied on the same porosity dataset

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Key words: Ordinary Kriging, Lagrange multiplier, Simple Kriging, porosity, mapping

The equations of Simple and Ordinary Kriging are compared to outline their differences in the estimation procedure. Emphasis is given to the Lagrange multiplier as a variable that allows the minimization of variance in Ordinary Kriging. The matrices and linear systems of kriging, which are most often performed in the background of the computer mapping algorithm, are analysed and presented in detail.

The authors' intention was to show the importance of careful selection of the appropriate deterministic geostatistical method for mapping of the reservoir's data. Furthermore, a detailed presentation of kriging's equations provides a better understanding of the Simple and Ordinary Kriging algorithms for geological engineers, as the two most-used geostatistical interpolation methods (it is also deserving to mention Indicator Kriging as the third).

The paper results included proposals, presented in four steps, for the determination of the Lagrange multiplier value in the Ordinary Kriging as well as graphical comparison of the Ordinary and the Simple Kriging maps interpolated for the same input porosity dataset.

References:

Balić, D., Velić, J. & Malvić, T.: *Selection of the most appropriate interpolation method for sandstone reservoirs in the Kloštar oil and gas field. Geologia Croatica*, 61, 1, 27–35 (2008).

Dorsel, D. & La Breche, T. (1997): *Environmental Sampling & Monitoring Primer (Kriging)*, at web site <http://www.cee.vt.edu/ewr/environmental/teach/smprimer/kriging/kriging.html>, last accessed on 27 Oct 2008.

Hohn, M.E. (1988): *Geostatistics and Petroleum Geology*. Van Nostrand Reinhold, New York, 400 pp.

Jensen, J.L., Lake, L.W., Corbett, P.W.M. & Goggin, D.J. (1997): *Statistics for Petroleum Engineers and Geoscientists*. Prentice Hall PTR, New Jersey, 390 pp.

Journel, A.G. & Huijbregts, C.J. (1978): *Mining Geostatistics*. Academic Press, London, 600 pp.

Krige, D.G. (1951): *A statistical approach to some basic mine valuation problems on the Witwatersrand. Journal of the Chemical, Metallurgical and Mining Society of South Africa*, 52, 119–139.

Liebhold, A.M., Rossi, R.E. & Kemp, W.P. (1993): *Geostatistics and geographic information system in applied insect ecology, Annual Review of Entomology*, 38, 303–327.

Malvić, T. (2008a): *Kriging, cokriging or stochastic simulations, and the choice between deterministic or sequential approaches, Geologia Croatica (Zagreb)*, 61, 1, 37–47.

Malvić, T. (2008b): *Izrada karte poroznosti krigiranjem u pješčenjačkim ležištima, primjer iz Savske depresije (Production of a porosity map by kriging in sandstone reservoirs, case study from the Sava Depression), Kartografija i geoinformacije (Zagreb)*, 7, 9, 12–19.

Malvić, T. & Đureković, M. (2003): *Application of methods: inverse distance weighting, ordinary kriging and collocated cokriging in porosity evaluation, and comparison of results on the Beničanci and Stari Gradac Fields in Croatia, Nafta (Zagreb)*, 54, 9, 331–340.

Malvić, T. & Balić, D. (2009): *Linearity and Lagrange Linear Multiplier in the Equations of Ordinary Kriging. Nafta (Zagreb)*, 59, 1, 31–37.

Smoljanović, S. & Malvić, T. (2005): *Improvements in reservoir characterization applying geostatistical modelling (estimation & stochastic simulations vs. standard interpolation methods), case study from Croatia, Nafta (Zagreb)*, 56, 2, 57–63.

Correction improvement for a geophysical extensometric monitoring system using finite element modeling

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Keywords: finite element modeling, terrain model, geodynamics, tide, gravity, mechanical deformation, extensometry, cavity effect

Introduction: The extensometric observations are used to study the recent Earth crust deformations, as well as to monitor geodynamic processes. Application possibilities are to analyze of natural effects caused by a wide spectrum of the Earth's physical processes, and man-made effects.

Systems: Monitoring of long period deformations of the Earth is usually performed by extensometers of different constructions capable to measure of changes in 10⁻⁸ order. The instruments are usually placed in natural or artificial caves, underground galleries.

Site: The extensometric monitoring system of Geodynamical Observatory of ELGI is situated in a natural limestone carst cave in Budapest. The observatory is equipped with two apx. 20 m long horizontal quartz tube extensometers in about ortogonal arrangement.

Problem: One of the most important factors influencing the accuracy of deformation measurements is the effect of the cavity system, distorting real deformations around the equipment. Cavernous rock body behaves in the sense of mechanical deformations differently than it would do filled with intact rock material.

Objective: Ideally we want to get the deformation values of the intact rock body at the site if the cavity containing the extensometer would not be there. In this study the finite element modeling was used to estimate the order and character of this influential effect.

Modeling: Geometry of the surface for the modeled terrain block is based on aerofotogrammetry data and represented by a triangular mesh. On site seismic measurement had been performed to estimate of in situ elastic parameters of limestones building up the cave's surroundings.

Results: Calculations have revealed about 8% of cavity effect, which should be the subject of numeric correction in the mechanical characteristics of the ELGI's extensometric system. Because the model was loaded by small gravity variations similar to the real tide effect (x 10⁻⁸ m/s²), only the linear behavior was considered.

Multivariable paleoecological and multivariate statistical analysis of mollusks retrieved from archeological sites and refuse pits: methods and results on some Hungarian examples

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Keywords: multivariable paleoecology, multivariate statistical analysis, gradient analysis, paleoecology, archeozoology, archeological refuse pits

Paleoecological analysis is generally aimed at elucidating the relationship between once-lived organisms and their environment. To fully capture and understand the complexity of the relationship between organisms and their environment requires the pursuit of numerous lines of evidence using techniques that will not mask or skew the evidence. Paleoecological community studies generally involve the investigation of several samples and the investigator is searching for a pattern a posteriori. Multivariate ordination is really useful in handling multiple samples composed of numerous species together and search for trends or gradients in our complex data sets. These gradients can inform us about the ecological conditions under which the site was formed. The methods of NMDS and DCA were adopted in our work to capture the ecological component of site formation; i.e. the environment in which the harvested fauna lived. This however must be interpreted in the light of other information on taphonomy. The present work will highlight some examples from Hungarian sites, where archeomalacological material was subjected to multivariate community analysis and the received variables were interpreted in the light of other variables reflecting taphonomy (valve presentation, valve fracturing), diet breadth and utilization (harvest evenness, mean targeted size, size distribution parameters of the targeted fauna). This modified version of the multivariable method, different from multivariate statistical methods enables us to capture the human component of the site formation as well. Pearson's rank correlation was calculated for the individual components to assess the strength of relationship between human components and natural components of site formation.

Statistical analysis and graphical displays of geochemical mapping results around former „Zrinski (Zrinyi) mine” (Mt. Medvednica, Croatia)

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Keywords: geochemical maps, statistical analysis, soil pollution, „Zrinski (Zrinyi) mine”, Mt. Medvednica, Croatia

The purpose of this study is to present statistical analysis and graphical displays of geochemical results for Hg soil gas and Hg soil distribution in the area around former mining site „Zrinski (Zrinyi)” on Mt. Medvednica, Croatia. The values of overall Hg concentrations in the soil gas show lognormal distribution. Moreover, spatial distribution of Hg data shows on the connection with the existing Pb-Ag-Zn mineralization and confirms anthropogenic origin of irregular landscape relief (waste rock clusters). Regression analysis of the dependence between Hg contents in the soil gas and the distance from the mine entrance also points to the considerable spatial dependence. Hg soil contents show also distribution similar to lognormal, and there is a weak correlation when compared with Hg soil gas content. Concentrations are mostly within background values, except in the immediate vicinity of the mine entrance where the values are significantly higher due to the mineralization influence concentrated in the waste-rock clusters. On geochemical maps, interpolated by mapping software, it can be seen that soil pollution caused by Hg is of local character with the spreading tendency to the south-west of the research area because of the dominant relief influence. Mercury found in the soil of the research location derives from the present mineral body and former mining activities.

Loess/Paleosols Sections in Eastern Croatia

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Keywords: loess, palaeosols, porosity, statistical tests, Pannonian basin, Croatia

The Pleistocene loess and Holocene alluvial sediments are dominant lithological members of Eastern Croatia. Impressive loess-palaeosol successions up to 30 m thick are exposed in Croatian part of Baranja (Zmajevac) and along the steep cliffs of the Danube River (Erdut and Šarengrad). The Croatian loess record provides an excellent high-resolution archive of climate and environmental change, providing evidence for the interaction between accumulation and erosion of aeolian and fluvial sediments during the Middle and Late Pleistocene. Sedimentological and pedological investigations were carried out on 110 samples collected from the loess sections at Zmajevac, Erdut and Šarengrad. Analyses include grain size analyses, XRF, microscopic analyses of light and heavy mineral fraction, chemical analyses of major and trace elements and REE, determination of carbonate content, pH, TOC and dating by infrared optically stimulated luminescence (IRSL)

The age determination of the loess sediments between the palaeosols by IRSL provides a reliable basis for identification of the soil forming periods. Geochemical (content of major and trace elements, and REE, TOC, pH, CaCO₃ content) and sedimentological (grain size, lamination, microscopic characteristic of carbonate concretions), characteristics of investigated palaeosols explained the main characteristics and degree of pedogenesis, while differences in composition of heavy and light mineral fraction emphasized differences in source material for the sediments under investigation. Presence of erosional discontinuities and infilling of crotovinas with soil material indicate that some of palaeosols are eroded and thus represent an incomplete record.

Elementary statistics shows no significant difference in chemical composition between profiles. Loess horizons contain <0.1% of TOC, while palaeosol horizons contain between 0.1 and 0.5% of TOC. Based on TOC values, the sub-groups of samples selected according to the degree of soil development can be distinguished. The results of F- and t-tests show that weathering coefficient Ba/Sr fits the criteria of equality of variances and means in less developed palaeosols and palaeosols. Accordingly, possibility cannot be rejected that two sub-groups of samples belong to the same population.

References:

DAVIS, J. C. (1986): *Statistics and data analyses in geology*.- John Wiley & Sons, 646 pp, New York.

GALOVIĆ, L., FRECHEN, M., HALAMIĆ, J., DURN, G. & ROMIĆ, M. (2009): *Loess Chronostratigraphy in Eastern Croatia- A First Luminescence Dating Approach.- Quaternary International, 1/2, 85-97.*

GALOVIĆ, L., MILEUSNIĆ, M., PEH, Z., DURN, G. & HALAMIĆ, J. (2006): *Mineralogical and geochemical characteristics of loess/paleosol section in Šarengrad, Srijem, Croatia.- U: Vlahović, Igor, Tibljaš, Darko, Durn, Goran & Biševac, Vanja (ur.): 3rd Mid-European Clay Conference - MECC06, Abstract book, Faculty of Science, Faculty of Mining, Geology and Petroleum Engineering, 46, Opatija.*

MAVLIĆ, T., VELIĆ, J. & PEH, Z. (2005): *Qualitative-Quantitative Analyses of the Influence of Depth and Lithological Composition on Lower Pontian Sandstones Porosity in the Central Part of Bjelovar Sag (Croatia).- Geologia Croatica, 58/1, 73-85.*

REIMANN, C. & FILZMOSER, P. (2000): *Normal and lognormal distribution in geochemistry: death of a myth. Consequences for the statistical treatment of geochemical and environmental data. Environmental Geology, 39(9), 1001-1014.*

SWAN, A. R. H. & SANDILANDS, M. (1996): *Introduction to Geological Data Analysis.- Blackwell Science Ltd, Cambridge.*

Palinspastic reconstruction of the Miocene sediments in western part of Sava depression using kriging interpolation method

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Key words: Palinspatical reconstruction, Kloštar oil field, Pannonian basin, Croatia, kriging

Palinspastic reconstruction is old-fashion but still effective tool for mapping and describing of hydrocarbon reservoir. Sandstone reservoirs of the Kloštar field, in the Sava depression, is typical represent of sandstone hydrocarbon pool in mentioned depression. The general view of forming of source rocks, reservoirs, traps and migration is well elaborated in some regional studies of this part of the Pannonian basin. But, the Kloštar field is analysed additionally in his-own palinspastic analysis as one of the most important Croatian hydrocarbon field. The geological sections, structural and thickness maps revealed that main heritage structures have the root in Palaeozoic basement (buried hills) and these forms had large influence on the structures created in Badenian, Sarmatian and partially in Pannonian. Also, the present-day field faulted anticline in that period was represented by strike-slip pull-apart basin. In Pontian compression started, mostly perpendicular on the marginal strike slip faults and reverted this structure, slowly but sure in pop-up type. Stress was changed from SW-NE to S-N in Pliocene and Quaternary. After all this changes, the final traps were mostly formed as present-day shapes already in Pliocene, and finally faulted, oriented and sealed in Quaternary. It means that oil had been generated in (mostly) Middle and Upper Miocene and migrated in traps in Quaternary (young reservoirs). Therefore, the structural development of the field can be divided in to two phases. First, pre-Lower Pontian, phase is characterized by continuous sedimentation as well as constant, regional influenced, synsedimentary tectonics. Second phase presumably started during Lower Pontian, but the main activity was Upper Pontian age with the tectonics as main influence in field structural development. Described geological history had been presented by Palinspastic sections as well as thickness and structural maps, where point data are interpolated by Ordinary Kriging technique.

References:

- Balić, D., Velić, J. and Malvić, T. (2008): Selection of the most appropriate interpolation method for sandstone reservoirs in the Kloštar oil and gas field. Geologia Croatica. 61, 1, 27-35.*
- Hernitz, Z., Jurak, V. (1973): Primjena paleostruktume i statističke analize naslaga mlađeg tercijara u području Ivanić-Grada (Sjeverna Hrvatska). Nafta, 24(7-8), str. 343-367.*

- Hohn, M.E. (1988): *Geostatistics and Petroleum Geology*. New York: Van Nostrand Reinhold.
- Pannatier, Y. (1996): *Variowin – Software for Spatial Data Analysis in 2D*. Springer Verlag, 91.
- Velić, J. (2007): *Geologija ležišta nafte i plina*. Zagreb: Sveučilište u Zagrebu, Rudarsko-geološko-naftni fakultet.

Potential application of non-controlled learning neural networks in geology

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Keywords: neural networks, Self Organized Map, different grouping problems, pattern recognition

Neural networks are derived from biological systems and since the processes in the nature, similarly to the active organism, are complicated systems, their study or their modelling using neural network can be done by an analogue way.

So this method provides an opportunity for getting solution for paleontological or geological problems which can be traced back to the different grouping problems, for example pattern recognition and revision of species. Self Organized Map (SOM) is a kind of algorithm in the field of non-controlled learning neural networks, which may a potential method for solution of geological or paleontological pattern recognition problems or in the analysis of geological scale problems.

SOM is primarily used as a dimension-reduction tool and as an abstraction process to represent data points with fewer representatives. This mapping preserves the original topology, i.e. it forms a locally correct projection while its distance mapping globally is a dear consequence of the local projection. A SOM consists of neurons organized on a regular low-dimensional (i.e. its dimension is lower than that of the original variable space) grid. Each neuron is a d -dimensional weight vector where d is equal to the dimension of the input vectors. These neurons control the classification using a suitable distance.

The advantages of the algorithm contrasted with a multivariable statistical classification method (for example a hierarchical cluster analysis) are as follows: it can reveal non-linear contact; the grouping process does not depend on the spatial position of the first two input vectors chosen during the reduction phase.

Transformation of porosity into indicator dataset and interpretation of facies; Case study from Lower Pontian sandstone, Sava depression

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Keywords: porosity, indicator variable, indicator variogram, sandstone, Sava depression

There is a lot of variogram analysis performed in sandstones of Pannonian and Pontian ages in Sava depression. The most detailed variogram analysis and kriging mapping in the Sava depression had been performed in sandstones of Pannonian and Pontian ages (e.g. Balić et al., 2008; Malvić, 2008; Malvić and Balić, 2009). The input dataset included porosity data collected in 20 wells as average value of oil-saturated sandstone reservoir of Lower Pontian age. The minimum was 5.448% and maximum 23.282%. The presumption of analysis is that porosity values can indicate on different sandstone facies (like sandy marl, marly sand, fine-grained and medium-grained) and, of course, marl. It means that basic porosity set had been transformed in several indicator dataset, based on several cut-offs. There had been determined the following cut-offs: 12.5, 18.0, 18.5, 19.0, 19.5, 20.0, 20.5, 21.0, 22.0, 23.0 and 24.0%. For each 'integer' dataset as well as for integral porosities is calculated variogram surface using Variowin 2.2.1 (Pannatier, 1996). The lag spacing was 400 meter both in X and Y direction and number of lags 6. These maps showed anisotropy (smaller variogram values) in direction NW-SE for the porosity, and the following cut-offs: 12.5, 18.0, 20.0 and 22.0. Due to not always clear anisotropy of variogram surfaces and relatively small number of data the variogram are calculated as omnidirectional. The variogram modelling is performed also by Variowin program, using lag spacing of 400 m and 8 lags in total. Variogram results will be base for mapping by Indicator Kriging in the next stage.

References:

Balić, Davorin, Velić, Josipa and Malvić, Tomislav (2008): Selection of the most appropriate interpolation method for sandstone reservoirs in the Kloštar oil and gas field. Geologia Croatica. 61, 1, 27-35.

Malvić, Tomislav (2008): Production of a Porosity Map by Kriging in Sandstone Reservoirs, Case study from the Sava depression. Cartography and Geoinformation - journal of Croatian cartography society, 7, 9, 12-19.

Malvić, Tomislav and Balić, Davorin (2009): Linearity and Lagrange linear multiplier in the Equations of Ordinary Kriging. Nafta, 60,1; 31-43.

Pannatier, Y. (1996): Variowin – Software for Spatial Data Analysis in 2D. Springer Verlag, 91 p.

Paleoecological and chronological reconstruction of archeological sites on the basis of anthracotomy in southwestern-Hungary

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Keywords: charcoal, Hungary, archeology

Charcoal and wood remains that can be found on archeological sites have an important function in research of Holocene environments. The basis of microscopic determination of wood fossils is that the anatomical build of the species are unique. The different species or genres can be distinguished from each other by the analyses of the characteristic features on three sections (transversal, tangential and radial).

Charcoal and wood residues come from firewood used in fireplaces by people, the burning of houses and other buildings or from wood fires that destroy at times on large sites.

In this study I would like to present the anthracological results of archeological sites in Zala county, southwestern Hungary. Our aims were the chronological classification of these sites and to compare charcoal data with pollen results to reconstruct the former environment using geomathematical methods. The studied sites give results not only from past environments, but also from the anthropogenic impact on vegetation from Neolithic.

Palaeoecological investigations on the core-sequence of the Vörös Marsh at Császártöltés

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The Vörös Marsh is the southern unit of the marsh system of the Danube-Tisza Interfluve running south in the watercourse of the River Danube. The marsh situated at the border of two significantly different regions on this area. The Solti Plain belonging to the Danube floodplain is covered with the network of abandoned watercourses of the River Danube. The Solti Plain and the adjoining Sand Dunes of the Danube-Tisza Interfluve are separated by an approximately 10 meter high steep loess-wall.

Peat cores were retrieved using a 5 cm diameter Russian corer. Detailed description of the peat cores follows the system described by Troels-Smith (1955). Samples collected from the layers between every 4 cm interval for sedimentological, geochemical analyses. The method of sedimentological was LOI (Dean 1974) and we used extraction-digestion method (Daniel 2004) for geochemical. Pollen, macrobotanical and malacological analyses were carried out at The Vörös Marsh by Jakab et. al. in 2004.

The quantitative plant macrofossil analysis technique (Jakab al. 2004) together with sedimentological and geochemical analyses have been used to reconstruct the postglacial marsh development or an eutrophic peat bog in South Hungary.

So as to interpret the results of the PCA completed on the basis of geochemical and sedimentological data I used macrobotanical analyses. Cluster Analyses was carried out on the results of PCA. The correlation of geochemical and macrobotanical and sedimentological analyses is reflected in the values of PCA and Cluster Analyses i. e. how reed-peat, sedge-peat, decomposed peat are separated. Consequently I could draw a conclusion how the examined area was developed.

The reconstructed palaeohydrological change was compared with the coincident terrestrial vegetation alterations. The Vörös Marsh get well oxygenized, nutrient and carbonate rich surface water since the sediment accumulation have started. Peet (*Phragmites*), which is rich in Mg and Ca, dominated plant associations emerged in the whole sequence. The rise of sedge (*Carex*), which is rich in K, was only a periodic event. Tussock forming *Caricetum elatae* plant association emerged in the fragmented channel, because of the increasing oligotrophy and improving climate.

Geomathematical section of the Croatian geological society

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Keywords: geomathematics, Croatian geomathematical section, Croatian Geological Society

Geomathematics in Croatian geology is relatively young discipline, mostly developed in the last decade. In fact, the first theoretical analysis of variogram analysis based on petroleum geology data started in year 2000. Of course, such tools were mentioned and published in other scientific discipline in Croatian bibliography, but, as in the world, geomathematics and especially geostatistics is hardly connected to analysis of hydrocarbon reservoirs.

There was published the first dissertation with comprehensive presentation of variogram theory as well as practice. After that the geostatistical papers had been started to publish, first in Croatian journal, and afterward internationally. Furthermore, together with geostatistics some analysis were based on neural networks approaches putting these two fields in the same box called "geomathematics". The papers gave enough material for the first geomathematical book, published in 2008 (dictionary) and another in 2009.

The most important event, which strongly supported geomathematics in Croatia, was IX. Congress of Hungarian geomathematics, held in Morahalom, 20-21 May, 2005. At that congress for the first time Croatian papers had chance to present geomathematical results of the Croatian part of Pannonian basin. After that, the cooperation continued each year and finally resulted in mutual geomathematical congress in 2008 – the 1st Croatian-Hungarian geomathematical congress. It has continued up to now.

All these facts initiated the establishing the Croatian Geomathematical Section as the part of the Croatian Geological Society in the 2007. The section facts are presented on this poster.

Element mobilization related to mylonitisation in the Mecsekajka shear zone (SW Hungary)

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Ductile deformation may significantly increase hydrodynamic activity of hard rock bodies. Although, fluid flow in mylonite zones is usually rather slow, evidence for element transport processes may infer its considerable role. Mórággy Granite Complex in SW Hungary is crosscut by several shear zones along which the host rock got mylonitized. Along the Mecsekajka zone parallel to these zones behaviour of the mylonites can be studied on the surface.

In the Köves-patak valley near to Bátaapáti a 2 m long section has been studied. Textural analysis infers continuous change from essentially undeformed orthogneiss host rock up to ultramylonites. The amount of K-feldspar, quartz and mica decreases, while chlorite and sericite becomes fundamental. In the most deformed samples calcite appears along shear bands.

Major element composition of over 20 specimens were measured using XRF analysis. Factor analysis indicates four independent geochemical processes; F1: role of host gneiss minerals, F2: K-feldspar alteration, F3: carbonatization, F4: accumulation of immobile elements. While spatial variation of F1 mimics the original gneissose structure, F2, F3 and F4 follow shear zone geometry. The role and degree of the element mobilization processes suggested by the last three factors was tested by the Isocon method of Gresens (1967) and Grant (1986). The results show that in the quartz-feldspar zones mobility of K_2O , Al_2O_3 and SiO_2 becomes significantly more intense towards the most deformed samples. In the biotite dominated zones of the original gneiss, on the other hand, only a little change of K_2O , Fe_2O_3 MgO can be detected, while CaO increases in both cases in the ultramylonitic samples.

Due to the most effective transport process of the mylonite zone material of K-feldspar left the rock body in concert with relative enrichment of mafic elements. As a consequence, decrease of total volume of over 50% can be estimated for the studied section, while – due to the intensive carbonatization – total mass increased slightly. Such extensive element transport processes clearly infer a significant role of fluid flow along the shear zone in question.

Pebble shapes: classical and new categories

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Keywords: pebble shapes, Zingg classes, static equilibria

The shape of sedimentary particles (e.g. pebbles) may carry important information on their history. Although pebble shapes have always been in the centre of interest among geologists, description of such three-dimensional shapes is not an easy task. Geologists have developed several classification schemes for rough estimation of the shape of worn stones. These classical systems can be easily used in statistical experiments to estimate shape distributions. Classical categories rely on standardized shape indices. These indices rest on length measurements of the three principal axes $a>b>c$ of the approximating three-axial ellipsoid. One of the most commonly used and most widespread classification scheme is due to Zingg, which classify pebbles into 4 categories (sphere, blade, disc, rod) relying on the axis ratios b/a and c/b . Although classical categories have proved to be useful tools and are widely used, these classification schemes involve subjective elements: classification depends on ambiguous length measurements, also, defining discrete classes involves an arbitrarily chosen constant.

Here we propose an alternative classification system which does not contain these ambiguities because our method rests on counting rather than on length measurements. This new classification system relies on the integer number of static equilibria. When placed on a horizontal surface, a convex rigid body (under gravity) will come to rest at a stable point of equilibrium. In 3 dimensions, a typical homogeneous, convex, rigid body may have three types of equilibria: stable point, unstable point and saddle point, their number will be denoted by S , U and H , respectively. (A cube has $S=6$ stable points on the faces, $U=8$ unstable points on the vertices and $H=12$ saddle points on the edges.) Due to Poincaré-Hopf Theorem we have the simple relationship $S+U-H=2$ between the three types of equilibria. Based on these result, we can define a unique classification for convex, rigid bodies based on the number and type of their equilibria: in 3D, class $\{i,j\}$ contains all convex, rigid bodies with $S=i$ stable and $U=j$ unstable equilibria (we mentioned the cube in class $\{6,8\}$). We show that using the number of static equilibria as categories is not only mathematically interesting but our system is also practically applicable for pebbles: simple hand experiments are suitable and easy to use to determine equilibrium classes.

Based on statistical results from two different locations we found remarkably small variance in the equilibrium class data sets indicating that pebbles are well mixed with respect to the new classes i.e. random sampling is very reliable. We also show that equilibrium classification is characteristic for the given geological locations.

Mathematical results indicate that macroscopic pebble shapes and equilibrium classes are closely related, although the latter do not completely determine the geometric shape. Statistical comparison between Zingg classes and equilibrium classes show that fair data on Zingg classes can be extracted from equilibrium classification, up to ~10-20% accuracy so the new classification provides all the information contained in Zingg classification. However, the new system is more sophisticated and capable of storing detailed information which can not be extracted from the Zingg system or any other classical scheme relying on axis measurements.

Image analysis of sutured quartz grain boundaries and its application for geothermometry

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Although, in most rock types changes in mineralogical composition are good indicators of igneous and metamorphic processes, in several cases only textural and structural characteristics report about the evolution. In most gneiss varieties, for example, because of the very simple mineralogy, PT (pressure-temperature) conditions of the meta-morphism can be estimated by a detailed study of microtextures.

Along boundaries of quartz grains in several metamorphic and igneous rocks, geometry usually follows a complex interfingering pattern. Under a common light microscope the length of the sutures ranges between approximately 10 and 1000 nm. These sutures form because along grain boundaries atoms or groups of atoms leave one crystal structure and get incorporated into its neighbour. This kind of diffusion is related to different parameters, like the relative crystallographic orientation of neighbouring grains or the temperature. (Kruhl & Nega, 1996). The complexity of a suture is unambiguously connected with the circumstances of deformation and the formation temperature.

Quartz is among the most common rock forming minerals. The shape of quartz grains is rather sensitive to pressure, temperature and deformation conditions of the rock forming processes. The aim of this work is to prepare a half-automatic image analysis algorithm to recognize monomineralic quartz-quartz grain boundaries in quartz rich rocks. An accurate digital recording of these sutures may contribute to precise measurement of fractal geometry parameters of the boundaries. Fractal dimension of the sutures (D) is a function of recrystallization temperature and therefore can be used as a geothermometer.

The complexity of the sutures can be defined in many possible ways, for example with measuring the length of the grain boundaries. It is rather hard to measure, especially because sutured grain boundaries are statistically self-similar patterns. Consequently, these curves can be quantified with the law of $L = r^{1-D}$ (L is the total length of each polygon, r is the length of one side of a polygon and the exponent D is called the fractal dimension). Fractal dimension values (complexity of sutures) of grain boundaries in rocks formed at different temperature intervals show that a large D-value is related to low temperature conditions, while small D-values suggest high temperature crystallization.

The classical method for the determination of the suture-complexity was based on an analog procedure. One has to redraw the sutures in the digital pictures of thin sections in several stages producing clean suture boundaries. Then the redrawn sutures need to be digitalized by scanning. Now they are converted into a compatible bitmap format for further processing. This

approach is relatively complicated, time consuming and is often extremely subjective, so it usually does not result in reproducible results.

A new recognizing algorithm has been performed instead. The aim was to work up such a half-automatic algorithm, which is able to recognize easier and better qtz-qtz grain boundaries and to create a wealth of reliable statistical data within a short period. The algorithm can be divided in to 6 steps. Five of them are rastergraphical and one is a vector-graphical step. As a result of the processing bitmap formats are generated that are immediately assessed for the Benoit 1.3 software, which calculates fractal dimension of the curves.

I analyzed the thin section of drilling samples from Dorozsma and the results were equal to the temperature values generated with other thermometral methods. Thus, this research proved the successful validation of this method, hereby the half-automatic algorithm is suitable in practice.

Geoinformatical support of a thermal water project

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Keywords: thermal water, database, query interface, spatial analysis

Nowadays the use of thermal water has larger and larger importance, the alternative energy of thermal water will be inexhaustable if the cold water is reinjected.

Hungary is rich of geothermal energy because in this area the geothermal gradient is higher then the global average, about 5-7 oC/100 m. One of the the biggest thermal water user of this region is the Árpád Agrár Zrt. in Szentes.

In my studies I create a complex geoinformatical support of this company's project using different tools.

This geoinformatical support has basically three, partly detached sides :

(1) On the one hand I create a relational database from data of paper reports (for example runoff, pressure, foot depth and temperature). This relational database means the seed of all analysis.

(2) On the other hand the relational database is so complex because it has fifteen datatable. That's why I copied web based query interfaces, with their functions. With these web interfaces the company users can easely query from the database and simultaneously they can use this system as a special management information system as well.

(3) Finally it is indispensable in this project to make spatial analysis with geoinformatical softwares and the comparsion of these analysis and stratigraphy model. For the spatial analysis I apply ArcGIS- ArcMap 9.2 program and RockWorks 14 which has long been the standard in the petroleum, environmental, geotechnical and mining industries for subsurface data visualization with popular tools such as maps, logs, cross sections, fence diagrams, solid models.

Geostatistical analysis of a reservoir

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Keywords: reservoir, porosity, permeability, distribution, kriging, stochastic simulation, sequential Gaussian simulation, surfaces, uncertainty

During my project my goal was to outline a reservoir's geomathematical and geostatistical model and analyse the model's uncertainty. For this I had stratigraphical data from 497 data points and geophysical data (porosity and permeability) from 118 data points.

At first the geomathematical analysis of the top and the bottom has been carried out. From this analysis the most important was the distribution check and the correlation, because these were the basis of the geostatistical modelling. During the geostatistical analysis kriged and simulated surfaces have been created for the stratigraphical position. The simulation has based on the variogram models, the spatial continuity has been analysed with variogram surfaces. The sequential Gaussian simulation's output was 100 realizations for the top and 100 for the bottom and of course the realization's E-type estimations and probability intervals.

For the geophysical data also a detailed geostatistical model have been carried out. Also kriged and simulated surfaces have been made for the geophysical data. 100 realizations have been created for the porosity and 100 for the permeability and the analysis of these realization's E-type estimations and probability intervals have been made.

Finally the uncertainty of the simulated values has been approached with the sequential simulation's width of the probability intervals in every grid points. With overlaying the four variable's uncertainty maps we can analyse the multivariable uncertainty.

The examination of time series of the Kis-Balaton Water Protection System (KBWPS) applying state of the art statistical methods

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Keywords: Lake Balaton, water quality, wavelet analysis, memory analysis, cluster analysis, Wilks' lambda distribution, Kis-Balaton Water Protection System, multivariate data analysis

Lake Balaton is the largest shallow freshwater lake in Central Europe. Its water quality is mainly affected by the supplying rivers and other water sources. The primary source is the River Zala. It supplies 45% of Balaton's water and 35-40% of its nutrient input (Lotz, 1988)¹. The waters of the Zala are filtered by Lake Kis-Balaton before entering Lake Balaton at Keszthely Bay (Fig. 1). During the nineteenth century, as a result of artificial water level modifications, Kis-Balaton vanished, so the River Zala's waters were unfiltered, Lake Balaton's nutrient load greatly increased, and its water quality started to deteriorate. That is why the Kis-Balaton Water Protection System (KBWPS) had to be constructed, to retain the inorganic nutrients at the mouth of the River Zala and stop the degradation of Balaton's water quality (Pomogyi, 1991)². The construction of the KBWPS was planned in two phases. Phase I was finished in 1985, but Phase II is still incomplete, as only a 16km² section was put in operation in 1992.

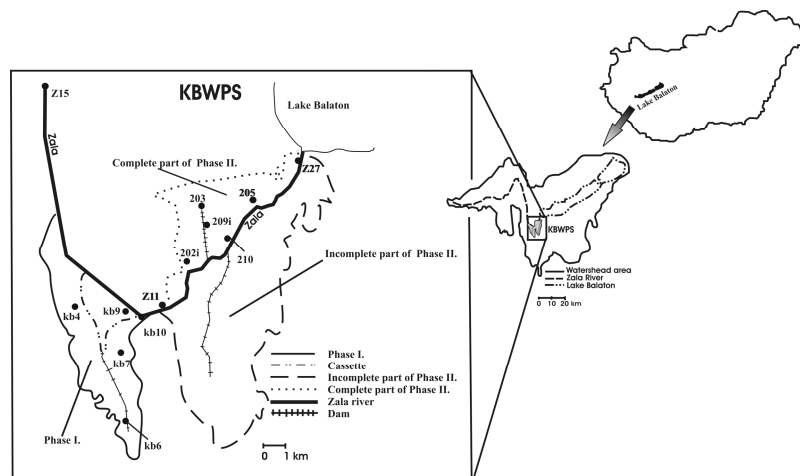


Fig. 1. The position of Lake Balaton in Hungary, its watershed area and the KBWPS with its sampling point

The aim of the present study was to examine the available physical, chemical and biological parameters using state of the art statistical methods to get a broader picture on the processes evolving in the function of KBWPS, and to point out the importance of completing the as yet unfinished (constructional) Phase II.

Multi-dimensional data analysis was used on the data of 25 physical, chemical and biological parameters for the time period 1984-2006 from 13 sampling stations. Monthly and annual trends were formed on three cardinal sampling points. Using the data from these three cardinal and eleven further monitoring points these points were clustered and grouped, then examined using Wilks' lambda distribution to define which parameters determine the formations of the cluster groups the most. In fine autocorrelation and wavelet spectrum analysis was used on 22 determining parameters to examine the memory and the periodicity of the processes in the KBWPS.

Sampling points were clustered then grouped. The groups were formed annually. The change in alignment of similar sampling points shows how the border between the determining groups altered through the years. This alteration followed the change of the macrophyte vegetation turning into an open water area. As the open waterspace expanded the phitoplanktons reproductional space grew with it. Chlorophyll-a indicates the phitoplankton mass, so the extinction of the macrophyte vegetation that resulted in a phitoplankton mass can also be followed in the annual trend of this parameter. Using Wilks' lambda distribution (**Fig. 2.**) it was possible to determine that the parameters responsible for eutrophication (first group) were

responsible for forming the groups of the sampling points. The next most important factors determining the groups were the variables in close relation with the parameters characteristic for the eutrophication (second group). The inorganic chemical components affected the conformation of the groups the least (third group).

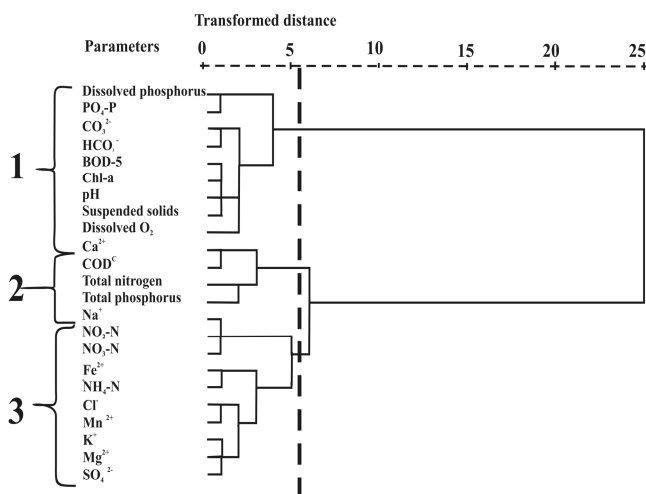


Fig. 2. Wilks' lambda distribution showing the three parameter groups determining the outcome of the cluster analysis

Morlet wavelet spectrum (**Fig. 3.**) analysis and autocorrelation analysis was applied on the data from the three cardinal sampling points. With these state of the art methods, the periodicity and the memory of the parameters in the two construction phases of the KBWPS, (the completed Phase I and the incomplete Phase II) were compared and the tracking capability of the periodical seasons of the two phases was analyzed. The results showed that the incomplete Phase II is unable to conserve the periodicity of the parameters, to the same

extent as the finished Phase I. In conclusion, we were able to point out the importance of completing the unfinished Phase II, so its puffer capacity could be enlarged.

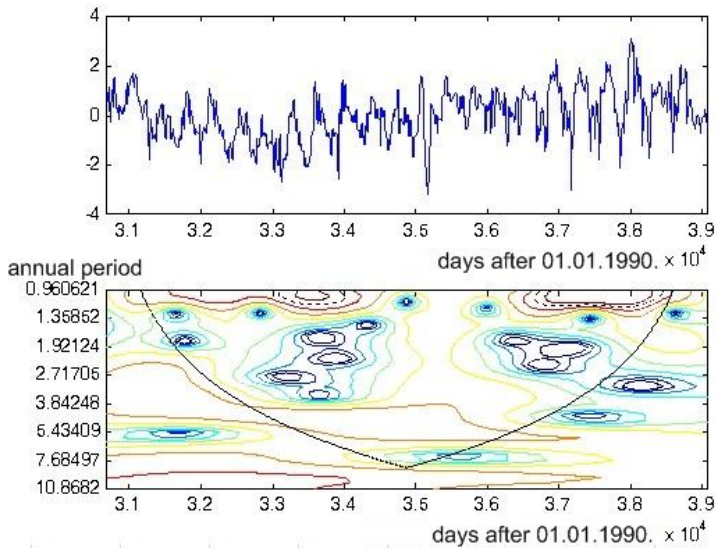


Fig. 3. Wavelet analysis output data, Ca^{2+} 's annual periodicity

References:

1. Gy. Lotz, 1988: A Kis-Balaton Vízvédelmi Rendszer. Hidrol. Tájékoztató. 20-22. October
2. Piroska Pomogyi editor, 1991: A Kis-Balaton Védőrendszer kémiai, biológiai, anyagforgalmi vizsgálatai, Összefoglaló jelentés az 1985-1990 közötti kutatásokról, Szombathely-Keszthely, pp.,71

The achievement of this research was that it pointed out changes in the KBWPS over a long time period with methods that have never before been applied to such a system. It also underlines the importance of the completion of the unfinished constructional Phase II.

This study could hopefully help scientists to get a broader perspective on processes evolving in the KBWPS, and when it comes to finishing the second phase of the reservoir system, more knowledge will be available on of what to expect regarding the quality of the water entering Lake Balaton.

The analysis of spatial distribution of traffic accidents using GIS methods

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Keywords: *Traffic accident, GIS, kernel map, k-function analysis*

The representation of traffic accidents in Geographic information systems helps to analyse their spatial distribution and to prevent them. At many places, including the Police Department of Szeged „pinmaps” on a wall are still used for this purpose. A more sophisticated method is to store the accidents in a GIS, which automates the data management of accidents and allows for more complex analysis.

With this study, our aim was to create a GIS which is able to store, represent and analyse the spatial spreading of traffic accidents in the city of Szeged. The data of accidents which happened in Szeged between 2002 and 2008 were provided by the police department.

During the analysis we intended to determine the traffic accident's relation to road quality and traffic density. This was done by counting the number of accidents per road length units. The results show a clear relation between them. Density maps were created using a kernel density method. This provided better visualization and easier interpretation of the spatial patterns of traffic accidents. Moreover, we normalized the kernel maps for all accidents with the ones created for pedestrian and child accidents. This way it was made possible to identify the locations where these type of accidents are more frequently occurring. Using K-function analysis, the data prove that there is clustering of child accidents around schools.

This study resulted a better understanding of the spatial spreading of traffic accidents. Furthermore, the hot spots of accidents in the city are identified. We could also prove the relation between road quality, traffic density and traffic accidents and that there is clustering of child accidents around schools.

The importance of remote sensing in the morpho-tectonical interpretation of Maramureş region

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Keywords: elevation models, digital image processing, lineaments.

The present article shows a possible interpretation of the Shuttle Radar Topography Mission (SRTM; Timár et. al* 2003.) on the Maramureş region (Romania, partly Ukraine). Based on morphologic elements (valleys and crests/highs) and with the use of digital filtering we compiled the lineament map of the perimeter. We concluded a scenario about a possible tectonic evolution of the regions. Finally we compared these footprints with some available tectonic maps. This study facilitates the oil seepage and gas emanation – as mud volcanoes – possible occurrences in the region.

Fig. 1: The grayscale display of the SRTM representing the Maramureş region



* G. TIMÁR, T. TELBISZ, B. SZÉKELY (2003):
Úrtechnológia a digitális domborzati
modellezésben: az SRTM adatbázis.
Geodézia és Kartográfia 55(12): 11-15.

Investigation of the Thermal Comfort Conditions of an Urban Green Area

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Keywords: urban green area, thermal comfort investigation, environmental monitoring (meteorological measurements), human monitoring (observation of people).

Due to the increasing extent of urbanization the number of people living in urban areas, and therefore affected by the strains of the urban environment is rapidly growing. One task of applied urban climatology is the recommendation of planning measures aimed to minimize climatic stress factors (i.e. thermal load, air pollution, noise) affecting human beings and the creation of comfortable urban spaces. It is very important to predict the effects of various strategies of town planning, because they affect the micrometeorological characteristics, and thus the well-being, performance and health conditions of the citizens. To make such predictions the physiological aspects of the thermal conditions of existing urban microenvironments (e.g. streets, squares, courtyards) need to be examined at the first stage.

The quality of open spaces in urban areas is of strong public interest. Parks and squares could play an important role in the recreation and outdoor activities of citizens; they can contribute to the life quality within cities. Human thermal comfort is one of the most critical parameters for the usage of an area (besides air pollution, noise level, aesthetics and accessibility), that's why the evaluation of thermal comfort (and stress) conditions of open public spaces is highly important. A detailed examination of a green space at the Ady square in the center of Szeged was performed, which – in accordance with the most recent human biometeorological methods – included thermal comfort index-based assessment (objective aspect) together with human monitoring (subjective aspect).

To get an appropriate picture on the area's use, human monitoring was conducted on the study area three times a week (Tuesday, Wednesday and Thursday) from 10th April to 15th May 2008, which included a counting of the visitors from 12 to 3 p.m., marking their location on a map as well as recording some of their personal features (age, gender, activity / posture, clothing). These subjective data sets were compared with the physiologically relevant assessment of thermal comfort conditions of the area in terms of an objective comfort index (PMV – Predicted Mean Vote). PMV (one of the most popular comfort indices of modern human biometeorology) was calculated from measured meteorological data (air temperature, air humidity, wind velocity, global radiation) with the bioclimate model RayMan. For the spatial analysis of the thermal comfort characteristics, surface morphological data of the area were also included in the simulation.

According to the data analysis (carried out with Microsoft Office Excel 2003) the attendance increased as the real thermal situation became warmer. The number of visitors especially rose in days with less cloud and significantly warmer conditions than the previous days. In order to illustrate differences between the spatial distribution of visitors according to their personal features (gender, clothing) the collected subjective data were processed with the software ArcView GIS 3.3. In addition we looked for significant correlations between the attendance (in the case of all subjects as well as in the case of various groups generated according to subjective features) and the thermal conditions using the software SPSS 11.0.

This examination threw some light on which are the most supportive thermal conditions for staying outdoors, as well as which parts of the area are preferred as a function of the actual thermal situation. The selected public space is an excellent example of how the area design could positively affect the number of people staying longer on the site by offering various microclimatic opportunities from which the most appropriate can be selected according to the actual (even in the case of stressful) weather conditions.

Landscape evolution modelling, the laboratory for theoretical geomorphology – an overview

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Geomorphological studies using numerical modelling appeared sporadically already throughout the 70's and 80's but they have only become widespread in the 90's. Numerical modelling as a research tool acts as a laboratory to speed up or slow down time or to study the effect of individual processes in isolation. Simulations are also useful to test hypotheses and to foster discoveries.

Questions tackled by numerical modelling concern process-form interactions. Well-known results are analytical expressions for channel profile curvature, valley density and the celerity of knickpoint propagation. However, we lack of analytical understanding in other cases, such as the location of the focus point of first order catchments, the planshape of catchments or the profile shape of crests. Other favoured research topics are the climate, tectonics and isostasy interaction, the optimal channel networks or karst modelling. Recently much research goes into the modelling of eolian processes.

The results of two theoretical projects are briefly summarized here. The first concerns the effect of storm duration on landscape evolution and the second is a hypothesis on the position of the focus point of first order catchments. The first study offers an analytical way to incorporate storm duration into the runoff function. This results that runoff for short storms will be a function of catchment shape and not merely of catchment size as for long storms (travel time of water within the catchment exceeds concentration time). For the short-storm case dynamic equilibrium surfaces show upward-convex channel and hillslope segments too, which is unusual for wash-erosion dominated landscapes. Analysing simple flow path geometries the model interprets the location of convexities: catchment tips and divergent hillslopes can produce convexities for only they show length-area relationship with exponents higher than unity.

The other research project presents the so-called finite perturbation analysis. This analysis is an attempt to interpret the position of the focus points of first order catchments by searching for stable catchment geometries. Key invention of the approach is that it quantifies the change in the drainage area of a point if perturbed. The perturbation reorganises the flow field through the work of erosion. The analysis is mainly based on analytical approximations and should be more thoroughly tested with a multiflow numerical model.

I also report about the current development of an open source modelling environment, called terRain. A modelling environment differs from a model in the sense that it offers functions to be freely combined into models. This facilitates programming and enables researchers from different fields to build their own models using the given spatial functions or to add new functions. Some description about the project is available here:

<http://terrainproject.googlepages.com/>

<http://code.google.com/p/terrainp/>