3rd INTERNATIONAL SYMPOSIUM OF SOIL PHYSICS

"The common people doing the unusual things"

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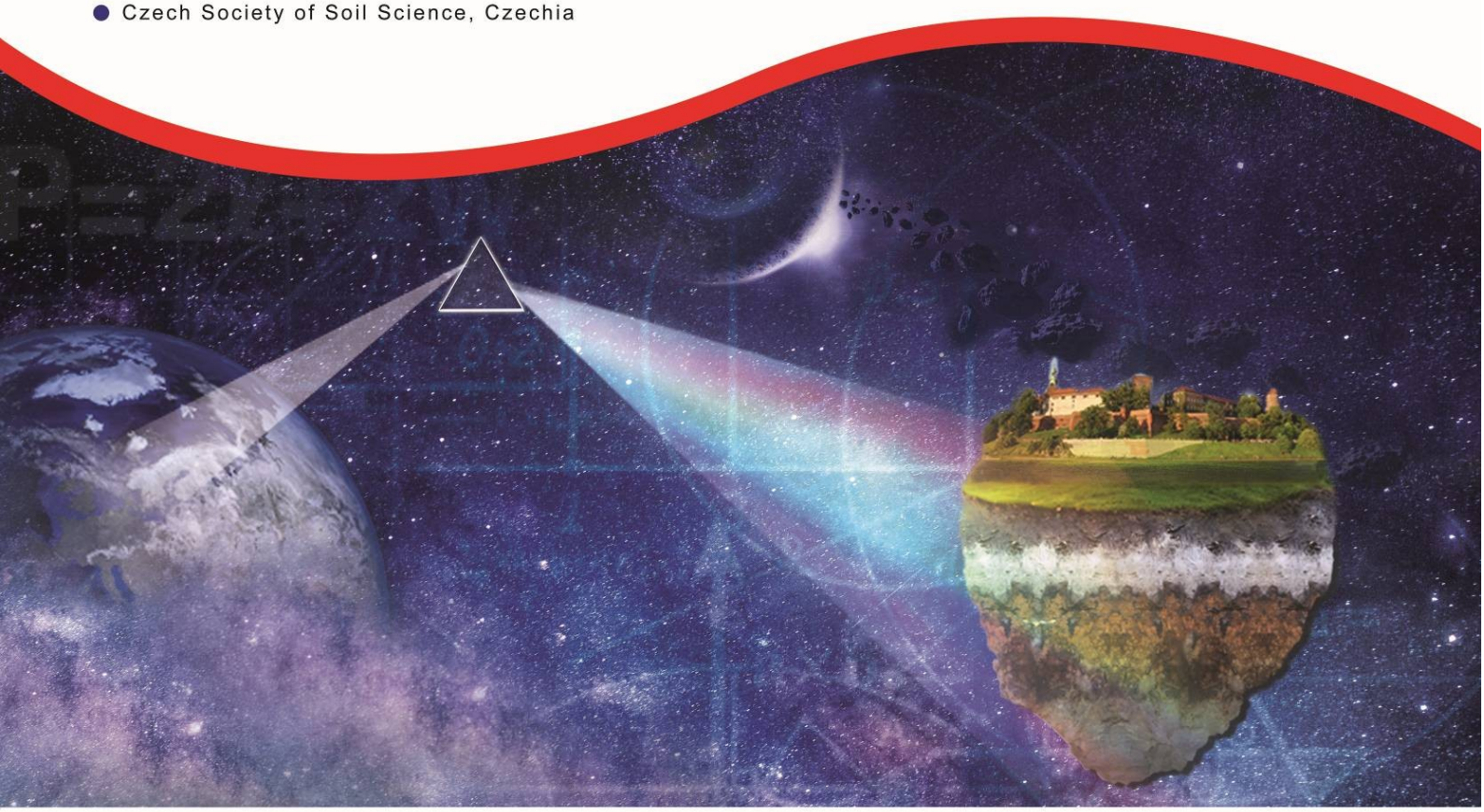

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3rd INTERNATIONAL SYMPOSIUM OF SOIL PHYSICS

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14-15 February 2018

Kraków, Poland

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Program of 3rd INTERNATIONAL SYMPOSIUM OF SOIL PHYSICS

Faculty of Agriculture and Economics, University of Agriculture in Kraków
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14th of February 2018

18:30	**Get-together meeting** *room 222, 2nd floor*

15th of February 2018

8:25	**Opening of the symposium** *room A, 2nd floor*
8:30-9:00	**KEYNOTE LECTURE** **Rainer HORN.** Research Innovations in Soil Physics – where do we need to go in 2030?
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10:45-11:00	**Coffee break** *room 222, 2nd floor*
11:00-13:15	**SESSION #2** Chairmen: **Bořivoj Šarapatka, Tibor Tóth** **Mykola KOCHIIERU, Virginijus FEIZA, Jonas VOLUNGEVIČIUS, Dalia FEIZIENĖ.** CO_2 efflux from the soil as influenced by the contrasting vegetation cover and management conditions in Cambisol. **Antanina STANKEVIČIENĖ, Vilija SNIEŠKIENĖ.** Changes of number and diversity of microscopic fungi in the rhizosphere of ornamental plants. **Barbora BADALÍKOVÁ, Jaroslava NOVOTNÁ.** Results of soil physical properties by incorporating of organic matter into the soil. **Jūratė ALEINIKOVIENĖ, Kęstutis ARMOLAITIS, Romutė MIKUČIONIENĖ.** Stability of soil organic matter in agro and forest ecosystems in Lithuania. **Beata HOUŠKOVÁ, Jarmila MAKOVNÍKOVÁ, Jan ŠLINSKÝ.** Ecological farming – mean for cultivating the soil in sustainable way. **Miloš ŠIRÁŇ, Jarmila MAKOVNÍKOVÁ, Beata HOUŠKOVÁ.** Possibilities of using different soil bulk density models of in Slovakia. **Tomasz ZALESKI, Mariusz KLIMEK, Bartłomiej KAJDAS, Agnieszka JÓZEFOWSKA, Joanna KOWALSKA, Karolina WOŹNICA, Justyna SOKOŁOWSKA.** Soil water balance in Retisol derived from silty deposite of Carpathians.
13:15-13:45	***Lunch***

13:45-16:00	**SESSION #3** Chairmen: **Rimantas Vaisvalavičius, Zbigniew Zagórski** **Miroslav FÉR, Radka KODEŠOVÁ, Antonín NIKODEM & Aleš KLEMENT**. Soil hydraulic parameters estimated from capillary rise and evaporation rates measured on the intact soil cores using HYDRUS-1D and their correlation with simultaneously measured maximal CO_2 efflux. **Michał BECZEK, Magdalena RYŻAK, Krzysztof LAMORSKI, Agata SOCHAN, Rafał MAZUR, Andrzej BIEGANOWSKI**. The use of X-ray computed microtomography for soil craters created after the raindrop splash. **András SEBŐK, Attila NEMES, Imre CZINKOTA, Viktória LABANCZ**. Effect of various ions on the sedimentation of soil: an optical approach. **Rafał MAZUR, Magdalena RYŻAK, Michał BECZEK, Agata SOCHAN, Andrzej BIEGANOWSKI**. Parameterization of the crown based on the analysis of splash on the soil and model surface. **Piotr BARTMIŃSKI, Marcin SIŁUCH, Guillaume DEBEANE**. Spectral properties of selected Polish Leptosols. **Jan SZATYŁOWICZ, Tomasz GNATOWSKI, Daniel SZEJBA, Edyta HEWELKE, Ewa PAPIEROWSKA, Andrzej ŁACHACZ.** Soil water repellency index of selected peat and moorsh soils **Jarosław KASZUBKIEWICZ, Krzysztof PAPUGA, Przemysław WOŹNICZKA.** Comparison of the dynamometric method with the pipette and hydrometer method used in the grain size analysis **Lilla MIELNIK, Jerzy WEBER**. Characterization of water-extractable organic matter from soils affected by fly-ash produced by lignite power station. **Jozef VARGA.** Geological conditions and land use effect on soil physical characteristics and soil biota
16:00-16:30	**POSTER SESSION** **Radka KODEŠOVÁ, Miroslav FÉR, Aleš KLEMENT, Antonín NIKODEM, Daniela TEPLÁ, Pavel NEUBERGER & Petr BUREŠ**. Water flow and heat transport under different surface covers observed and simulated using HYDRUS-1D. **Aleš KLEMENT, Radka KODEŠOVÁ, Miroslav FÉR, Šárka NOVOTNÁ, Antonín NIKODEM**. The impact of different root distributions on root-uptake simulated with HYDRUS-1D and 2D. **András MAKÓ, Viktória LABANCZ, Gyöngyi BARNA, Kálmán RAJKAI, Zsófia BAKACSI, Andrzej BIEGANOWSKI**. Comparison of various macro- and micro-aggregate stability indicators of the soils. **Antonín NIKODEM, Radka KODEŠOVÁ, Miroslav FÉR & Aleš KLEMENT** Using scaling factors and HYDRUS codes for assessing soil water regime within the erosion affected agricultural area. **Tibor TÓTH, Géza TUBA, József ZSEMBELI, Lajos BLASKÓ**. Relationship between physical and chemical properties of sodic soils in a long-term field reclamation experiment.
16:30	**Closure of the symposium**
16:45	**Kraków touristic trip**

Abstracts

Stability of soil organic matter in agro and forest ecosystems in Lithuania

Jūratė ALEINIKOVIENĖ[1], Kęstutis ARMOLAITIS[2], Romutė MIKUČIONIENĖ[1]

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Soil organic matter (SOM) is composed of organic and inorganic components. We were seeking to estimate the stability between organic matter inputs and outputs throughout organic matter mineralization. It was an obligatory admire for carbon storage evaluation in soils of agro and forest ecosystems.

SOM accumulation have been estimated in a long-term field experiments where were adjusted: (i) arable land with conventional tillage and minimized tillage systems with cereal crop rotation and cover crop treatment in *Planosols*; (ii) arable land, perennial grassland and forest land in *Arenosols* and in *Luvisols*.

In first experiment, over the 16 years soil tillage systems with permanent plant rotation and cover crop treatment have influenced the accumulation of SOM via soil organic carbon (SOC) stabilization. However, along the conventional tillage the pools of SOC were not increasing significantly. While shallow rotovating, cover cropping and no-tillage have been processed, the accumulation of SOC has increased on average by 1.5 times in ploughed (0-20 cm) horizon. Therefore, along the minimized tillage the microbial biomass accumulation has been increasing significantly, wherefore, intensified accumulation of SOC as well as humification were ascertained.

In second experiment, it was found that in mineral topsoil (0-20 cm) SOC stocks were higher in soils of 50-60-yaer-old deciduous forest plantations than both in arable land and grassland. It was expressed by the decomposition of forest floor, higher content of carbon in microbial biomass and higher rate of humic acids in humus fractional composition and, to a minor extent, by lower intensity of soil respiration.

Our observations highlighted the land use specificities to the contribution on the SOM. In agro ecosystems, the process of supplementing the SOM was long-term achieved through adapted tillage practice and the addition of crop and grass as well as microbial biomass organic components. While, in forest ecosystems the forest floor was as componential of the SOM and reflected in the SOC stocks in the mineral soil.

Results of soil physical properties by incorporating of organic matter into the soil

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During years 2013–2016 basic physical soil properties and soil structure in silage maize monoculture cultivated on the slopes was monitored. The experiment was established in the field trial in sugar beet growing region on Carbonate Chernozem, clay loamy textured. Monitoring was carried out in three variants with different dose of applied compost: Variant 1 – Control, without compost; Variant 2 – Compost 20 t.ha-1 applied in autumn; Variant 3 – Compost 40 t.ha-1 applied in autumn. The following soil parameters were monitored: reduced bulk density, porosity, actual contents of water and air, maximum capillary capacity, minimum air-holding capacity, soil structure, water stability of soil aggregates, and penetrometric resistance of soil. Samples of intact soil were collected by means of Kopecky cylinders. Soil samples were collected in five replications from three different depths, viz. 0-0.10; 0.10-0.20 and 0.20-0.30 m. Soil structure was determined by method of dry aggregation from two different depths, viz. 0-0.15;0-0,30 m. Values of water stability of soil aggregates were estimated using the method of sieve analysis.

The obtained results showed that applied compost has a positive impact on the soil physical properties. By compost incorporating soil compaction was reduced, its porosity was increased and soil structure has improved. Better results were obtained at a higher dose of the compost.

Spectral properties of selected polish Leptosols

Piotr BARTMIŃSKI[1], Marcin SIŁUCH[1], Guillaume DEBEANE[2]

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Visible and near infrared (VIS-NIR) spectroscopy is a rapid, low-cost, and efficient nondestructive analytical method for characterizing soils and can be used to analyze several constituents simultaneously. The method correlates diffusely-reflected, near-infrared radiation with the chemical and physical properties of materials (soils). Moreover, the method is easy to implement, does not require any chemicals, and is non-destructive. The quantitative predictions of primary (e.g. total N, total C) and secondary (e.g. cation exchange capacity, clay content) soil attributes can be very accurate. With the rise of precision (site-specific) agriculture, chemical and physical characteristics of many samples from a limited area are needed and conventional laboratory analysis is often too costly.

23 soil profiles were selected for the research, located in the area of the Lublin district. They were classified mostly as Rendzic Leptosols (according to World Reference Base) and Proper Rendzinas (acc. to Polish classification). Following parameters were analysed in the laboratory: particle-size distribution, organic carbon, reaction, sorption complex properties, $CaCO_3$ content.

Spectral Evolution SM-3500 Spectrometer was used for the collection of spectra, in the range 350-2500 nm. Spectral resolution was 3 nm, 8 nm and 6 nm, depending of bandwidth (350-100, 1500, 2500, respectively). Analysis was carried out in laboratory conditions, using properly prepared soil samples (dried and sieved through 2 mm) and contact probe, equipped with tungsten halogen source.

On the basis of the analysis, some correlations were calculated between particular soil characteristics and collected spectra. Statistical methods (PCA) were used for grouping samples.

Acknowledgement: This research was partially financed by the National Science Center (NCN - Poland) grant No. 2016/21/D/ST10/01947

The use of X-ray computed microtomography for soil craters created after the raindrop splash

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Soil as a top layer of the Earth's and being one of the most important components of terrestrial ecosystem, is extremely exposed on continuous degradation as a result of various physical and chemical factors. One of the most important physical degradation is water which causes the splash. Soil splash phenomenon is the first stage of water erosion process initiated when a water drops hitting soil surface during rain can cause the transport of the mass of splashed soil particles detached from the surface, breakdown of soil aggregates, create sediment for transport or cause the crusted surface. In specific conditions, one of the aspects of soil splash is micro-crater formed upon the impact of raindrop.

The aim of this study was to determine the suitability of the X-ray microtomography in crater formation after the drop impact on soil surface.

The measurements were conducted on Haplic Luvisol (Siltic) soil with different initial moisture content. Soil samples were dried, sieved through a 2mm mesh and placed in aluminium rings (36 mm diameter). In order to ensure different initial water content, samples were humidified to three moisture levels (pressure head: 0.1, 3.16 and 16 kPa). Water drops with a diameter of 4.3 mm had been created using capillary dosing system and released from 1.5 and 2.7 m, which was related to kinetic energy equal to 0.6 and 1.1 mJ respectively. One drop was used for each soil ring and after the impact, the samples were immediately transferred to the microtomograph. All measurements were made in 3 replications.

GE Nanotom 180S X-ray microtomography was used for 3D scanning of samples in order to determine the geometrical parameters of crater. The voxel size for scans was set to 15 µm. For each scan, 2000 2D images of rotated specimen were taken and based on this 3D reconstruction was created using Phoenix Datos |x v.2 software. Based on the 2D cross sections that runs through the centre

of the sample, the following parameters of the crater were measured: diameter, depth, height of the rim.

The choose of the adopted method and results from the measurements allowed to determine few general statements: 1) X-ray microtomography is a useful and efficient tool in the investigation of craters formed on soil surface after the drop impact; 2) the dimensions of the crater increase linear with the increasing energy of the falling drop; 3) the geometrical parameters are dependent on initial

moisture content (the higher water content, the bigger dimensions); 4) the crater depth has a stronger dependence on the energy of falling drop than the crater diameter.

Acknowledgement: This work was partly financed from the National Science Centre, Poland in the frame of project no. 2014/14/E/ST10/00851

Refrences

Beczek M., Ryżak M., Lamorski K., Sochan A., Mazur R., Bieganowski A. Application of X-ray computed microtomography to soil craters formed by raindrop splash. Geomorphology 303, 357-361, 2018.

Potential of visible and near-infrared spectroscopy as a tool for soil classification

Guillaume DEBAENE[1], Jacek NIEDŹWIECKI[1], Piotr BARTMIŃSKI[2]

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Soil discrimination or soil profile description are often cumbersome processes involving extensive field observations and many analytical procedures. This paper evaluate the applicability of visible and near-infrared spectroscopy (VIS-NIRS) as a fast, cheap and reliable method for soil classification or discrimination and for soil profile examination. Several examples with mineral and organic soils will be presented. These include mineral soil classification according to e.g. the soil organic content, classification of soils according to their texture (in the field or in the laboratory), profile preliminary description and also classification of different types of organic soils.

For that purpose, a field spectrometer (PSR-3500, Spectral Evolution) with a contact probe was used. Results indicates that VIS-NIRS is a promising technique for preliminary soil description and can classify soils according to their chemical or physical properties and horizons. Instead of complex chemical and physical analyses, VIS-NIRS is suggested as a useful, rapid, and inexpensive tool for soil investigation.

Soil hydraulic parameters estimated from capillary rise and evaporation rates measured on the intact soil cores using HYDRUS-1D and their correlation with simultaneously measured maximal CO_2 efflux

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The CO_2 emission from soils is influenced by many factors. To study the impact of organic carbon contents, and soil-hydraulic conditions a new experiment was designed to measure soil emission from the samples under controlled soil-water conditions. Study was performed on the intact soil samples from the morphologically diverse study site in loess region of the Southern Moravia, Czech Republic. The original soil type within this area is a Haplic Chernozem (remaining on top parts), which was due to erosion changed into a Regosol (steep parts) and colluvial soils (base slope and the tributary valley). Sampling locations were selected to characterize diverse soil conditions within the area, i.e. soil samples were collected in July 2014 after wheat harvest from topsoil at 5 positions (summit, shoulder, backslope, footslope and toeslope) of the elevation transect and also from the parent material (loess). Initially air-dried soil samples were placed at the top of a clay tank and samples were wetted by a capillary rise up to almost full saturation and soil respiration was measured. Numerical inversions of the measured cumulative capillary rise and evaporation data using the HYDRUS-1D program were applied to simulate water regime in the columns and to estimate soil hydraulic parameters. In all cases, the net CO_2 exchange rate (NCER) rapidly increased in the beginning of wetting. Next, NCER decreased with increasing soil-water content (summit, shoulder, backslope and loess) or remained relatively stable (footslope and toeslope). The average soil-water content values at the maximal values of NCER for summit, shoulder and footslope were similar. Lower average soil-water content values at maxNCER were simulated for backslope, toeslope and loess, which was attributed to high contents of loess substrate in topsoil samples. Maximal values of NCER measured on topsoils were closely related to the organic carbon contents (R=0.94) and the maxNCER RESαvalues obtained on all samples correlated with estimated shape parameters (R=0.856) and nRES (R=-0.876) of the soil-water retention curves, and saturated hydraulic conductivity (Ks) values (R=0.856).

Ecological farming – mean for cultivating the soil in sustainable way

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Soil structure is important soil property influencing directly soil fertility and soil functions. It is good and direct characteristic sign of soil status, respective good evidence if soil is degraded or not. In conventionally cultivated soils the soil structure is the most exposed soil parameter to the external factors with either positive but more often negative influence. It is important for fertile soil to have well developed and stable soil structure. Agronomically valuable structure is the most important soil structure category.

Ecological farming without use of heavy machinery, without turning soil layers like during classical ploughing and without using fertilizers is influencing soil structure in positive way. Even temporarily slight compaction of soil profile because of no till does not create unfriendly environment for soil structure development with stable aggregates in dry as well as wet conditions. Longer effect of ecological soil cultivation, better results in amount of stable soil aggregates and their consistent size development.

Our experiments with ecological farming in comparison to the conventional one are showing direct increase in amount of agronomically valuable structure in following direction: *Conventional farming – one year of ecological farming – 3 years of ecological farming – 5 years of ecological farming.*

According to the basic principles of sustainability, the system is sustainable only if all its parts are in balance. Taking into account these principles, ecological farming is a good example how to be in balance with the other parts of environment, how to cultivate soil in sustainable way.

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Comparison of the dynamometric method with the pipette and hydrometer method used in the grain size analysis

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The aim of the presented work was to compare the results of the granulometric composition measured by an innovative dynamometric method, developed by the authors, with the results obtained in the method of hydrometry and the pipette method, treated as the reference one. Repeatability of results obtained in the dynamometric method was also determined. The content of three fractions with dimensions <0.002 mm, 0.002 - 0.063 mm and 0.063 - 2.0 mm was measured. The results were compared using linear regression, and in the repeatability analysis, additionally by RMA (reduced major axis). It was found that the proposed dynamometric method is characterized by good repeatability of results and no systematic errors when compared with the pipette method. The RMSE (root mean square error) value for the pipette method calculated for the 3 fractions considered in total was 4.9096 and was lower than the analogous calculated for the hydrometer method, for which it amounted to 5.4577. For different fractions, values of determination coefficients in the comparison of dynamometric and pipette methods were within the range of 0.9681 - 0.9951,. It was found that slightly larger differences in the results in relation to the pipette method occur when measuring fraction <0.002 mm and 0.002 - 0.063 mm, and smaller for the fraction 0.063 - 2.0 mm. Similarly, greater differences between repetitions in the dynamometric method were observed for fractions <0.002 mm, and smaller for fractions 0.063 - 2.0 mm. Possible sources of errors in the dynamometric method were discussed and possible ways of their reduction were

The impact of different root distributions on root-uptake simulated with HYDRUS-1D and 2D

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Knowledge of the distribution of plant roots in a soil profile (i.e. root density) is needed when simulating root water uptake from soils using the HYDRUS programs. Barley and wheat were planted in a flat laboratory box under greenhouse conditions. Roots were excavated at the end of the experiment and root densities were assessed using root zone image processing and by weighing. For this purpose, the entire area (width of 40 and height of 50 cm) of each scenario was divided into 80 segments (area of 5x5 cm). Root density in each segment was expressed as a root percentage of the entire root cluster. Vertical root distributions (i.e. root density with respect to depth) were also calculated as a sum of root densities in each 5 cm layer. Resulting root densities, measured evaporation from the water table (used as the potential root water uptake), and the Feddes stress response function model were used for simulating substrate water regime and actual root water uptake for all scenarios using HYDRUS-1D and HYDRUS-2D. The application of two root detecting techniques resulted in noticeably different root density distributions. Differences were mainly attributed to the fact that fine roots of high density (located mostly at the deeper part of the box) had lower weights in comparison to the weight of few large roots (at the box top). Thus, at the deeper part, higher root density (with respect to the entire root zone) was obtained using the image analysis in comparison to that from the gravimetric analysis. Conversely, lower root density was obtained using the image analysis at the upper part in comparison to that from the gravimetric analysis. On the other hand, fine roots overlapped each other and therefore were not visible in the image, which resulted in lower root density values from image analysis. Root water uptakes simulated with HYDRUS-1D using diverse root densities obtained for each cereal declined differently from the potential root water uptake values depending on water scarcity at depths of higher root density. Usually, an earlier downtrend associated with gradual root water uptake decreases and vice versa. Similar root water uptakes were simulated for the presented scenario using the HYDRUS-1D and HYDRUS-2D models. The impact of the horizontal root density distribution on root water uptake was, in this case, less important than the impact of the vertical root distribution resulting from different techniques and sowing scenarios. For more details see Klement et al. (2016).

References

Klement, A., Fér, M., Novotná, Š., Nikodem, A., Kodešová, R. (2016): Root distributions in a laboratory box evaluated using two different techniques (gravimetric and image processing) and their impact on root water uptake simulated with HYDRUS. Journal of Hydrology and Hydromechanics, 64(2), 196-208.

Physical degradation of soils in conditions of Slovakia

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The main aim of this contribution is to inform scientific board about the current physical degradation of soils in conditions of Slovakia. There are concrete physical threats to soil (soil erosion, soil compaction) evaluated on the basis of representative soil monitoring system in Slovakia, which consists of 318 monitoring sites where all soil types, geology, climatic regions, various land use are included. There are permanently monitored important parameters in connection to recommendation of European Commission for evaluation of current state and development of soils concerning physical degradation processes since 1993 year.

The following methods have been used: soil erosion (on selected soil transects): 137Cs (gamaspectrometrically with high resolution); pH/KCl; SOC (soil organic carbon; dry way using CN analyzer); P (according to Egner´s method), K (according to Schachtschabel´s method); texture (according to FAO); soil compaction: bulk density (ϛd); porosity (P); maximum capillary water capacity (wKMK) in 100 cm^3 cylinders; texture (according to FAO).

Soil erosion belongs to the most environmental problems and the most extended degradation processes in Slovakia. In addition, the area of soil erosion distribution and its intensity is determined by using of the erosive predictive model where the USLE (Universal soil loss equation) is included. This interactive and predictive model was created for the farmers. Soil compaction is monitored and evaluated in the soil monitoring network only on arable land. The physical degradation was especially manifested in compacted and the eroded soils.

On the basis of obtained results it was calculated about 39% of the agricultural land is potentially affected by soil erosion in Slovakia. The significant sensitivity to compaction was detected mostly on cultivated arable soils - texturally heavy Fluvisols, Luvisols, Albic Luvisols and Planosols. In the case of soil texture, the physical conditions of monitored soils are deteriorating in the direction from texturally loamy to clayey soils.

Finally, the physical degradation processes belong to the most environmental degradation risks with strong influence on decreasing of soil production ability and therefore it is necessary to monitor them also in the future.

CO_2 efflux from the soil as influenced by the contrasting vegetation cover and management conditions in cambisol

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Soil CO_2 efflux is an index of the metabolic activity of heterotrophic microbes and plant roots. It differs among contrasting ecosystems and varies within environmental conditions. The efflux of CO_2 from the soil surface can vary markedly in magnitude both in time and space. In this research we investigated the temporal dynamic changes of CO_2 efflux from the soil surface using a closed chamber method (LI-COR LI-8100A Automated Soil CO_2 Flux System). Measurements were done on a Cambisol in a grassland, park and in arable land under conventional tillage (CT) in Central Lithuania. Soil CO_2 efflux was measured every 3-4 weeks during the growing season from May to September, 2017. The soil vegetation cover substantially affected the soil respiration rate. The greatest efflux values ranging from 0.81 to 3.21 μmol CO_2 m-2 s-1 were recorded in the grassland site and from 0.48 to 2.19 μmol CO_2 m-2 s-1 in the park, while the lowest values 0.33–0.88 μmol CO_2 m-2 s-1 were observed in the site with a sparse plant cover – in the arable land under CT. These efflux values were twice lower than in the park and 3 times lower than in the grassland.

Soil temperature and moisture are the main factors exerting the greatest influence on soil gas origination rate. The relationship between soil CO_2 efflux and temperature at a 5 cm depth can be described by a linear regression model (y=0.1249x-0.9454, R2=0.9548). Soil CO_2 efflux displayed a typical polynomial relationship with soil volumetric water content at a 5 cm depth; however, the relationship was very weak.

According to the results of topsoil respiration under contrasting vegetation cover and management conditions in Cambisol, the CO_2 efflux differed in quantity and was directly related to ground vegetation density. The same trend of efflux origination from the soil during the vegetation period were observed in all experimental sites.

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Water flow and heat transport under different surface covers observed and simulated using HYDRUS-1D

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Water and thermal regime of soils affects many processes in soils including contaminant and biological processes. Different soil covers influence water and thermal regimes in soils within urban areas. The goal of this study was to calibrate the model HYDRUS-1D for simulating coupled water and thermal regime in Technosol type soils with grass cover, and to use this model for predicting water and thermal regimes under different materials covering the soil surface. For this purpose soil water contents were measured at depths of 10, 20, 30, 40, 60 and 100 cm at 4 locations and temperatures were measured at depths of 20, 40, 80, 120, 150 and 180 cm at three locations (all covered by grass). In addition sensors for simultaneous measuring soil water contents and temperatures were installed under different soil covers (grass, bark chips, sand, basalt gravel and concrete paving) at a depth of 7. The parameters of soil hydraulic properties were obtained on the 100 cm^3 undisturbed soil samples using the multi-step outflow experiment and numerical inversion of the measured transient flow data using HYDRUS-1D. HYDRUS-1D was then used to simulated the water regime within the soil profile under the grass cover using climatic data and some of the soil hydraulic parameters were additionally numerically optimized using soil water contents measured at all depths. Water flow and heat transport were then simulated using these parameters, measured thermal properties and temperatures measured close to the surface applied as a top boundary condition. Simulated temperatures at all depths successfully approximated the measured data.

Next, water and thermal regimes under another 4 different surface covers were simulated. Soil hydraulic properties of different materials were partly measured and partly optimized when simulating soil water regime using the soil water contents measured at the depth of 7 cm (sand, bark chips, and concrete paving) or set (basalt gravel). The greatest soil water content variability was obtained (measured at the depth of 7 cm and simulated at different depths) for grass and gradually decreased for sand, basalt gravel, bark chips and concrete paving. However, in the case of concrete paving the measured soil water contents at the depth of 7 cm could not be successfully approximated using HYDRUS-1D due to the fact that measured soil water contents reflected 3D character of water flow below the paving. The largest temperature oscillations during each day at the depth of 7 cm were measured for concrete paving (due to this large daily data oscillation measured values could not be influence by surrounding area) and decreased as follows: basalt gravel, sand, grass and bark chips. As result also temperature oscillations simulated at different depths using measured temperatures

as top boundary conditions followed the same trends. The highest temperatures at different depths during the warm periods were simulated for concrete paving and decreased as daily temperature oscillations. The highest temperatures during the cold period were simulated for basalt gravel and decreased for grass, bark chips, sand and concrete paving. For more details see Kodešová et al. (2014).

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Comparison of various macro- and micro-aggregate stability indicators of the soils

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Soil structure is an important property that influences the hydro-physical characteristics of soil. One of the measures describing the soil structure is referred to as soil aggregate stability, which characterizes the resistance of soil macro- and micro-aggregates to the effect of external destructive forces. Physical, chemical and microbiological properties of soils (cementing constituents, i.e., clay, organic matter, sesquioxides, colloidal lime or even arbuscular mycorrhiza content) may be responsible for aggregate stability in varying degrees. Numerous methods and indicators can be found in the literature for the analysis and characterization of aggregate stability. In this presentation, we would like to compare some indicators calculated from the results of classic wet sieving (WS) and particle size distribution (PSD) measurements. Determination of soil PSD curves before, during and after disintegration of aggregates was performed with the laser diffractometer method (LDM). The WS and LDM PSD measurements were completed in distilled water and in non-polar liquid medium, as well. Heterogeneous soil samples, in terms of their physical, chemical and mineralogical properties, were included in the studies.

Stability indices and indicators characterizing soil macro- and micro-aggregate stability from different points of views, and dissimilar environmental conditions. The investigated aggregate stability indicators correlated with each other and with other soil characteristics differently.

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Parameterization of the crown based on the analysis of splash on the soil and model surface

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Splash is a natural commonly occurring phenomenon, with raindrops hitting the pavement during the rainfall as an example from everyday life. Therefore, it is not surprising that the splash is intuitively associated with a drop of water. However, this phenomenon can be caused by the impact of drops of other liquids or even solids. In addition, the drop can hit very diverse systems, from deep tanks filled with different liquids through thin layers of liquids to dry surfaces such as the soil surface. The large diversity of initial conditions is related to the diversity of the dynamics of the phenomenon and even the shape (aspect) which it takes. One of the forms taken by the splash is the crown.

The presented work focuses on the method of crown parameterization based on the results from two different experimental systems.

Tests were carried out using drops of water with a diameter of 4.2 mm falling from a height of 1.5 m on samples containing saturated soil classified as silt loam in the first variant of the system and a smooth surface made of glass in the second variant of the system. To create a layer of liquid required for the formation of the crown, we decided to use a series consisting of 10 subsequent drops hitting one after another, assuming that the measurement was performed only for the last drop. Measurements were recorded using a high-speed camera (Vision Research Miro M310) with a sample rate of 3260 frames per second at a resolution equal to 1280 × 800 pixels. Parameterization was made based on selected frames, calculations of pixels, and Vision Assistant software.

The description of the phenomenon required considering parameters of different characters, among which we can distinguish the values of the duration of the crown, the size of the crown, and the rate of form growth.

Conclusions

1. The presented method of crown characterization allowed comparing the phenomenon in two different systems.
2. For the full description of the phenomenon, in addition to the static parameters relating to the dimension of the crown, data such as the rate of growth and duration of the form are also required.
3. The thickness of the liquid layer and the roughness of the surface underneath had the greatest impact on the differences registered between the soil samples and the smooth glass surface.

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Characterization of water-extractable organic matter from soils affected by fly-ash produced by lignite power station

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The water-extractable organic matter (WEOM) is a soluble fraction of soil organic matter, which is the most active and mobile part of the soil organic matter pool. Despite that it is only a small part of the soil organic matter, WEOM has a significant impact on many environmental processes in the soil. It plays, among others an important role in the stabilization and preservation of organic carbon. The WEOC fraction is the most sensitive to any change of conditions, and thus reflects the anthropogenic impact on the soil. The aim of study was to identify qualitative and quantitative differences of WEOM isolated from ectohumus horizon of soils located at areas surrounding fly ash dumping site formed after burning of lignite in the Bełchatów power station, central Poland. Soil samples were taken from a distance of 50 m from the dumping site, while control soil samples were taken at the distance of 4 km. Soil WEOM was extracted according to the method proposed by Zsolnay. The WEOM characterization was carried out by UV-Vis absorption spectroscopy, fluorescence spectroscopy Fl and the delayed luminescence (DL). In addition, various parameters derived from spectroscopic analyzes were calculated: the aromaticity and hydrophobic contents indexes (SUVA254, SUVA280), parameter indicative of decomposition and molecular size (E4/E6) from UV-Vis spectra and the humification index (HIX), biological index (BIX) from the fluorescence spectra at their specific emission and excitation wavelengths. The results indicated that the WEOM fraction isolated from the soils located at areas surrounding fly ash dumping site shows significant qualitative and quantitative differences. The characterization of both concentration and composition of WEOM will contribute to a better understanding of processes occurring in studied soils. Slight but important differences in WEOM properties, can be highlighted by luminescence spectroscopy analysis (Fl and DL) both in the luminophores types and in their relative intensity and efficiency.

Cutting through the spider-web of publishing your soil physics research

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Today there is an unprecedented amount of new data and knowledge generated in most research fields – including soil physics, and there is a greater scope and extent of potential practical applications than ever before. The question comes inevitably, how to maximize international visibility of one's research, and the first decision to make is what publication outlet to choose. It is the joint interest of readers, authors, reviewers, editors and publishing houses that scientific results should be reported as high impact, high quality studies without unnecessary and avoidable delay. All too often there is pressure on scientists to increase the number of scientific papers they publish. Authors can undeniably face the frustrating and disappointing experience of their study being rejected by journals. In yet other cases authors may not even consider higher-ranked journals as outlets for their work, whereas they could do so. There is often a disconnect between authors and journals/publishers simply because of lack of experience (e.g. due to young (scientific) age), or due to misconceptions about the drivers or the process of manuscript evaluation and publication. It seems sensible to try to support authors in developing and reporting their related research efficiently, so that the overall value of their work, together with their publishing experience, will improve. This presentation is intended to help un-code some of the conceptions and misconceptions of publishing in international journals – hopefully in a discussion format during and potentially after the presentation. Part of the information reported in this presentation is based on an anonymous online survey of a group of soil physicists with substantial experience in publishing and reviewing and/or editing papers in the subject area of pedotransfer functions, but the presentation will use as wide generalizations as possible.

Using scaling factors and HYDRUS codes for assessing soil water regime within the erosion affected agricultural area

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Soil hydraulic properties with the areas heavily affected by water erosion may significantly differ. As result, soil water regimes at various sites of this area can also considerably differ. Study was performed on soil samples from the morphologically diverse study site in loess region of the Southern Moravia, Czech Republic. The original soil type within this area is a Haplic Chernozem (remaining on top parts), which was due to erosion changed into a Regosol (steep parts) and colluvial soils (base slope and the tributary valley). One representative transect, with the most diverse terrain attributes (i.e. elevation, slope, curvature, exposition etc.), which caused the most variable soil properties, was delineated. Five sampling points were selected assuming that soil at different points should be modified by different stages of erosion-accumulation processes: summit, shoulder, backslope, footslope, and toeslope. Grab soil samples were used to measure basic soil properties. Soil hydraulic properties, $\theta(h)$ a $K(h)$, were measured on 100-cm^3 undisturbed soil samples (taken before and after the vegetation period) using the multistep outflow experiment and numerical inversion with HYDRUS-1D. Next the reference soil hydraulic properties, $\theta^*(h^*)$ a $K^*(h^*)$, and scaling factors (αh, αK a $\alpha\theta$) were evaluated to describe spatial and temporal variability of the soil hydraulic properties. In general, larger values of αh factor and lower values of αK a $\alpha\theta$ factors were obtained before vegetation period in comparison to those obtained after the vegetation period. While no trends in scaling factors along the elevation transect were observed before vegetation season, the evident trends were observed after the harvest. Finally, HYDRUS-2D was used to simulate water flow in simplified 2D-transces under the ponded infiltration using the data (i.e., the reference soil hydraulic properties and scaling factors) obtained from both sampling episodes.

Textural changes in chernozems within fifty years in the Czech Republic

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Chernozems are the most fertile soil in the Czech Republic, which represent at about 12 % of the arable land. Because of intensive agriculture these soils are negatively influenced by erosion processes and degradation. In this paper the textural changes in chernozems during fifty years are evaluated. Data set from the period of Soil survey (1961–1970) was compared with the present situation. Period of Soil survey in the Czech Republic was characteristic by parcels border removing and intensive soil exploitation. We evaluated the topsoil (0.00–0.30m) of chernozems, regardless the subtype. Statistical evaluation (t – test, N = 90) is presented for Moravia region (districts Uherske Hradiste, Brno, Zlin, Prerov, Prostejov, Kromeriz, Vyskov, Breclav, Hodonin, and Znojmo). Content of particles < 0.01 mm was determined by the pipette method and compared with the previous data set from the Soil survey. Results showed that average content of particles < 0.01 mm were 40.2 ± 1.12 % (Soil Survey) or 40.3 ± 1.18 % (nowadays); difference is not statistically significant. But in set of results increased sharpness from 0.73 (soil survey) to 1.14 (nowadays) and decrease skewness from 0.23 (soil survey) to 0.09 (nowadays). We can observed (with respect to character of chernozem samples) after 50 years of intensive agriculture that: the original distribution began to change and it became more normal distribution (according skewness) but leptokurtic (according sharpness), very likely as consequence of the water erosion on some places (not part of this work, but erosion was confirmed by a change of Cox to multi-peak distribution).

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Water, nutrients and cereal crop productivity under different management intensity

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Valinava long-term experiment (55.22° N, 23.51° E) established in 1991 at the Institute of Agriculture, Lithuanian Research Centre for Agriculture and Forestry. The experiment is situated on the terrace of the DotnuveleRiver and occupies 4.4 ha. Prevailing soil is sandy loam and light loam Endocalcari – Endohypogleyic Cambisol (CMg-p-w-can). Crops are grown in 4-course crop rotation: spring barley, red clover, winter wheat and spring oilseed rape under three levels of management intensity: a) conventional, b) integrated and c) organic.

Cereals in conventional and integrated agroecosystems were applied with herbicides, fungicides and insecticides and in organic system were grown without application of industrial fertilisers and plant protection measures.

The growing period of crops during the experimental years was warmer than the climate normal, with contrasting rainfall. Drainage water runoff measurements show that substantial part of precipitation (up to 310 mm) was lost during the non-growth period resulting in lower levels of ground water table and temporary moisture deficiency in crops. On average, the yield of winter wheat grown without fertilizers and pesticides was 67%, spring barley 70%, spring rape 47% and red clover 124% of that under conventional management. Export of phosphorus from the field with crop production in both organic and conventional management in the same descanting order: winter wheat > spring barley> spring rape > red clover. P concentration in drainage water varied in a wide range, however, now significant difference between organic and conventional fields were found.

Effect of various ions on the sedimentation of soil: an optical approach

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Eroded soil particles and free or attached nutrients travel distances from the source area, and may eventually end up in our surface waters and cause undesirable changes to the environment. To slow or prevent this, a number of mitigation measures, such as e.g. sedimentation lakes, dams and wetlands were set up around Norway. This work was motivated by the assumption that coagulation of particles can yield larger effective particle-diameters. This may accelerate sedimentation, and help reduce the amount of material that is effectively lost from the vicinity of the source. Our specific aim was to inspect the effectiveness of various ions in enhancing coagulation and accelerating the process of sedimentation. In the material that we used, most of the particles could be found in clay fraction, where the colloid size prevents the settling. We used several ions as coagulants to attach them together. Over 3 hours of settling time, we took photos at every 10 minutes and analysed them using specific software. The cations that we examined were: Na^{+}, Ca^{2+}, Mg^{2+}, Fe^{2+}, and Al^{3+}, in 10, 20, 40 and 80 mg/L doses.1 gram of soil was dissolved in 500 ml of solution as our test material. The examined anions were: Cl^{-}, $SO4^{2-}$, and OH^{-}, in the amount relevant for the cation doses. We established certain metrics to determine the effectiveness of the ion groups. We compared the effect of cations and anions and their concentration on sedimentation time, using the half time of the background-adjusted colour of the mixed solutions, as a signal of sedimentation.

Possibilities of using different soil bulk density models of in Slovakia

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Soil bulk density is one of the main direct indicators of soil health, soil compaction but it is also an important aspect of different next models. The determination of bulk density is laborious and time consuming therefore its values are often missing in soil databases. Available databases of Slovakia (Slovakian partial monitoring system-soil database a Complex soil survey database) were used to create of bulk density estimation models based on two different principles (texture triangle model and PTF model) and were then compared on a chosen territory. The prediction of soil bulk density on PTF principle was created by way of applying multi-regression methods. Models of soil bulk density in an equilibrium state, with different combinations of input parameters (soil particle size distribution and soil organic carbon content in %), have been validated using a data set from 15 principal sampling sites

of Slovakian partial monitoring system-soil, that were different from those used to generate the bulk density equations. The created bulk density models were used in the selected area by way of a point-by-point view and subsequently evaluated for their use in models as determining agroecosystem services potential, soil carbon stock, nutrients reserves and water balance.

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Changes of number and diversity of microscopic fungi in the rhizosphere of ornamental plants

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During the years of investigation 138 species belonging to 43 genera were ascertained in Dianthus caryophyllus rhizosphere. The microscopic fungi of Penicilium, Aspergillus, Mucor, Trichoderma, Mortierella genus and species of Acremonium strctum, Gliocladium radicicola, Paecilomyces variotii dominated in the substratum prepared for plants growing and in rhizosphere. Species variety of dominanting genus decreased during the vegetation. Fusarium genus was an exception, of which dominanting species variety increased. Detection frequency of microscopic fugi species during the vegetation increased. In the second half of Dianthus vegetation (bloom - the end of vegetation) the dominance of pathogenic species gradually expanded: Fusarium (detection frequency (A%) 2.33 - 6.98% and 5.88-47.06%), Verticillium (2.33-23.53%), Sclerotinia (10.37-23.26%) species and Botrytis cinerea (3.51-11.75%).

Soil water repellency index of selected peat and moorsh soils

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The paper presents the results of the laboratory measurements of water and ethanol sorptivity, which were carried out for organic soils from the Biebrza River Valley (moorsh, reed, sedge alder and moss peat). The sorptivity measurements were conducted using capillary infiltration method applied to undisturbed soil samples during their drying process. In order to estimate the influence of soil hydrophobicity on water sorptivity the repellency index was calculated. The results of measured values showed that the water and ethanol sorptivity depends on soil moisture content. The performed analysis of the measured data indicated that hydrophobicity of peat and moorsh soils leads to decreasing values of the soil water sorptivity. The magnitude of the influence depends on moisture content and soil type. It was found that decreasing of the soil moisture content leads to higher hydrophobicity of the soil, which reduces the water sorptivity and delay the starting moment of water infiltration into the soil. The decrease of soil moisture content to a critical value caused increasing values of the water sorptivity, while the further moisture loss by the soil lead to decreasing vales of the sorptivity. The obtained values of the water sorptivity at pressure head equal to pF=2.7 were equal to 0.482 cm min-0.5 for moorsh soils, 0.405 cm min-0.5 for moss peat and 0.102 cm min-0.5 for alder peat. The performed research shows that the soil water repellency index depends on soil moisture content, the values of the index increase as soil moisture content decrease. Within the examined soils, the highest influence of hydrophobicity on the water sorpitivity was observed in moors and sedge peat and the lowest in moss peat.

Erosion processes and their influence on soil properties in the intensively used landscape of South Moravia (Czech Republic)

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The presented research concerns the degradation of agricultural land in South Moravia, where negative changes in soil properties are caused mainly by erosion processes. According to the soil degradation assessment for the Czech Republic (eg. Šarapatka, Bednář, 2015), this region is heavily affected by water erosion. The focus of our observations was therefore mainly water erosion. With the use of the afore-mentioned degradation model, archive aerial surveys, current orthophoto maps, aerial photography, and erosion patterns (USLE, USPED), we selected areas on erosion and accumulation slopes. A more detailed observation was carried out at these locations, not only of basic physical properties of soil (especially texture and influence on fine fractions), but also of changes in chemical and biological properties with carbon shifts in individual parts of the slope and changes in carbon quality, which also influenced biochemical soil characteristics. We also focused on historical changes in the landscape, where we used the results of the Soil Complex Survey of the 1960s, i.e. approximately 50-year-old results, which contain the results of physicochemical analysis of soil samples from several horizons of the soil profile. In our poster, we present a comparison of changes in selected soil properties in erosion and accumulation parts of the slope, taking into consideration the morphology of the terrain with the emphasis on the basic physical properties and organic matter in the soil. At the same time, the presentation is a guide to site-selection procedure in order to monitor degradation changes in the landscape and to propose measures to mitigate soil erosion in intensively farmed landscapes.

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Relationship between physical and chemical properties of sodic soils in a long-term field reclamation experiment

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In the Great Hungarian Plain, on sodic (solonetz) soil at Karcag a long term reclamation experiment is being carried out. Sodic soils are very good examples of the close relationship between soil chemical (salinity, sodicity, alkalinity) and physical (swelling, water retention, hydraulic conductivity) properties. The tillage of the clayey sodic soil is limited by large plasticity, cracking and slow infiltration in this area. After 35 years we opened soil profiles and the soil parameters were compared to unimproved soil profiles in each of the three treatments, 1) zero, that is unimproved grassland plots with deep loosening, 2) chemically reclaimed cultivated plots with gypsum and/or lime, deep loosening, surface drainage, 3) drained cultivated plots with chemical reclamation, deep loosening, surface drainage, subsurface drainage pipes. In all soil horizons soil salinity and sodicity decreased significantly, and pF values showed significant decrease in the subsurface horizons, the hydraulic conductivity demonstrated significant increase in the surface horizon. In conclusion the reclaimed plots became less extreme. The resulting database with a wide range of chemical and physical properties permits an analysis of the relationship between these.

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Geological conditions and land use effect on soil physical characteristics and soil biota

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Slovakia is predominantly mountainous country situated in the western Carpathian arch. The dominant rocks include sedimentary formations, but the cores of the mountains are formed by granites and metamorphites. Naturally, most of the Slovak territory should be covered by forest. But because of land use changes, about 50 % of the present Slovak land territory is agricultural land.

The aim of the study was to analyse the impact of different geological conditions, land use and management on selected soil physical properties with subsequent effect on earthworms as important soil organisms. The research was conducted at three study sites, situated in the different geological, climatic and natural conditions of Slovakia, each with 3 plots differing in land use (arable land - AL, permanent grasslands - PG, forest land - FL). Očová study site (OC) is situated in Poľana Mountain with Haplic Planosol developed on polygenic sediments. Tajov study site (TA) is situated at Kremnica Mountain with Haplic Cambisol developed on slope deposits. Liptovská Teplička study site (LT) is situated in Low Tatras Mountain with Rendzic Leptosol developed on dolomitic limestones. During the year 2014 in two periods (beginning of June, end of September-beginning of October), we measured penetration resistance of soil (PR), total depth of the penetration resistance measurement (DP), and soil moisture in the depth of 0.05 m (SM) at each study site and plot. Earthworms were hand sorted, counted and weighted. The statistical analysis was conducted using the PASW Statistics software.

We found out high variability of measured parameters conditioned by time, space and land use diversity. PR values of all measurements ranged from 0.19 to 5.00 MPa, DP values from 0.02 to 0.80 m, and soil moisture from 2 to 50%. Significant negative correlation rate was measured between penetration resistance and depth, and penetration resistance and soil moisture under different land use. T-test confirmed statistical differences of penetration resistance and depth mainly between plots used as arable land and forest land. The earthworm density and biomass was significantly higher in permanent grasslands compared to forest and arable land. In arable land we recorded significant correlation between earthworm density, penetration resistance and depth of measurement. In permanent grasslands we recorded significant correlation between earthworm density and soil moisture. The results confirmed the impact of natural conditions, geological substrate, land use on selected physical characteristics and pointed to the related changes in earthworm communities.

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The content of potassium as indicator of soil profile formation and its physical properties change

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The aim of this investigation is to identify peculiarities that influence soil formation of the youngest (Northern Lithuania) and the oldest (Eastern Lithuania) loamy soils. This topic is actual both in the practical and theoretical context – it helps to solve the issues of soil classification (especially for the identification of Planosols) and allows more accurate assessment of soil resources and their quality.

In fact, the proper identification of Planosols had become one of the most important problems as regards the diagnosis of Lithuanian soils. The accumulation of macro-elements (including potassium) in deeper horizons of soil profile is relevant for optimization of the agrochemical soil improvement measures.

The accumulation of potassium in Lithuanian soils is associated with two key sources – it refers to chemical composition of soil parent material and the frequency of fertilizer application in the different agroecosystems. In case when fertilization is applied, the most of soil potassium accumulates in the A humic horizon due to the sorption of humic substances while in the deeper soil horizons it is mainly present in the potassium feldspars. This potassium is usually detected during the laboratory tests when the feldspar is broken down to potassium oxides (Minerals in …, 1989).

Our hypothesis is that fluctuations of potassium concentration in the deeper soil horizons are related to clay illuviation process (*lessivage*) and chemical weathering of feldspars, therefore, these indices could be considered as one of the indicators showing the ongoing changes of soil-forming processes and soil physical properties.

This indicator is very applicable when examining the age of soil parent rocks because the territory of Lithuania is rather contrasting in this point of view. The limit of different age of soil forming deposits passes by the Medininkai highlands and by the eastern edge of the Eišiškės plateau in the south-eastern part of Lithuania where it differs about 10 times. To the west of this limit, the surface of Lithuania territory is formed by the Upper Pleistocene glaciers (in Lithuania it called the Nemunas glaciation, in Europe – the Würm glaciation) – its age can be dated to the time period about 12000

to 25000 years ago. To the east of that same limit, the highlands are formed by the penultimate glaciation (in Lithuania it called the Medininkai glaciation, in Europe – the Riss glaciation) and the age of this territory dates to between about 100,000 and 130,000 years ago. Thus, here the epigenetic soil formation processes took place about 10 times longer than in the Upper Pleistocene glaciers affected territory and the light textured morainic layers due to this time gap were formed on the surface. The particular outstanding feature of these layers it is their grayish brown colour (Semmel A. 1980) (in Russian literature known as *палевый горизонт*). Moreover, such layers (horizons) in Lithuania are characteristic only for soils that were formed on the sedimentary deposits of middle Pleistocene.

In order to discover the above mentioned soil formation peculiarities and taking into account the importance of potassium for diagnostic purposes, the two relatively natural soil profiles (both soil pits were excavated in the forests of about 100 years old) were investigated in our study – Luvisol as representing the Northern Lithuania lowlands surface (encompassing the period of 12 000 years) and Planosol as representing the Medininkai highlands surface (encompassing the period of 130 000 years). It is important to mention that soil investigation site selection in the terrains of mature forests allowed us to avoid any soil development interactions caused by anthropogenic activities (first of all – agrarian practices).

Methods

Several methods used to study above mentioned transformations: a) particle size distribution of the soil particles in the liquid dispersion was determined using the light-scattering technique, b) soil organic carbon (SOC) content was determined by the Tyurin method modified by Nikitin (1999) with spectrophotometric measure procedure, c) soil total potassium (K) – by atomo-absorciometric procedure after wet digestion with sulphuric acid (Šlepetienė et al., 2010). Undisturbed core samples were collected using stainless steel rings (100 cm 3 volume) for soil water potential (hPa) determination in four replicates. Soil physic characteristics (total porosity, soil density) were determined at -4, -10, -30, -100 hPa matric potentials (ψm) in a sand-box, at -300 hPa ψm (in a sand-kaolin box). Loose soil samples were used for determination of water content at -15500 hPa ψm retention by implementing a high pressure membrane apparatus. Morphology of the soil profile was described in detail and the soil typological unit was identified according to WRB guidelines (WRB 2014).

Results

The data shows that the total K content varies in the range from 4.52 to 12.63 g kg^{-1} in Luvisol, and from 1.06 to 7.41 g kg^{-1} in Planosol while generally in both soils its content increases with increasing of soil depths (Table 1). The differences in total K content of investigated soil profiles are

determined by a several factors such as the age and chemical composition of soil parent rock (material) in relation to soil-forming processes that have taken place in the course of the thousands years. For instance, the Planosol formed in the Medininkai highlands is about 10 times older than a Luvisol formed in the Northern Lithuania lowlands, therefore, respectively this soil material is much more weathered and thus it contains a significantly less total K content and its distribution in soil profile correlates with the weathering stage of parent material and periglacial processes ($r_{(2–20\mu m)} = 0.982$, $r_{(< 2\mu m)} = 0.832$). As to alterations in total K content of Luvisol formed in the Northern Lithuania lowlands, it is most likely related to clay illuviation processes and soil parent material chemical weathering ($r_{(2–20\mu m)} = 0.834$, $r_{(<2\mu m)} = 0.831$). It is assumed that the increase of soil silty fraction (2–20µm) amount at depth of 30-60 cm and its correlation with total K content shows the evidence of soil parent material weathering. The distribution of mobile K in both studied soil profiles is related to the distribution of soil organic material and its migration throughout the soil profile.

Table 1. Soil profile characteristics and indicators

Luvisol from the Northern Lithuania lowlands		**Clay, µm**	**Silt, µm**		**Bulk density, g cm^3**	**Total porosity, m^3 m^{-3}**	**Total C, g kg^{-1}**	**WEOC, g kg^{-1}**	**Total K, g kg^{-1}**	**Mobile K, mg kg^{-1}**
		< 2	**2 - 20**	**20- 63**						
0-20	**Ah**	0,15	7,56	15,31	1,08	0,59	31,28	0,5	4,52	83,87
20-33	**AEl**	0,27	12,52	24,60	1,21	0,545	23,31	0,46	5,06	66,03
33-60	**El**	0,75	21,10	29,27	1,605	0,39	9,51	0,32	8,14	106,52
60-80	**Btkj1**	0,72	19,48	27,83	1,75	0,34	1,71	0,17	12,63	110,38
80-130	**Bkj2**	1,62	37,99	20,57	1,97	0,255	1,24	0,14	12,29	107,49
130-170	**Ckg**	1,83	35,25	24,64	1,98	0,25	0,88	0,13	12,57	113,27
$r_{(bulk\ density/total\ K)}$=0,96, $r_{(bulk\ density/total\ C)}$= - 0,97, $r_{(total\ K/total\ C)}$=-0.97, $r_{(total\ C/WEOC)}$=0,98, $r_{(125\text{-}200\mu m\ /total\ C)}$=0,96, $r_{(bulk\ density/total\ porosity)}$= -0,99, $r_{(<2\mu m\ /total\ K)}$=0,83, $r_{(2\text{-}20\mu m\ /total\ K)}$=0,83, $r_{(<2\mu m\ /mobile\ K)}$=0,74, $r_{(2\text{-}20\mu m\ /mobile\ K)}$=0,72.									
Planosol from the Medininkai highlands		**Clay, µm**	**Silt, µm**		**Bulk density, g cm^3**	**Total porosity, m^3 m^{-3}**	**Total C, g kg^{-1}**	**WEOC, g kg^{-1}**	**Total K, g kg^{-1}**	**Mobile K, mg kg^{-1}**
		< 2	**2 - 20**	**20- 63**						
0-7	**O**	0,77	33,64	50,05	1,35	0,54	59,31	0,04	1,70	213,04
7-17	**Ah**	0,21	9,59	18,01	1,39	0,47	24,20	0,03	1,30	170,15
17-31	**AEl**	0,38	12,33	16,92	1,41	0,415	8,76	0,02	1,06	130,00
31-56	**El**	0,44	11,54	14,55	1,685	0,365	2,11	0,02	1,57	100,00
56-70	**EljBt**	1,14	19,70	14,88	1,725	0,35	2,35	0,02	2,28	94,95
70-105	**BtElj**	1,55	29,94	18,21	1,8	0,325	1,32	0,03	5,63	331,62
105-140	**Bg**	1,25	36,30	20,13	1,67	0,37	0,98	0,02	7,41	575,99
140-180	**Br**	1,44	39,34	19,16	1,79	0,325	1,13	0,02	7,07	691,67
$r_{(bulk\ density/total\ K)}$=0,68, $r_{(bulk\ density/total\ C)}$= - 0,99, $r_{(total\ K/total\ C)}$=0.99, $r_{(total\ C/WEOC)}$=0,92, $r_{(63\text{-}125\mu m\ /total\ C)}$=0,99, $r_{(bulk\ density/total\ porosity)}$= -0,93, $r_{(<2\mu m\ /total\ K)}$=0,83, $r_{(2\text{-}20\mu m\ /total\ K)}$=0,98, $r_{(<2\mu m\ /mobile\ K)}$=0,68, $r_{(2\text{-}20\mu m\ /mobile\ K)}$=0,95.									

The study revealed some differences in the distribution of total potassium as compared to the distribution of soil clay and silt fractions in different-aged soils as resulted due to particular soil-forming processes. For instance, the distribution of total potassium was equally strongly correlated both with the distribution of clay (<2μm) and silt (2-20μm) fractions in Luvisol formed in the Northern Lithuania lowlands, thus, indicating that illuviation process (*lessivage*) occurs in this soil profile (Table 1). Meanwhile, the distribution of total potassium in Planosol formed in the Medininkai highlands is more closely related with the distribution of silt (2-20μm) fraction, thus, indicating the weathering of soil parent material (periglacial soil formation conditions). In this case, the feldspars (source of potassium) are weathered into silty fractions, therefore, the increase of those are determined in this soil profile (Table 1).

The data shows that total potassium content has a direct strong correlation (r = 0.83 in Luvisol and r = 0.83-0.98 in Planosol) with soil clay and silt fractions content, thus, indicating a direct relationship between these soil constituents. However, this relationship remains statistically significant only in subsoil whose formation is not affected by organic matter (SOM) and total C. Nevertheless, the bulk density of topsoil is dependent on total C content at much greater extent (r = 0.97 in Luvisol and r = 0.99 in Planosol). Thus, when soil bulk density correlation with total C content increases, its correlation with total K content decreases.

The correlation of total and mobile K with total C can be estimated only by analyzing the distribution of potassium in the humic soil horizons (Ah, AhEl). The negative correlation (r = -0.97) indicates that the soil is not affected by the agricultural activity (in the Northern Lithuania lowlands), and the distribution of K in the soil is related to the illuviation process. The positive strong correlation (r = 0.99) shows a direct or indirect effect of adjacent agricultural areas (Habib et al. 2014) and potassium sorption in soil organic matter.

Soil density and total porosity are directly related therefore their correlation is strong r > 0.9 (table 1), nevertheless, in Planosol it was estimated a little bit lower. This implies the assumption that more and more factors affects soil development within process of its particular formation, however, the direct relationship between different factors is distorted by the effect their synergistic interactions. Thus, it likely that periglacial processes and the migration of organic material into the deeper layers throughout soil profile has had a significant effect in regard of such regularities.

Final summarizing

The complex analysis of soil profile morphology, soil texture (granulometric composition), potassium content, organic carbon quality and soil physical properties enables researchers to evaluate soil formation peculiarities and the ongoing processes, to determine the causes of the changes in soil physical properties and to predict further soil development peculiarities and regularities.

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Soil water balance in Retisol derived from silty deposit of Carpathians

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Retisols derived from silty deposits dominate in the soil cover of the Carpathian Foothills in Poland. The hydrophysical properties of these soils are determined by the grain-size distribution of the parent material and the soils' "primary" properties shaped in the deposition process. The other contributing factors are the soil-forming processes, such as lessivage (leaching of clay particles), and the morphogenetic processes that presently shape the relief. These factors are responsible for the "secondary" differentiation of hydrophysical properties across the soil profile. Both the primary and secondary hydrophysical properties of soils (the rates of water retention, filtration and infiltration, and the moisture distribution over the soil profile) determine their ability to take in rainfall, the amount of rainwater taken in, and the ways of its redistribution. All of them together with climate condition: amount of precipitation, wind, temperature and solar radiation and plant cover have influence on soil water balance

The aim of the study, carried out during 2015-2016, was to investigate the soil water balance in Retisol derived from silty deposits located on opposite exhibition – north and south.

Soil moisture data were measured by 6 sensors at depths: - 10 cm, 20 cm, 40 cm, 60 cm and 80 cm. Meteorological data came from meteorological station situated 50 m away from the soil profile.

Water balance of the Retisols during vegetation season was negative. The monthly soil water balance vary from month to month, however, positive values of water balance may be present, and was connected with the amount and distribution of precipitation. The water balance of the soils has positive values from March to April due to water accumulation during the winter season, and low evapotranspiration. In the summer and autumn months, the water balance may have positive values on several days in a row. This happens mainly during the periods of continuous heavy rainfall, or in cases, when the total precipitation of a given month exceeds its long-term average.

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