DEGRADATION AND REVITALIZATION OF SOIL AND LANDSCAPE

Proceedings

Bořivoj Šarapatka and Marek Bednář
(Eds.)

10th–13th September 2017

Olomouc • Czech Republic

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Czech Society of Soil Science
Societas Pedologica Slovaca
Soil Science Society of Poland
Hungarian Soil Science Society
Ministry of Agriculture of the Czech Republic
Ministry of Environment of the Czech Republic
Palacký University in Olomouc

under the auspices of

The Czech Minister of Agriculture, Ing. Marian Jurečka,
The Czech Ministry of the Environment,
Rector of Palacký University, prof. Jaroslav Miller
and Dean of Faculty of Science, Palacký University, prof. Ivo Frébort

invite you to the international conference

DEGRADATION AND REVITALIZATION OF SOIL AND LANDSCAPE

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Foreword of Marian Jurečka, Minister of Agriculture of the Czech Republic

Based on the Strategy of the Ministry of Agriculture with a view to 2030, the Ministry of Agriculture aims to ensure the food self-sufficiency in basic commodities of the Czech Republic. That is why it is necessary to sustain an adequate area of agricultural land and its quality.

Soil is endangered by accelerating degradation processes caused by climate change. A large amount of agricultural land is located in developed areas, so it can be assumed that within couple of decades, the land will no longer serve the agricultural purpose. Forced collectivization of the 1950s has significantly damaged the relationship of owners and their land. Nowadays 71 % of field area is rented out and fields are often used for short-term profits only. The share of leased land is very high compared to the Western European countries.

That is why the Ministry of Agriculture has prepared a set of indicators of the quantity and quality of agricultural land and promotes effective protective measures. We cooperate with other ministries such as the Ministry of the Environment.

It is great that our country is prospering economically, bringing many new transportation, industrial and residential buildings. However, it is not possible for these buildings to be constructed on the most fertile soils. Preferably they should be build on brownfields or in locations with a lower soil quality and areas without other significant limitations such as the Protected Area of Natural Water Accumulation. This is the reason why the Ministry of Agriculture, in cooperation with the Research Institute for Soil and Water Conservation, prepared an Interactive Map, where every investor can find an ideal plot for his project. This application is freely accessible, it is called the Land Use Limitations, and we advocate its use by state administration, self--government and the private sector.

I am glad that the public has already noticed our topic of soil protection – as well as the topic of water resources protection, which we also devote our time to at the Ministry of Agriculture. Media cover these issues, and active landowners and farmers are showing interest in ways how to protect the land. Nowadays, it is not usual to think in the scope of hundreds of years. But such is the nature of soil protection. Under favorable conditions, it takes 100 years for 1 cm of high quality horticulture to be formed, so once a field is flushed down by torrential rain or permanently built-up on, the damage is irreversible.

People today are forming relationship to the soil again. They feel connected to it and want to keep it for the next generations. It is in the good interest of all of us to do our best for the soil today.

Marian Jurečka
Minister of Agriculture

Welcome speech of Vladimír Dolejský, Deputy Minister of the Ministry of Environment

The protection of agricultural soil should be firmly embedded in every cultural society. Maintaining farmland in a healthy state is a reflection of our responsibility, maturity and consciousness of the real weight of fundamental values.

The natural functions of the soil system of the Czech Republic have been damaged for a long time. Degradation factors that damage the soil are one of the greatest threats to sustain the productive and non-productive functions of the agricultural landscape. Unfortunately, the effects of degradation factors, especially with the influence of climate change, are steadily increasing. I consider the water erosion and the associated loss of organic matter from the soil environment as one of the most fundamental problems threatening the sustainability of farming. The Soil organic matter is a component that has a crucial influence on optimal soil structure. If the soil structure is damaged, the soil is less resistant to external influences and, together with soil compaction, can significantly contribute to the decrease of water retention capacity.

The reason of this unfavorable state can be perceived primarily in a combination of two factors. On one hand, it is a negative consequence of the long-term unhealthy way of farming on large agricultural land and, on the other hand, as a negative consequence of climate change, or ever-increasing weather extremes.

As one of the most fundamental problems I consider the management of large-scale monocultures. The originally heterogeneous landscape has become a sterile medium that loses its resilience and the above mentioned problems are further accelerating.

It is one of my priorities to address the issues of water retention in the countryside. This is also closely related to the issue of significantly reduced capacity of farmland to retain water. Significant manifestations can be seen, for example, in continuously decreasing levels of subsurface water resources, minimum water flows in waterways during dry periods or accelerated sur-

face runoff. Longer droughts and more and more frequent soil spills are clear evidence.

The Ministry of the Environment develops the maximum possible activity to face the negative trends mentioned above. As one of the first steps on this long journey, it is a proposal to address one of the most important degradation factors – water erosion.

Based on the long-term and high-quality horizontal cooperation with the Ministry of Agriculture for the protection of agricultural land, it is possible to link both legislative and subsidy requirements.

In this context, I would like to point out that we are preparing a legislative instrument, which would ensure effective protection of the quality of agricultural soil, the Decree on the Protection of Agricultural Soil against Erosion.

This decree has been prepared on the expert basis provided by the Research Institute for Soil Improvement and Soil Protection. Afterwards the Ministry of the Environment managed to intensively cooperate and consult the decree with Ministry of Agriculture, the State Land Office, the Czech Hydrometeorological Institute, with colleagues from the Czech Pedological Society, and a number of experts from the professional sphere.

This conference is a very impressive meeting of our national and foreign experts on soil issues. Discussions at this conference bring new perspectives and approaches in relation to soil conservation and management.

I believe that meetings like this one are crucial to ensure a regardful approach of farming to soil conservation, and thus an important contribution to ensuring respectful behavior towards our future generations.

I would like to thank the Czech Pedological Society for the organization of this conference and express my delight at its long-term attention to the field of pedology, which each member of this society fulfills through its patronage.

Vladimír Dolejský
Deputy Minister
Ministry of Environment

Dear Colleagues,

In cooperation with Societas pedologica slovaca we organise annual Soil Science Days as an opportunity for scientists from throughout the former Czechoslovakia to get together. After the last meeting we decided that in 2017 we would organise a bigger event, namely an international conference in cooperation with soil science associations of the V4 countries. A year has passed and we now meet for this event, entitled „Degradation and revitalization of soil and landscape", in the city of Olomouc, where you will feel the genius loci of a historical and academic city. As early as in prehistoric times the land above the flood plain of the river Morava provided an attractive location for settlement. Over the course of time a city gradually developed, and during the middle ages became the centre of authority for the whole of Moravia, one of three historical lands in what is now The Czech Republic, and in the mid-16th century a university was founded here, the second oldest university in the Czech Republic. The wealth of the region was in part due to the fertility of the soil, which was a good prerequisite for agricultural settlements as early as the Neolithic age. Gradually the whole region known as Haná became famous as an agricultural region.

Soil, both agricultural and forest, has always been the basis of production, and care of the soil provided a living for the local population. It is no different today. Unfortunately, we are witness to many degradation factors which disrupt the soil's production and non-production functions. This applies not only to the place in which we have gathered, as these problems are truly global. I believe that the Olomouc conference will be a platform for discussion and exchange of specialist experience which will lead to the minimization of soil degradation and improvement in soil properties. We are delighted that representatives of the central body of Czech state legislation are taking part in the conference, in fact as co-organisers, as this body makes decisions regarding soil conservation. Together we should all help towards raising general public awareness of the importance and vulnerability of soil. In planning the Czech and Slovak soil science conferences we always try to alternate the venue between the two countries and give an opportunity to get to know the diversity of soils within the variety of the natural environment. This year's international conference is no exception to this, and we have selected both agricultural and forest soils. We have therefore arranged *two excursion routes. The first leads to south Moravia, with its distinct cultural wealth and folk traditions. It is not only one of the warmest and most fertile areas of the Czech Republic, but also an area considerably threatened by degradation of agricultural soil. The second route leads to the unique ethnic and cultural region of hilly Valachia in eastern Moravia, where we will be able to focus on the issues of forest soils. On both excursions there is sure to be interesting discussion on the subject of prepared soil samples.*

I am sure that we will manage to create a pleasant atmosphere for you in Olomouc, in which we will not only gain new information, but will also enjoy three days together in the setting of a historical city, as well as on an excursion to a picturesque agricultural or hilly Central-European landscape.

On behalf of the organisational and scientific committees of the conference.

Bořivoj Šarapatka
Chairman
of the Czech Society of Soil Science

PROGRAMME

10. 9. 2017

18.00 – 20.00 Registration

19.00 – 20.00 Welcome drink

11. 9. 2017

10.00 – 12.30 Opening

***Marian Jurečka*, Minister, Ministry of Agriculture of the Czech Republic and *Simona Prečanová*, Chief Adviser to the Minister, Director of Department for Strategy and Sustainable Development**

Welcome speech
Vladimír Dolejský, Deputy Minister of the Ministry of Environment and *Jiří Klápště*, Director of the Department of General Nature and Landscape Protection, Ministry of Environment

Jaroslav Miller, Rector of the Palacký University in Olomouc and
Ivo Frébort, Dean of the Faculty of Science, Palacký University

Presidents of Soil Science Societies of V4 countries

Three invited lectures
Blum W. E. H.: Threats to soil and landscapes – general development and future scenarios, a worldwide perspective

Horn R.: Effect of landuse management systems on coupled hydraulic mechanical soil processes

Kosaki T.: Revitalization of degraded soils: a challenge in International Decade of Soils (IDS) for achieving Sustainable Development Goals (SDGs)

12.15 – 13.15 Lunch

13.15 – 14.45 Program block:
Degradation causes and consequences

Zádorová T., Penížek V.: Morphology and characteristics of colluvial soils in different soil regions

Gracheva R.: Convergence and divergence of soil properties of abandoned agricultural landscapes, North Caucasus

Weber J., Jamroz E. et al.: Changes in properties and morphology of Podzols in the vicinity of the fly-ash dumping site of the electric power plant

Vojvodíková B.: Use brownfield sites as protection of soil – examples of possibility for application environmental economy

Hofman J., Scherr K. E. et al.: Residues of atrazine and simazine in arable soils from the Czech Republic

Kodešová R., Klement A. et al.: Pharmaceuticals dissipation in soil--water-plant system

14.45 – 15.05 Coffee Break

15.05 **Opening of the Exhibition of Paintings – Colors of the Earth (Irena Ráček) and Geopictures (Ivan Doležal)**

15.15 – 15.45 Commented poster section – block
Degradation causes and consequences

15.45 – 16.45 Program block
Degradation monitoring and assessment (Part I.)

Klápště J.: Soil protection in the Czech Republic in the context of ongoing climate change

Sobocká J., Balkovič J. et al.: Specific position of technogenic soils in the MSCS 2014 and relation to the WRB 2014

Kobza J., Barnačíková G. et al.: Soil degradation processes in conditions of Slovakia

Kabala C.: Soil quality monitoring in Poland: system organization and recent results

16.45–17.45 Workshop

Ministry of Agriculture of the Czech Republic and Research Institute for Soil and Water Conservation: Operating instructions for application of GIS tools Land use limits and Soil erosion control calculator (two groups – 1st in the English language, 2nd in the Czech language)

From 19.00 Social evening

12. 9. 2017

9.00–10.15 Program block
Degradation monitoring and assessment (Part II.)

Kavian A., Habibnezhad M. et al.: Field study of runoff and sediment yield control by vegetative buffer strips

Barančíková G., Halas J. et al.: Soil organic carbon concentration on selected peatlands in Slovakia

Šarapatka B., Čáp L. et al.: The effect of water erosion on selected chemical and biochemical properties of Chernozem soils

Poláková Š., Klašková L. et al.: The active substances of the plant protection products in the soil samples originated from Basal Soil Monitoring System

Borůvka L., Šrámek V. et al.: Digital mapping of potentially toxic element contents in forest soils: importance of the principal stand factors as predictors

10.15 –10.40 Coffee Break

10.40–11.10 Commented poster section – block
Degradation monitoring and assessment

11.10–12.30 Program block
Degradation monitoring and assessment (Part III.)

Łukasik A., Rachwał M. et al.: Soil magnetic susceptibility as an effect of concentration of natural and anthropogenic iron minerals in soil: Assessment of background value for forest topsoil on Polish Lowlands and Uplands

Rachwal M., Wawer M. et al.: Magnetic signature of heavy metal contamination of urban soils influenced by different kinds of industry

Ryżak M., Beczek M. et al.: The noise of the soil splash

Nagy G., Dezső J. et al.: Modeling of soil moisture dynamics in the multilayered Entisols under drought case study at Drava Valley

Soler-Rovira P., de la Peña E. et al.: Effects of warming and altering drought-precipitation events on the biogeochemical mechanisms that rule C cycling in agricultural soils amended with biochar

12.30–13.30 Lunch

13.30–14.00 **Invited lecture**

Havlicek E.: European Soil Partnership and EUROSOIL 2020: towards bridging the gap between science and policy

14.00–14.30 Ministry of Agriculture of the Czech Republic, *Chocholouš, J., Randusová, A.:* Land protection projects in the agricultural sector of the Czech Republic and web application of the land usage limits

14.30–15.00 Coffee Break

15.00–16.15 Program block
Revitalization measures

Glina B., Bogacz A. et al.: Effectiveness of five-year restoration of degraded mountain fen peatland – case study from the Central Sudetes (SW Poland)

Zakharchenko E. A., Miischenko Y. H.: Impact of different tillage practices and green manure on physical properties of Chernozem soil

Tóth T., Zsembeli J. et al.: Long term effect of the reclamation of Solonetz soils

Kozák J., Borůvka L. et al.: Restoration and development of soil cover on dumpsites

Biro B., Kocsis T. et al.: Combination of soil and foliar bioeffective treatments improve growth and fruit quality of tomato (var. Mobil) in organic agriculture

16.15–16.45 Commented poster section – block
Revitalization measures

16.45–17.15 Discussion

From 17.30 **Guided city tours** (two groups – in English, in Czech)

13. 9. 2017

EXCURSIONS – South Moravia

– Moravian-Silesian Beskids

POSTERS

11–12. 9. 2017

Section 1: **Degradation causes and consequences**

1. *Janderkova J.:* An integrated approach to landslide and surface erosion mapping
2. *Balla D., Incze J. et al.:* Estimation of soil naturalness grade and their changes between 1784 and 2010 in Tokaj Nagy-Hill based on soil and land cover databases
3. *Zaleski T., Mazurek R. et al.:* Geotechnical deformation of soil cover as a cause of trees' decay
4. *Gus M., Stolarczyk M. et al.:* Evolution of sandy soils as a result of human activities – a case study from the Błędów Desert
5. *Barna G., Bakacsi Z. et al.:* Methodological experiences of aggregate stability measurements
6. *Kanianska R., Jaďuďová J. et al.:* Soil compaction and its impact on selected classes of soil arthropods contributing to ecosystem services
7. *Tobiašová E., Barančíková G. et al.:* Parameters of soil structure in relation to main factors that influence it
8. *Stolarczyk M., Gus M.:* Organic matter transformation in mountain peatland soils under influence of human activities – an example of Upper San river valley (Western Bieszczady Mts.)
9. *Jeřábková J., Borůvka L. et al.:* Potential mobility of chromium in soils: Comparison of anthropogenically polluted and naturally enriched sites
10. *Holubík O., Matoušková Š. et al.:* Effective soil management practices: tackling organic matter and nutrient loss
11. *Fér M., Kodešová R. et al.:* Behaviour and transport of four pharmaceuticals in the undisturbed soil columns
12. *Klement A., Kodešová R. et al.:* Sorption of ionizable pharmaceuticals in different soil types
13. *Nikodem A., Klement A. et al.:* Discharge and root uptake of pharmaceuticals from sewage sludge applied in soils
14. *Schmidtová Z., Fér M. et al.:* Sorption of three pharmaceuticals in aggregate interiors and their coatings
15. *Hulisz P., Pindral S. et al.:* Can soil degradation favour the occurrence of rare and protected species?

Section 2: **Degradation monitoring and assessment**

1. *Ilavská B., Bezák P.:* Upgrading of the soil units system in agricultural land of Slovakia in the context of the identification of soil degradation
2. *Žigová A., Artemyeva Z. et al.:* Conditions of soil cover on Permo-Carboniferous rocks in the Český Brod area 45 years after afforestation
3. *Madarász B., Jakab, G. et al.:* Assessment of infiltration and soil erosion after 12 years of conservation tillage in Hungary
4. *Koliada V., Nazarok P. et al.:* The use of Digital Relief Model (DRM) to assess the potential water erosion hazard
5. *Hegyi B., Szabó S. et al.:* Changes in extent and topography of vineyards and estimation of its influence on historic soil loss in Eger Wine Region using GIS methods
6. *Poruba M., Kohoutová L.:* Degradation monitoring and assessment – Main Soil Unit 08
7. *Podhrázská J., Kučera J.:* Optimization of methods for the assessment of vulnerability to wind erosion and proposals of protective measures in intensively exploited agricultural countryside
8. *Sedmidubský T.:* Evaluated soil-ecological units and their significance for soil and landscape
9. *Sobocký I.:* Data collection and methodology design for drought prediction in Zahorska lowland
10. *Homolák M., Bebej J.:* Investigation and remediation of contaminated sites by means of geophysical methods
11. *Walkiewicz A., Bieganowski A. et al.:* GHG mapping over cultivated fields in ground and aerial measurements – project assumption
12. *Kapička A., Jaksik O. et al.:* Magnetism of soils applied for estimation of erosion at an agricultural land
13. *Gömöryová E., Fleischer P. et al.:* The effect of post disturbance management on soil microorganisms at the windthrow plots in Tatra Mts. (Slovakia)
14. *Pospíšilová L., Hábová M. et al.:* Effect of liming onto soil biological parameters
15. *Józefowska A., Pietrzykowski M. et al.:* The effects of tree species and substrate on biological soil properties and carbon sequestration in reforested post-mining soils
16. *Koco Š., Skalský R. et al.:* Detailed analysis of land cover changes as a factor of soil organic carbon storage dynamic in arable land

17. *Kotroczó Z., Veres Z. et al.:* The effect of organic matter manipulation on soil humus carbon content (Síkfőkút, Hungary)
18. *Pavlenda P., Capuliak J.:* Soil organic carbon stock change at the forest-grassland border zone
19. *Vašíčková J., Šindelářová L. et al.:* The impact of flood event in the year 2013 on the contamination of the agricultural soils
20. *Borůvka L., Němeček K. et al.:* Effect of logging residues processing and mechanical soil preparation on the content of selected elements in a forest soil as measured by X-ray fluorescence spectrometry
21. *Barzegar A., Oustan S. et al.:* Impact of sodium dodecylbenzene sulfonate (SDBS) on soil health deterioration
22. *Prášková L., Němec P.:* Available Microelements in Agricultural Soils in the Czech Republic
23. *Magiera T., Łukasik A. et al.:* Application of magnetic susceptibility as an indicator of physical and chemical degradation caused by dust deposition

Section 3: **Revitalization measure**s

1. *KonečnáJ., Podhrázská J. et al.:* Evaluation of ecological effects of land consolidations
2. *Antal J., Borza, T.:* Dimensioning of contour and riparian buffer strips
3. *Jafarian Z., Saleh I. et al.:* The Efficiency of Vegetative Buffer Strips in Water Pollutants Control
4. *Houšková B., Makovníková J. et al.:* Ecological farming – one of the methods to achieve zero soil degradation
5. *Reininger D., Fiala P.:* Degradation of forest soil in the Český les Mts
6. *Hybler V., Prax A. et al.:* Impact of the revitalized network of channels on the dynamics of groundwater in the floodplain forest
7. *Kavian A., Elahi E. et al.:* Soil erosion mitigation with native wood strand mulches
8. *Hervai A., Czigany, S. et al.:* 3D Soil moisture interpolation with ArcGIS software
9. *Gere R., Gömöryová E. et al.:* The effect of tree species on physicochemical and biological soil properties
10. *Hanajík P., Bartalský E. et al.:* Soil dehydrogenase activity at windthrow area with secondary succession

11. *Kocsis T., Kotroczó Z. et al.:* Biofertilizer inoculation improve biochar effect on sandy soil with maize
12. *Fehér B., Aranyos T. et al.:* Effect of sewage sludge compost extract on the Lupine-Rhizobium symbiosis
13. *Bielská L., Škulcová L. et al.:* Sorption and (bio)availability of DDE in soils amended with biochar
14. *Kardos L., Attila E. et al.:* Comparative evaluation of communal sewage sludge in pilot scale and industrial scale based on vermicomposting
15. *Malić N., Matko Stamenković U. et al.:* Dynamics of chemical properties in the mine technogenic soil in five years reclamation
16. *Polláková N., Šimanský V.:* Changes of soil organic matter in land transformed from arable to forest
17. *Bielská L., Škulcová L. et al.:* Risk assessment of biochar: a novel soil amendment and remediation tool
18. *Uzarowicz L., Kwasowski W.:* Properties of technogenic soils (Technosols) developed from ashes from lignite-fired „Bełchatów" thermal power station, Poland
19. *Fiala K., Štýbnarová M. et al.:* The assessing of nutritional and hygienic status of some grazing areas of the Mohelno Serpentine Steppe – preliminary results
20. *Jafarian Z., Kargar M. et al.:* The respective influence of soil variables in the plant species distribution

KEY SPEAKERS
INVITED LECTURES

Threats to soil and landscapes – General development and future scenarios, a worldwide perspective

Blum, W. E. H.

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Soils and landscapes are non renewable resources and must be protected against degradation or revitalised in case of necessity, especially in view of the fact, that only 12 % of the global land and soil resources are suitable for food and fibre production, 24 % can be used for grazing, and 31% produce forests. The remaining 33 % of land is unsuitable for any kind of sustainable use. – These two thirds of global land and soil resources, available for sustainable agricultural and forest land use, are threatened by eight main global developments:

The increase of the world population and its change in spatial distribution; the loss of fertile soils through sealing and the use of soil material for construction by urbanisation, industrialisation and further human activities, including agricultural and forest landuse; changes in human life style and increasing demands for living space and specific food stuff; increasing demands for bioenergy, especially biofuels; increasing globalisation and changes in world economy, with an increase of speculative performances in agricultural production and marketing; climate change and its impact on the protection of soils and landscapes; worldwide decrease in fresh water supply and need for agricultural extension; global spreading of alien and invasive plant and animal species, threatening plant covers which protect against soil and landscape degradation.

We will show the global distribution of land and soil resources and discuss future scenarios, based on visible trends in global developments, threatening land and soil protection and the sustainable use of soil and land resources.

Effect of land use management systems on coupled hydraulic mechanical soil processes

Horn, R.

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Soils are the most critical life-supporting compartments of the Biosphere. They provide numerous ecosystem services such as habitat for biodiversity, water and nutrients, as well as producing food, feed, fiber and energy. Soils undergo intense and irreversible changes due to a non-site adjusted land management and improper application of machinery and techniques in its broadest sense. However, to feed the rapidly growing world population in 2050, agricultural food production must be doubled using the same land resources footprint. It furthermore requires a definition and following of site-specific functionality differences, which may exclude or concentrate certain land use or management forms in order to optimize yield and soil protection at the same moment.

Soil physical, chemical as well as physicochemical research have not only to quantify scale dependent processes and functions, but they also have to include the obtained results in coupled soil models which allow to link those processes and functions. These links between detailed and well--defined intensity properties and functions and the uncounted number of models available needs further improvement. But the definition of boundary conditions and the inclusion of site and climate dependent soil properties and functions in combination with the transition from rigid to non-rigid soil systems are furthermore not well defined. Thus, the research e.g. on water fluxes, soil mechanical properties (from rheometrical to geophysical approaches), the overall available problem of hydrophobicity and wettability as a function of climate change induced increased drying intensity must be quantified more in detail and boundary conditions must be defined. Furthermore, the link between thermal, hydrological, gaseous fluxes and processes under various mechanical and hydraulic stresses and consequences for soil degradation but also soil amelioration need more attention and will be discussed in the oral presentation.

Revitalization of degraded soils: A challenge in International Decade of Soils (IDS) for achieving Sustainable Development Goals (SDGs)

Kosaki, T.

President-elect, International Union of Soil Sciences, and
Professor, Aichi University, Nagoya, Japan
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Fifty-two percent of the agricultural land is moderately or severely affected by soil degradation and threatens 1.5 billion of people globally and 74 % of the poor directly. In 2015 the UN adopted Sustainable Development Goals (SDGs) to end poverty, to protect the planet, and to ensure prosperity for all by 2030, one of which, Goal 15, is directly related to soil degradation. While the IUSS started International Decade of Soils (IDS) to advance scientific knowledge and technology, promote public awareness and enhance involvement in policy making about soils and soil sciences and one of the major topics during the decade is surely soil degradation. Desertification is one of the challenges in soil degradation and thus will be discussed here together with an example how to revitalise the degraded soils as well as the societies there.

Wind erosion is a major contributor to desertification in the Sahel. We designed and tested a new land management practice, termed the "Fallow Band System," which sets 5-m-wide herbaceous fallow bands, shifting every year, in the farm to trap wind-blown soil materials due to wind erosion which is expected to provide the soil and plants with organic matter and mineral nutrients, respectively. The results showed that the "Fallow Band System," the do-nothing practice, can be useful for preventing desertification, restoring soil fertility, and improving crop production in the Sahel, West Africa. This practice was extended to 439 households in 75 villages, 23 districts and 5 regions in Niger and further effort of the extension has still been continued under the collaboration with the local NGOs there. The "Fallow Band Systém" can be one of the components for revitalizing degraded soils, land and local communities and be used for the South-South Cooperation when advancing SDGs and promoting IDS.

European Soil Partnership and EUROSOIL 2020: towards bridging the gap between science and policy

Havlicek, E.

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In recent decades, soils have received increasing attention at the global scientific, policy and public levels and the environmental, economic and societal values of soils are more and more acknowledged. However, the link between society needs and scientific research should be strengthened: too often, scientists carrying out "targeted" research tend to answer questions that were actually not asked by land users while the general public remains unaware of the challenges at stake. Soil, being by its very nature a complex subject requires a holistic approach, implying a multidisciplinary approach that involves scientists from different disciplines (e.g. climatologists, hydrologists, agronomists), policy makers from different fields (e.g. agronomy, forestry, spatial planning) and stakeholders from different backgrounds (e.g. farmers, urban dwellers, nature protectors).

Launched by the FAO in 2012 with the support of the European Commission, the Global Soil Partnership pursues its mandate to improve governance of the world soil resources in order to maintain healthy soils, to guarantee food security and to sustain all essential ecosystem services provided by soils on which our societies depend. The European Soil Partnership (ESP), similar to other Regional Soil Partnerships, was established in 2013 with the specific aim of promoting sustainable soil management in Europe.

Among other tasks outlined in its recently approved Regional Implementation Plan, the ESP seeks to bridge the gap between scientists, policy makers and soil users and will advocate for the value and relevance of soil issues during the upcoming EUROSOIL conference in 2020. To this end, the ESP will work closely with the European Confederation of Soil Science Societies to "Connect People and Soils" and to help prepare the EUROSOIL 2020 accordingly.

LECTURES

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Degradation causes and consequences

Morphology and characteristics of colluvial soils in different soil regions

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Colluvial soils have received attention in different areas of environmental and geoarchaeological research over last two decades. However, their pedological functioning and status as a specific soil unit have been seldom discussed. The complex formation from different materials in different conditions leads to an exceptional heterogeneity of colluvial soils that has been only partially depicted so far. We present the formation, morphology and properties of colluvial soils developed in different regions under different pedological, geological, climatic and historical conditions. We focus on the role of colluvial soils in the agricultural landscape and their potential in soil organic carbon sequestration. The results of our long-term research showed significant differences in colluvial profiles, namely in the thickness of colluvial horizons, stratigraphy and soil organic carbon content. In studied soil regions, we observed the colluvial soils depth varying from 80 cm to 5 meters and analogically diverse stock of soil organic carbon stored in colluvial bodies. The character of studied colluvial soils varies from soils formed exclusively from A horizon derived material to mature colluvial soils with profiles mirroring the eroded soil profile of upward slope positions. These profiles give evidence of a distinctive reshaping of the soil cover structure given by a massive redistribution of soil material and reflect the real impact of soil erosion in agricultural landscapes.

Convergence and divergence of soil properties of abandoned agricultural landscapes, North Caucasus

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Soils of abandoned agricultural landscapes are the informative objects for study of the natural processes following the land use transformation. In the mountains of the North Caucasus, agricultural landscapes including the terraced slopes occupy the vast areas of intermontane basins. During the centuries, the slopes at the altitudes 1000 (1400) – 1800 (2000) m a. s. l. were predominantly used under croplands. Arable lands were converted into the grasslands 60 – 100 years ago and were grazed or mowed up to 1990th; grasslands are abandoned or underused during the last 25 years. Therefore, mountain soils have experienced a number of transformations and various impacts such as terracing, plowing, grazing, and abandoning. At present, meadow steppes occupy the former croplands regardless of the windward or leeward mountain slope. Soils of the opposite slopes have such similar properties as thin grey-brown humus horizon, low humus content and degraded soil structure; stones are removed from the topsoil; difference depends on parent rock and degree of erosion. Their place in the classification have to be defined. At that, buried soils discovered in the soils of the southern slopes have clear Chernozem-like properties, and buried soils on the northern slopes we identified as Phaeozems and Cambisols. Contrasting buried soils are evidences of the climate-induced soil diversity in the past, before intense and long unifying impact of agricultural land use causing the soil convergence. The post-arable time was not enough to restore soil properties. In the absence of anthropogenic impact, the most favorable conditions for the organic matter accumulation are on the platforms of agricultural terraces; unmanaged soils of terraces escarps and steep slopes being under permanent erosion contribute in the fragmentation of soilscape. Researches were supported by the Federal Program, Project 0148-2014-0019 «Mountain regions of Russia under global change: diversity, natural and socio-economic state and tendencies of development”.

Changes in properties and morphology of Podzols in the vicinity of the fly-ash dumping site of the electric power plant

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The soil profiles under study were Podzols derived under pine forest from loose quartz sand, located close to the dumping site of the electric power plant Bełchatów, central Poland. Soil profiles located at a distance of 50, 100, 400 and 500 m from the dumping site were analysed. Control profiles were located 7 km away from the object. In all horizons of investigated soil profiles the main physico-chemical and chemical properties were determined, and additionally humic substances were studied (optical density, elemental composition and atomic ratios of humic and fulvic acids). The fly ash from the landfill characterized by high salinity and strong alkaline reaction (pH=10), which contributed significantly to the changes of the pH values in soils horizons. The neutralization of reaction of soils adjacent to the landfill was found, which manifested in an increase of pH values, especially in ectohumus horizons. Transformation of organic matter in surface horizons contributed to intensification of humification processes and transformation of E horizons into transitional AE horizons. The impact of the landfill was also noted in deeper soil horizons, contributing to changes in morphology of Podzols analyzed. This probably results in vanishing of the humic substances in the illuvial Bhs horizons, and consequently Bhs horizons have been converted into a relatively poor in humic substances Bs horizons. Leaching of low molecular humus fraction – typical for podzolization – has been minimized as a result of pH changes caused by the impact of the dumping site. In result, originally occurring humic substances in the Bhs horizon (present in the Bhs horizons of control profiles) have been probably transported out of the soil profile, and then into the groundwater. This thesis needs confirmation in further detailed investigation on humic substances extracted from former Bhs and present Bs horizons.

Use a brownfield sites as protection of soil – examples of possibility for application environmental economy

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This paper deals with soil issues and their protection in the case of non--agricultural use (eg industrial production). It focuses on the evaluation and, above all, the comparison of the value of the soil from the point of view of environmental economics. The aim is to show concrete examples of social loss if agricultural land isused for industrial use (don't used previously used land). I the begin of this article is introduction several brownfield sites (sites over 10 ha) that are suitable for industrial use. For evaluation possibility for industrial use was applied the assessment model (EFE-BROW Model) important fact for evaluation is the function assigned to them by the master plan. The value of these sites is determined from the perspective of environmental economics. The next part of article included the application of the method of environmental economics on selected sites of already existing industrial zones. (Sites were selected where an industrial area in the past was located on agricultural land. Evaluations are made for the soil before it is built.) The article outlines the problems or barriers that are associated with the application of this model. Next part compare this evaluation and try to show social lost or benefits. An integral part of the article is the identification of the reasons why the brownfields are still abandoned and unused. In conclusion, on the basis of the above mentioned examples, the possibilities to proceed with the protection of agricultural land are proposed by supporting and removing barriers for the use of brownfield sites for industrial production .

Residues of atrazine and simazine in arable soils from the Czech Republic

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Current agricultural management is usually based on high consumption of pesticides which may bring problems related to their residues in soil and water. Although simazine was never intensively used for crops in the Czech Republic and atrazine was banned more than 10 years ago, their residues, mostly 2-hydroxy transformation products (TPs) have been frequently found in Czech agricultural soils monitoring. The frequent findings and also sometimes high levels have been reported also from monitoring of groundwater and surface water, where dominant residues are desalkylated TPs or parental compounds. Similar observations have been made for soils and water also in other European countries. In this contribution, the results of the triazine herbicides and their transformation products in 75 agricultural soils of the Czech Republic will be shown and then the possible sources and reasons of their presence will be investigated and discussed. The links to water monitoring data will be also identified. Triazine herbicides or their TPs were the most frequently found pesticides (89 % soils) from all about 60 compounds monitored. They were strongly negatively correlated to soil pH. Association of simazine TPs with terbuthylazine and its target crops proved the frequent residues of this banned compound originate from terbuthylazine impurities. In contrast, frequent atrazine-2-hydroxy residue is probably legacy of the high atrazine usage in the past.

Pharmaceuticals dissipation in soil-water-plant system

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It has been documented by many studies that human pharmaceutical are not entirely removed from waste water in wastewater treatment plants. As result pharmaceuticals contaminate surface and ground waters. They may pollute also soils (which can be considered as a chemical degradation of soils) and could be up-taken by plants, if contaminated water is used for irrigation. Behavior of pharmaceuticals in soils is controlled by their sorption onto soil constituents and degradation. Batch sorption and degradation tests were performed for 7 pharmaceuticals and 13 soils. While compounds' sorption affinity depended on their ionization and particular soil properties, pharmaceutical persistence in soils was mostly depended on soil type. In general, for compounds that were degradable in the studied soils, lower average dissipation half-lives and variability were calculated for soils of better quality (soils with well-developed structure, high nutrition content and associated biological conditions as Chernozems) in comparison to those of lower quality (Cambisols). Base on those results, the highest potential to migrate in the soil water environment is expected for carbamazepine, followed by sulfamethoxazole, trimethoprim and metoprolol. Extended transport of other compounds (atenolol, clindamycin and clarithromycin) seems improbable. Next the root uptake of 3 compounds from 3 soils was studied. Five plants (radish, arugula, salad, spinach and pea) were irrigated with water contaminated by a single compound or their mixture. The amount of compounds and their metabolites in roots and leaves (also stems and pods) were evaluated after the harvest. Despite that atenolol and sulfamethoxazole relatively rapidly dissipate from soils, they and their metabolites were detected in all plants. Carbamazepine is very stable in soils and fractions of its metabolites are usually low. However, very high concentrations in all plants were measured not only for carbamazepine but also for its metabolites. The degree of compound transformation depended on plant family.

LECTURES

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Degradation monitoring and assessment

Soil protection in the Czech Republic in the context of ongoing climate change

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The soil protection in the Czech Republic has been taken for a long time as a matter of course/for granted. After 1989, with the rapid economic development, its importance has been considerably reduced, especially because of economic reasons. The soil has been regarded as an abundant medium, which is the best to build on and on which is the best to create jobs. At the turn of the millennium, the rate of soil sealing reached about 15 ha per day (currently it is around 9 ha per day). Apart from the negative interventions in the soil (agricultural land fund) in terms of area protection, soil degradation factors are also a significant problem that is negative influence of especially qualitative characteristics.

However, the ongoing climate change is also beginning to interfere with soil protection. With the increasing extremity of its manifestations, solutions of problems with water shortage or food self-sufficiency will become more and more relevant.

In the context of this situation, the Ministry of the Environment prepares a decree on the protection of agricultural land against erosion. Its main objective is to reduce the amount of soil plucked annually from agricultural land to a tolerable limit. That is to ensure sustainable farming, to significantly increase the water retention in the soil and last but not least, to prevent damage to health and property.

Soil degradation processes in conditions of Slovakia

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AbstractSoil degradation processes are observed and evaluated on the basis of soil monitoring network in Slovakia, which consists of 318 monitoring sites on agricultural and alpine soils. There are monitored important soil parameters which are related to the main threats to soil – soil contamination, soil acidification, soil salinization and sodification, decline in soil organic mater, soil erosion and compaction. The latest results and knowledge concerning land degradation processes in Slovakia are presented in this work. On the basis of obtained results no significant changes in risk elements concentration (Cd, Pb, Cu, Zn, Cr, Ni, Co, Se, As) were indicated during monitoring period in Slovakia. It means the soils which were contaminated at the beginning of soil monitoring process are also contaminated at present (about 1,4 % of land cover in Slovakia where anthropogenic and geogenic influence is included). Slight trend of acidification was indicated on acid to very acid soils. In contrast, soil salinization and sodification processes are running more or less paralelly, but the process of sodification seems to be dominant in conditions of Slovakia. There are about 5 thous. ha of salined soils in Slovakia. The stabilization of soil humus content has been observed especially on arable land during the last period. In qualitative parameters of humus (CHA/CFA, Q46) no significant changes were indicated during last 24 years. The physical degradation was especially manifested in eroded and compacted soils. On the basis of obtained results about 39 % of agricultural land is potentially affected by soil erosion in Slovakia. The slight sensitivity to compaction was detected mostly on cultivated arable soils (Cutanic Luvisols, Albeluvisols – Retisols, Planosols as well as Chernozems and texturally heavy Fluvisols and Cambisols). There are about 700 thous. ha compacted of agricultural soils in Slovakia.

Specific position of technogenic soils in the MSCS 2014 and relation to the WRB 2014

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The diagnostic features of Technosols involved in the WRB system (2014) is perceived by soil scientists very variously, and diagnostics of these soils can be vague or incorrect. Technogenic soil types are occurred generally in urban, industrial, traffic, mining and military areas (SUITMA) and have very diverse properties caused by human-induced activities. To understand and classify such soils is not easy due to their hug diversity, and unclear provenance. The Slovak anthropogenic soils classification system introduced the key features recognizing soil types of technogenic soil group: 1) human-transported and altered material (HTAM), and 2) artefact content. It recognizes two horizons – technogenic topsoil horizon and technogenic subsoil horizon. HTAM is human-transported and altered material what has been moved from outside source area by human activity (aid of machinery or hand tools). This definition does not include events of erosion, flooding, eolic, colluvial or alluvial activities or natural catastrophe. However, bomb spillage causing soil removing – yes. Three varieties of HTAM layers were distinguished: i) HTAM of natural origin – with share of < 10 % artefacts, ii) HTAM of natural-technogenic origin with share of 10 – 40 % artefacts, iii) HTAM of technogenic origin with share > 40 % artefacts. Artefacts (x) represent solid or liquid (gaseous rarely) in soil, which are manufactured or modified by man, as a result of industrial, construction, mining and other activities. Examples are buildings materials, glass, ceramics, rubber, plastics, metals, etc. Soil types Anthrozem and Technozem in the MSCS (2014) are characterized as ex-situ located material, developed from HTAM and/or containing artefacts. Topsoil horizon can be developed as a result of initial pedogenetic processes or as a result of recultivation measures. Also gleyic or stagnogleyic processes are taken into consideration. The cumulative horizons of HTAM is in thickness > 60 cm.

Soil quality monitoring in Poland: system organization and recent results

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Local- and global-scale human impacts, in particular the chemical contamination, threatens the soil functions like food production, filtering, buffering, etc. and may create a direct threat to human health. Thus, soils are involved in the environmental monitoring system, which aims to track changes in soil quality and identify polluted areas requiring remediation. Monitoring of geochemical background is to assess the natural concentrations of substances in soils and to identify the general trends in soil quality in Poland. It is implemented under three programs: (1) Integrated Environmental Monitoring, (2) state-level network "Monitoring of the arable soils' chemistry", founded and operated by IUNG, and (3) state-level network "Forest monitoring", managed by IBL. All three programs are components of the State Environmental Monitoring System (PMŚ). Monitoring of contaminated sites and sites exposed to pollution is carried out on a local scale. Until 2014, the local soil monitoring was the duty of counties. Since 2014 the counties are responsible for monitoring in the so-called "sites of historical contamination" only. An essential importance have a local monitoring networks around the industrial installations qualified the most harmful to the environment and obliged to have an "integrated environmental permission". These duties were extended in 2014 for monitoring of the soil and groundwater quality within installations. Environmental monitoring is also carried out beyond the PMŚ system, as the statutory tasks of national parks (eg. KPN and PNGS) and universities (eg. WUELS). Monitoring of soil in Poland has been conducted in a wide range, but some serious shortcomings remain, including: incompleteness of the system, incomparability of results, and difficult access to research results obtained by the various institutions carrying out the monitoring investigations.

Field study of runoff and sediment yield control by vegetative buffer strips

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Soil erosion and sediment yield in Iran, have become a subject of interest in recent years. The application of vegetative buffer strips is an effective strategy of BMPs to mitigate the surface runoff and soil loss. Vegetative buffer strips contain a special plant species being passed by the flow before getting into the water bodies. The main aim of the present study is to evaluate the impact of three different types of vegetative buffer strips to reduce the surface runoff and sediment yield. The experiments were carried out using the experimental plots with the dimension of 1×10 m^2 as well as the artificial runoff with a flow rate of 1.65 Ls^{-1} during a year. The results of this study showed that the vegetative buffer strips reduced the runoff volume by 35–90 % and sediment concentration by 42–94 %. According to the results, the vetiver grass has a high efficiency in runoff and sediment control; but, due to the probability of creating the concentrated flow among the bushes of vetiver grass, it is strongly recommended to use a resistant plant with a density and uniformity similar to the turf grass and consistent to climatic conditions of the study area along with the vetiver grass. Also, periodic cutting the plants is as an effective strategy to deal with the role of vegetative buffer strips as a source of nutrients and sediment.

Soil organic carbon concentration on selected peatlands in Slovakia

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One of the most important environmental factors influencing soil carbon content is temperature. A gradual increase of temperature, which is consequence of global climate changes, can shift humus formation from humification to mineralization. On increasing mineralization are particularly vulnerable natural soils with high content of organic carbon. One part of natural soils with high carbon content (alpine soils) is included in Soil monitoring system in Slovakia which was started in 1993. However, another soil type, peatlands, was not originally included in Soil monitoring system. Peatlands are very sensitive on environmental changes and they represent very rare, threatened and often relic ecosystems. For this reason since 2008 they are also included in soil monitoring system in Slovakia. Peatlands are ecosystems which are created on locations permanently waterlogged. Slovak peatlands represent quite small real area estimated about 0.57 % of the total area of Slovakia however they have great ecological value. Among other things peatlands are an important terrestrial reservoir of organic carbon (OC). There are three types of peatlands that can be distinguished in Slovakia: raised bogs, transitional mires and poor or rich fens. During 2008–2014 period samples were taken from 7 sites of peatlands which are located in different climatic and geographic conditions of Slovakia. The obtained data show considerable differences in organic carbon content among studied peatlands. The highest OC concentration on peatland Hypkanya (transitional mire) and the lowest OC concentration on Belianske Luky (fen) were found. The differences among quality of peat organic matter were assessed on the basis of 13C NMR spectra. ***Acknowledgement:*** This work was supported by the Slovak Research and Development Agency under the contract No. APVV-14-0087. We thank also to Ministry for Agriculture and Rural Development in Bratislava for financial support of Soil monitoring system in Slovakia contract No 471/2014-310/MPRV SR.

The effect of water erosion on selected chemical and biochemical properties of Chernozem soils

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In recent decades erosion processes have influenced agricultural soil quality. Our research focuses on the South Moravian Chernozem area (CZ) and a study of selected soil properties on different parts of slopes. From the results it is apparent that statistically higher activity of dehydrogenase and acid phosphatase were recorded in accumulation areas. Higher activity, not statistically significant, was found in terms of urease, nitrate reductase and alkaline phosphatase, also in accumulation areas. The influence of erosion processes on nutrient content was also significant. In accumulation areas of slopes supplies of potassium and phosphorus were higher in comparison with erosion areas. The opposite trend was evident in calcium, where statistically significant higher levels were found in erosion areas of slopes, which is linked to the chemistry of soil-forming substrate. This trend also influenced pH. Differences were also found in characteristics relating to soil organic matter. Overall nitrogen content was significantly higher in accumulation areas, the same was true for carbon, although its increase in these areas was not statistically significant. There was a statistically conclusive difference in quality of organic matter in these areas expressed by the carbon content of humus matter, carbon in humic acids and the C:N ratio. Results also showed a relationship between content of carbon and nitrogen and activity of the majority of studied enzymes. The results of the research indicate changes in soil properties in individual areas of slope, which can significantly influence both production and non-production soil characteristics.

This research was carried out with the help of the National Agency for Agricultural Research of the Czech Republic – projects no. QJ1630422 and QK1720303.

The active substances of the plant protection products in the soil samples originated from Basal Soil Monitoring System

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The active substances of the Plant protection products (PPP) has been analyzed in soil samples collected from 40 plots of the Basal Soil Monitoring System (BSMS) since 2014. The BSMS system was set up in 1992 and nowadays it comprises 214 monitoring plots defined precisely in terrain. They are managed in a manner characteristic of our agriculture and sampled in defined schemes in specific intervals. Soil samples from the mentioned 40 monitoring plots have been collected each year and analyzed for the active substances of the PPP, organochlorine pesticides, PCB and 16 EPA PAH. Approximately 100 active substances overall have been applied to the 40 plots each year. Azole compounds (e.g. tebuconazole, epoxiconazole), cypermethrin, chlorpyrifos, florasulam and aminopyralid are the most frequently applied substances. About one third of the applied substances has been measured in the ÚKZÚZ National reference laboratory. A scope of the analysis included the frequently used active substances, substances important from the point of view of groundwater and surface water contamination and toxicologically relevant compounds and metabolites. Although the method comprised mainly herbicides, the predominantly detected active substances in soil samples were fungicides. The list of measured substances is continuously extending with other azole fungicides and toxicologically relevant substances and metabolites. In 2015 atrazin-2-hydroxy, derivate of atrazine, was firstly detected in 23 soil samples including permanent grassland. Last year terbuthylazine-2-hydroxy, derivate of terbuthylazine, was added to the list of measured substances, was detected in 25 soil samples and became the most frequently detected substance in 2016. Important group of measured substances represented compounds applied on soil but not detected in collected samples. These are primarily substances with a short half-life.

Digital mapping of potentially toxic element contents in forest soils: importance of the principal stand factors as predictors

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Functioning of the forest ecosystems can be deteriorated by the presence and excessive amounts of potentially toxic elements (PTE) in soils. An attempt was made to develop models for spatial prediction of PTE (As, Cd, Pb, and Zn) in forest soils of the Czech Republic. The objective of this contribution is to analyze the importance of principal stand factors as predictors for the models, and to interpret their importance in the PTE spatial distribution control. Artificial neural networks, random forests, and multivariate adaptive regression splines were used as model types. Various combinations of data on stand factors (topography – digital terrain model, geology, vegetation, legacy soil information) were used as the inputs for model calibration, together with measured PTE content in 4 soil depths on 120 sites all over the Czech Republic. The models were validated using an independent dataset. For the best models for each element and depth, relative weights of the predictors were recorded from the models. As PTE content in soils is influenced by anthropogenic activities, the reliability of models based purely on natural stand factors is generally less reliable compared to similar models e.g. of soil organic carbon distribution. The performance of the models for PTE spatial distribution improved when the relative position to the principal sources of pollutants (industrial areas) were added as predictors. Data on vegetation and location were more important predictors in models for forest floor. For deeper mineral horizons, the importance of geology was stronger. Relief data were important for all depths. Soil class was particularly important for As and Pb. We can conclude that even the data, whose spatial distribution is strongly influenced by human activity, can be spatially predicted with a reasonable accuracy. However, appropriate selection of model types and best predictors is a crucial issue.

Soil magnetic susceptibility as an effect of concentration of natural and anthropogenic iron minerals in soil: Assessment of background value for forest topsoil on Polish Lowlands and Uplands

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Magnetic susceptibility (MS) is an easily measurable geophysical parameter determining the extent to which a substance becomes magnetized when it is placed in an external magnetic field. For more than three decades, it has been successfully applied in environmental research, especially in pollution related investigations. MS of soil reflects the presence of ferro/ferrimagnetic minerals (magnetite, maghemite, titanomagnetites) which can be of natural and anthropogenic origin. In the natural environment, their magnetic signature is very strong, and although they occur in soil only in small amount they are the main contributors to the overall magnetic signal. On the contrary, magnetically weak antiferromagnetic minerals, as goethite and hematite are present in soil in much larger amount. During high temperature technological processes and all another based on burning of fossil fuels, iron ferro/ferrimagnetic minerals arise being the constituent of emitted dusts which afterwards are deposited on the soil surface. In this study, the topsoil horizons were studied for magnetic susceptibility and heavy metal (HM) contents. The samples were collected from 171 soil profiles located in forest preserves equally distributed over an area of Poland. The investigated soils represented a broad range of distinctive soil types. The magnetic susceptibility values (mean $\chi = 23 \times 10–8$ m^3 kg^{-1}) and heavy metal contents were relatively low, for both the upper organic and mineral horizons. These findings suggest that the forest preserves soils were only slightly polluted as result of urban and industrial dust depositions. ***Acknowledgement:*** The research project received funding from the National Science Centre of Poland on the basis of the decision number DEC-2013/09/B/ST10/02227 and Norway Grant PNRF-68-A1/1/07, conducted by the Department of Forest Soil Science, University of Agriculture in Cracow, Poland.

Magnetic signature of heavy metal contamination of urban soils influenced by different kinds of industry

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During recent decades, successfully application of geophysical methods into environmental research had arisen all over the world. Magnetic susceptibility, a geophysical parameter, has been used for time- and cost-effective detection of magnetic anomaly, predominantly accompanied by geochemical anomaly related to enhanced content of potentially toxic elements, mostly heavy metals. Therefore, integrated geophysical/geochemical method supported by scanning electron microscopy, X-ray diffraction or statistical data analysis become a useful tool not only for identification of polluted soils, but also for spatial, temporal and vertical distribution of contaminants. Additionally, combination of these methods enables discrimination of pollution sources. Soil magnetic anomaly is caused mostly by ferrimagnetic or antiferromagnetic iron minerals, which thanks their well developed specific surface area are able to incorporate heavy metals into their lattices or adsorb them on their surfaces. The occurrence of these minerals (e.g. magnetite, maghemite, hematite, goethite, pyrrhotite) results in the enhanced value of magnetic susceptibility. In the frame of presented study, magnetic mapping was carried out in the surroundings of power plant, steel works and Pb-Zn ore smelter located in the Upper Silesia Region (Poland). The strongest magnetic signal was found in the vicinity of multi-pollution source consisting of 3 iron/steel works and heat/power station, but the lowest – adjacent to a non-ferrous metallurgical smelter. Afterwards, soil sampling was carried out and after standard preparation, soil samples were subjected to chemical and mineralogical analyses. Results exhibited differences in magnetic and geochemical properties, as well as mineral composition of soils depending on the dominating pollution source. The significant positive correlations between soil magnetic susceptibility and heavy metal contents in soil confirmed usability of this method in soil monitoring and assessment of the contamination level. ***Acknowledgement:*** The research project received funding from the National Science Center of Poland on the basis of the decision number DEC-2013/09/B/ST10/02227.

The noise of the soil splash

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The aim of the study was to determine the sound pressure level (noise) after the water drop impact during the soil splash phenomenon. The experiment was conducted on three types of soil with different textures and initial moisture content. Dry soil samples were humidified to four moisture levels related to the specific pressure head (pF 0, pF 1, pF 1.5, pF 2.2). Ten consecutive water drops (4.3 mm in diameter and released from the capillary at a height of 1.5 m) were falling on the soil surface of the sample and sound pressure changes were registered after each drop. The sound pressure levels were recorded using eight microphones of type 40 PH (G.R.A.S. Sound & Vibration Company, Denmark) and two NI-9234 (National Instruments) acquisition cards. A LabView (National Instruments) dedicated application was used for registering and analysing sound pressure signals from the measuring system. In order to minimalize the level of sound waves reflected from the walls and reduce the outside noise, the measuring system was installed in an anechoic chamber (AGH University of Science and Technology, Kraków). All measurements were done in 15 repetitions. The values of the sound pressure level ranged from ca. 30 dB to 40 dB for the three types of soil. The sound pressure level depends on the particle size distribution and its highest value is 42 dB for sandy soil.
This work was partly financed from the National Science Centre, Poland in the frame of project no. 2014/14/E/ST10/00851.

Modeling of soil moisture dynamics in the multilayered Entisols under drought case study at Drava valley

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Through capillary rise, groundwater table depth directly impacts both water management of soil, soil degradation and natural vegetation growth. Although the drought hazard in the top 20 cm of the rhizosphere was estimated from soil hydrological behavior along the Hungarian section of the Drava floodplain, the different texture layers of the soil profile is influence to available water . For monitoring purposes, a Decagon 5TM Soil Moisture and Temperature Sensor and MPS-2 Dielectric Water Potential sensors were used at sample sites in 20 and 70 cm deep. Five soil textural types (STT) were identified at 19 sites, each covering an area of 30 to 70 hectares. Hydrus-1D models were applied for 69 profiles of various textural composition at three different groundwater table depths where capillary rise had modeled. Albeit the area is topographically uniform, model runs indicated extreme spatial variation in soil moisture at a depth of 20 cm. Our results pointed out that none of the five STTs can be exclusively influenced by drought hazard. Hydrus-1D inverse models were validated with five STT of one sample area measured volumetric water content (VWC) time series data at three different groundwater table. The measured VWC was exceeded by the model results, the correlation between the measured and modeled data was 79 % the best approximate model in the observed point at a depth of 70 cm. Our result show that the different soil texture of sequence layers can significantly influence the available water content and drought endangerment of soil. Our results are adaptable for floodplains under humid continental and temperate maritime climates and recommendations can be made for best farming practices.

Effects of warming and altering drought-precipitation events on the biogechemical mechanisms that rule C cycling in agricultural soils amended with biochar

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Extreme weather events have reached a significant increase in frequency and severity in the last decade and its consequences on agroecosystems in most cases are unknown. The IPCC climate change scenarios for the Mediterrenean region of Europe projects a global increase of temperature and a reduction of annual rainfall along with an increase in the occurrence of heavy precipitation events. Environmental manipulation studies are integral to determining consequences of soil degradation processes associated to climate warming. The main objective of this research project (BIODRAINSOIL) is focused on understanding the physical, chemical, biochemical and microbiological processes that interact in agricultural soils amended with biochar under a climate change scenario. Experimental manipulation of drought and precipitation events and warming are performed to project a future climate change scenario with a severe reduction of annual rainfall and an increase of soil temperature. Rain exclusion shelters and open-top warming chambers (OTCs) were installed in a field experiment (La Poveda, Madrid, Spain) to assess Med- and long-term changes in the dynamic of different fractions of soil organic matter and on crop production. Soil volumetric water content and soil temperature are monitored. Enzymes activities involved in the biogeochemical cycles of C, N and P, and metabolic and phenotypic parameters of soil microbial communities are analysed. The results obtained can help to better understand: (1) the effects of a 30 % reduction of annual rainfall and a 3 ºC temperature increase on soil organic matter and soil biogeochemical processes; (2) the impact of prolonged drought and severe precipitation pulses in summer on net emissions of gases that affect climate, and (3) the response of soil microbial communities and their possible adaptations to increases in temperature and frequency and intensity of drought-rewetting cycles in soils. ***Acknowledgement:*** This research project (CGL2015-65162-R) was supported by the MICINN (MINECO, AEI, FEDER, UE).

Land protection projects in the agricultural sector of the Czech Republic and web application of the land usage limits

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Over the last 15 years, the Ministry of Agriculture has registered a significant growth of construction on the land belonging to the Agricultural Land Fund of the Czech Republic. As part of the Land Use section of the Strategy of the Resort until 2030, the Ministry of Agriculture has set the goal to develop effective tools which could help prevent the occupation of the most fertile agricultural land. As a result, the Research Institute for Soil and Water Conservation (VUMOP, v. v. i. in Czech), in co-operation with the Ministry of Agriculture, presented a new web application – Land Use Limitations. The application can determine whether a particular landsite anywhere in the Czech Republic is suitable for agricultural, industrial or other use. It is a useful tool to prevent the unnecessary occupation of quality agricultural land for industrial and other purposes. The interactive tool is available at: www.limitypudy.vumop.cz.

The application promotes the preservation of the quality agricultural land for production, both in terms of the efficiency of production on these soils, and the extra costs associated with responsible land management in less suitable localities. The application analyzes the availability of land areas classified in the lower classes of the Agricultural Land Fund protection (including different complementary conditions), which allow parameterization to different scenarios. Another objective of the application is to help solve the problem brownfields, which are also managed in the application.

LECTURES

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Revitalization measures

Effectiveness of five-year restoration of degraded mountain fen peatland – case study from the Central Sudetes (SW Poland)

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In the Central Sudetes at the turn of 19th and 20th centuries large mire areas underwent intensive drainage treatments in terms of forestry use. Forest management connected with drainage cause multidirectional changes in hydrological conditions, as well as in physical and chemical properties of organic soils. To improve the conditions of degraded peatlands in central Sudetes the restoration program was launched in the year 2010. The methods used in restoration are: drainage ditches blocking, trees clear--cutting with biomass removal and regular mowing of shrubs and grassy plants. The aim of the study was to assess the effect of 5-years peatland restoration on organic soils and vegetation composition. Study fen peatland is located on the northern slope of Skalniak ridge, in the central part of the Stołowe Mountains (central Sudetes). Field survey including vegetation and soil investigation were carried out in September 2010 and 2015 within the research transect (3 sampling plots). To estimated the number of plant species Braun-Blanquet method was used. In soil samples following parameters were determined: labile organic carbon carbon content, rate of organic matter mineralization, state of secondary transformation, potential hydrophobicity. Both, field observation and laboratory analysis showed positive effect of restoration treatments on study peatland ecosystem. Noticeable improvement of soil conditions as well as vegetation composition were observed.

Impact of different tillage practices and green manure on physical properties of Chernozem soil

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The results of a study of the physical properties of Chernozem typical (black soil) in the short field crop rotation of the northeast of the Forest-Steppe of Ukraine (fields of Sumy National Agrarian University): buckwheat, winter wheat, potatoes, barley are presented in the article. The purpose of the research was to compare the effectiveness of different types of tillage for digging green manure in: plowing to a depth of 28–30 cm, tillage by subsurface cultivator to the depth of plowing, surface tillage by disk tiller to a depth of 13–15 cm and 6–8 cm. Oil radish (Raphanus sativus var. oleifera) was used as green manure which planted after harvest of the primary crops. As the area of degraded soils in Ukraine increases due to a decrease in the amount of organic matter, the actual task of modern agriculture is a reducing of an anthropogenic load intensity on cultivated agricultural land. Therefore, at this time, it is especially important to choose a variant of tillage for digging the green manure in, which would contribute to sustainable production growth of fertility by stabilizing the soil agrophysical indices. Ten years of data across all crops shows an advantage of tillage by subsurface cultivator compared with over turning at 28–30 cm for incorporating the green manure. There was a strong trend towards increasing in the state of aggregation (by 4.3 %), water stability (by 1.1 %), bulk density (by 1.7 %), hardness (by 5.7 %), total porosity (by 0.5 %), capillary porosity (by 0.9 %) and aeration (by 0.2 %) in the root 0–30 cm layer of Chernozem typical compared with deep tillage. The surface tillage by disk tiller leads to an improvement of these parameters only in the top layer 0–10 cm, in the lower layers the agrophysical parameters of fertility deteriorated. There was a definite trend towards lower the parameters of the entire 0–30 cm layer when disk tiller on 13–15 cm was used (compared with plowing). Thus, research has shown the expediency of tillage by subsurface cultivator for incorporating the green manure into the Chernozem soil to optimize the structural stability, water stable aggregation and hardness.

Long term effect of the reclamation of solonetz soils

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Solonetz soils are typical in the Great Hungarian Plain. Our study was carried out at one typical location, Karcag. Main limitations of clayey solonetz there are large plasticity, swelling and low hydraulic conductivity. These conditions were intended to be improved with chemical and hydrological reclamation and cropping of the native grassland. After 35 years, soil profiles, opened in arable plots, under mostly cereal production, were compared to unimproved profiles. There were three augerings and one profile sampling through the full depth of soil profile in each of the three treatments, i) zero, that is unimproved grassland plots, ii) reclaimed cultivated plots with chemical reclamation, deep loosening, surface drainage, iii) drained cultivated plots with chemical reclamation, deep loosening, surface drainage, subsurface drainage pipes. This order of treatments represents increasing intensity and cost of reclamation. For example the salinity after 35 years remains high in treatment i), decreases in ii), and is lowest in iii). The same order was proved by changes of chemical and physical properties, as decrease of salinity and sodicity, alkalinity, field capacity and wilting point, increase of soil organic matter content and hydraulic conductivity. Soil salinity and sodicity decreased significantly in all soil horizons (A, B, C), pF values demonstrated significant decrease in subsurface horizons, hydraulic conductivity showed significant increase in surface horizon. The other properties followed the mentioned tendency, but differences were not statistically significant. In spite of extreme soil physical properties of the solonetz, the reclamation was successful. Reclaimed solonetz plots became less extreme both in terms of chemical and physical properties, which was reflected by increasing yields during the years.

Restoration and development of soil cover on dumpsites

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The open cast mining results in disturbance of a very large area landscape. There is a long time lasting experience of handling with dumpsites in the Czech Republic. This study is dealing with man made soils development. The biological recultivation can be considered as return back of disturbed landscape into its agricultural or forest use. The original soil cover and it features were taken in consideration as much as possible. Our results are besed onmainly on the the more than 25 years of work in the area under study. It is clear that the main soiil forming process in that areas was anthropogenic one. Differend recultivation techniques were applied and a the resulting soil development was studied. Both soil phusical and chemical properties and it development were evaluated. In the case of physical properties the main concern was paid to bulk density, soil porosity and soil structure including its stability. The studied chemical proerties included humus content, plant nutrients, soil reaction and because the studied area could be considered as endangered by contamination also the content of potentialy risk elements was determined. On one locallity the problem of extreme acidity due to pyrite weathering was also studied. All the soil characteristics were studied in the long term development. Our results prooved different quality of newly developed soils with accordance of recultivation techniques used. It was possible conclude that that development of man made soil undes study led to formation of soilcover having similar quality as the origin one.

Combination of soil and foliar bioeffective treatments improve growth and fruit quality of tomato (var. Mobil) in organic agriculture

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BIOFECTOR (7th EU Framework Programme, grant agreement 312117) works on "an improved understanding and utilization of biological processes supporting soil fertility and soil quality". Soil biofertilizer treatments, the bioeffectors ("BEs") are combined with foliar bioactive natural compounds interacting positively to plant growth and development. Such treatments are beneficial of organic and sustainable agricultural practices. Tomato Solanum lycopersicon Mill. 'Mobil' was used in the experiment among field condition. Bioeffector products, as BE-1: *Trichoderma harzianum* T-22 (TRIANUMTM),BE-4: Hungarian Trichoderma TDM (PANNON Trade), including *Azotobacter* and *Azospirillum* N2-fixers, BE-2: P*seudomonas* sp., BE-3 (PRORADIXTM): *Bacillus amyloliquefaciens* (RHIZOVITAL 42F1) were applied on the bases of the supplier's recommendations. Foliar application was also used during the vegetation periods of applying algal Super 50 treatment (BIOATLANTIS) and neetle extracts. Growth of tomato, shoot and root biomass and food quality of tomato friuts was assessed beside general soil characterization, including MPN counts of bioeffectors in tomato rhizosphere. Results were evaluated by statistical probes. Combined soil and foliar microbial inoculations proved to have better beneficial influence, on tomato yield, then the only single bioeffector, BE-treatments. Foliar application of algal product has synergistic positive effect mainly with controls, the neetle extract with BE-microorganisms. Brix value and acid:sugar ratio was also better in case of combined soil-plant treatments. The bioeffectors are providing powerful tools replacing fertilizers in organic agricultural practices.

POSTERS

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Degradation causes and consequences

An integrated approach to landslide and surface erosion mapping

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The areas with high erosion susceptibility have often higher risk of landslide occurrence in view of the fact that landslides and soil erosion induced by water interact with each other. For any type of slope instability, rainfall infiltration and run-off are very important processes, which strongly depend on the duration and intensity of rainfall, slope angle, as well as soil conditions and soil properties. A study area where landslides and superficial soil erosion occur inside the same area under different type of land use was selected and an integrated approach to their mapping and assessment was applied. Database of Slope Instability Register and detailed soil maps were used as the mapping base for the landslide and soil survey. Slope instability database is based on verified mapping and landslide description and documentation. Additionally, modern remote sensing methods such as the LIDAR imaging, and the geophysical methods were used. Soil redistribution as a consequence of the landslides events is generally responsible for changes in hillslope topography. Usually, mass movement results in a decrease in the failure area and an increase in the area of deposition. The failures and soil redistribution processes lead to changes in local slope gradient, which affect subsequent soil erosion.

Estimation of soil naturalness grade and their changes between 1784 and 2010 in Tokaj Nagy-Hill based on soil and land cover databases

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The World Reference Base of Soil Resources (WRB 2014) classification contains proper tools to express the presence of anthropogenic influences on soils in form of qualifiers, diagnostic horizons, materials and properties referring soil profile features being clearly connected with anthropogenic activities. Due to reclassification of historical and contemporary land cover databases, assigned them to these diagnostic features, we compiled a dataset suitable for mapping and estimation of spatial extent of soil naturalness state for the Tokaj Nagy-Hill. Based on this datasets classes having 1. no soils (in definition of WRB) 2. dominantly natural or close to natural soils (no any anthropogenic feature according WRB) 3. soils with significant anthropogenic influences (presence of anthropogenic qualifiers, materials, horizons), and 4. dominantly anthropogenic soils (anthropogenic reference group: Anthrosol or Technosol) were distinguished. It allowed not only to assess the recent state of soil naturalness, but also to diagnose most relevant changes between 1784 and 2010. Recently in Tokaj Nagy-Hill 48.5 % of the surface is covered by soils in dominantly natural or close to natural state (2010). On 9.0 % anthropogenic reference groups can be found and on 38.5 % and basically natural soils with recognizable anthropogenic influences, as ploughing, terracing or truncation by erosion were mapped. Generally, in average for five investigation periods (1784–1858, 1858–1884, 1884–1940, 1940–1989, 1989–2010) decreasing anthropogenic influence on soils could be diagnosed on 35.73 % of the area, and an decreasing intensity of human impacts on 8.01 %.

Geotechnical deformation of soil cover as a cause of trees' decay

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The study was conducted in the Ludowy Park in Bytom. It was added to the register of objects of cultural heritage in 1955. Due to its historical and natural values, as well as economics and recreational functions, the Park is worthy of special care. Currently, there are many interesting species and varieties of trees and shrubs growing in the park, which add to the value of its natural importance. In recent years, valuable species of trees began to die and become fall, the European beech especially. The aim of the study was: i – assessment of the soil and habitat condition and geomechanical deformation of the soil cover in the park, ii – assessment of the health of trees and shrubs growing in the Ludowy Park in Bytom and identifying the causes of harmful factors. Soil cover of the park was characterized by a typological differentiation, variability of morphological features, colors and thickness of genetic horizons and also in chemical and physical properties. In the relief of the park occurred a number of non-contiguous deformation of terrain; surface faults (thresholds), cracks, fissures to a depth of several meters and small hallows caused by the influence of mining activities. Trees growing around faults inclined and their root systems have been damaged. On the one hand, this causes the loss of tree statics, subsequently leading to spontaneous fall. On the other hand, the chain of disease begins, its various stages can be listed in the following order: 1. Mining damages – relief deformations, 2. Breaking the roots of the trees especially hairy roots, 3. Disorders of water and alimentary system, 4. Reducing trees resistance to diseases and to insects, 5. Root and butt rot tree disease, 6. Deterioration of the ability of anchoring of roots and mechanical strength, 7. Falling trees as a result of damage caused by wind and snow.

Evolution of sandy soils as a result of human activities – a case study from the Błędów Desert

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Sandy areas are important places for testing the effects of abiotic and biotic factors on soil morphology and evolution, where human activities cause dynamic changes in the natural environment. The Błędów Desert is an example of this kind of area, where soil cover was destroyed during intensive deforestation initiated in the Middle Ages. As a result of this activities sand exposed to drifting. In order to stabilize the shifting sand man began the reforestation of this area in the 20th century. The main aim of the study was to determine the evolution of sandy soils. Three representative study areas were selected: (1) a reference surface in a plantation forest with soils undisturbed by aeolian processes – one pedon, (2) an active deflation hollow – two pedons, (3) a deflation hollow stabilized by reforestation (forest planting ca. 30 and ca. 100 years ago – two pedons). The studied pedons were excavated in the field, described, and sampled. Also, undisturbed soil samples were collected for micromorphologic analysis. In laboratory, basic physical and chemical properties were determined. The results proved the complexity of the soil process formation, which strongly depends on the aeolian processes and human activities. The studied soils are found at various stages of development, mostly characterized by a relatively rapid accumulation of soil organic matter. Initial stage of podzolization was noted in few pedons. History of changes in the environment is to a substantial degree reflected in morphology and micromorphology of the studied soils.

Methodological experiences of aggregate stability measurements

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There is no objective or generally applicable method to quantify soil structure. It is not known yet how the structural properties depend on other soil and environmental parameters, and how they affects other soil physical properties. Our work aims to characterize statistically the interrelationships between the particle size distribution (PSD), structure and pore size distribution (in connection with fluid retention and conductivity) of soils analysing existing and a newly built soil structural databases. For this purpose a new soil physical database with structural information will be built which represents the major Hungarian soil types. Considering the soil structural properties, more accurate and reliable pedotransfer functions can be developed to predict fluid retention and conductivity. We present our first results. Soil's aggregate stability can be a good indicator of soil structure. We have measured the aggregate stability with wet sieving apparatus (Eijkelkamp) after different pre-treatments (e.g. different way and time of pre-moistening) of several soil samples (N=51). Sequentially we determined the particle size distribution of the water stable and non--stable fraction with laser diffraction method (Malvern Mastersizer 3000). The correlation of aggregate stability, particle size distribution and other soil parameters were analysed. This research is supported through the New National Excellence Program of the Ministry of Human Capacities and by the Hungarian National Research, Development and Innovation Office Foundation (Grant No. K 119475).

Soil compaction and its impact on selected classes of soil arthropods contributing to ecosystem services

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Soil arthropods play an important role in many soil processes and can influence soil chemical, physical, and biological properties what reflected in fulfilling of ecosystem services. In opposite, soil processes including degradation can affect abundance of soil fauna. In the soil, arthropods function as ecosystem engineers and litter transformers. During the spring 2015, we observed the impact of soil compaction on the abundance of selected classes of soil non-flying arthropods using soil as a habitat. We collected soil arthropods from 6 different study sites and 3 different soil types (Fluvisol, Cambisol, Regosol) located in various natural conditions of Slovakia with two different land use (AL – arable land, PG – permanent grasslands). In 2015, at each site, seven plastic traps were placed flush with the surface, and after one month arthropods were collected. The individuals were identified and counted according to 5 classes (Arachnida, Isopoda, Diploda, Chilopoda, Insecta). Within the Insecta class we counted only order Dermaptera. At each study site in the places where plastic traps were placed the penetration resistance (PR) of 0.2 m depth was measured as the soil characteristic directly related to soil compaction. The average PR value from 6 study sites was 1.00 MPa for AL (minimum value 0.63 MPa, maximum value 1.47 MPa) and 1.28 MPa for PG (minimum value 0.72 MPa, maximum value 1.71 MPa). The paired t-test confirmed difference of PR between AL and PG ($p = 0.029$). The correlation analysis showed positive correlation rate between PR and Arachnida (Spearman correlation coefficient, SCC 0.587) at AL. In contrary, at PG the negative correlation rate was observed between PR and Arachnida (SCC -0.350), Diploda (SCC -0.389), Dermaptera (SCC -0.398). This work was supported by the Slovak Research and Development Agency under Grant No. APVV-0098-12 Analysis, modelling and evaluation of agro-ecosystem services.

Parameters of soil structure in relation to main factors that influence it

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Soil structure is in a close relation to both, organic and mineral, soil components; therefore it is the most influenced by soil genesis, soil texture, and ecosystem. The influence of these factors is reflected on different parameters of soil structure, however each of them responds to another factor. Experiment included 2 groups of soils with different texture (fine and coarse grained) with 3 soils (HCh – Haplic Chernozem, CLu – Cutanic Luvisol, HCa – Haplic Cambisol) in each of this group, and each of the soil on 4 different ecosystems (forest, meadow, urban, and agro-ecosystems). The most significant influence was in the case of soil texture, particularly on coefficient of soil structure (Kst) and weighted mean diameter (WMD). Higher values of both parameters were in the fine grained soils. Positive correlation was recorded in the case of Kst and WMD in relation to the fraction of clay and silt, and a negative correlation in relation to the fraction of sand. The impact of soil genesis was reflected only on the coefficient of stability (Kw), with a positive correlation for the quantity of soil organic matter (SOM) and a negative for its quality. According to this, the most favourable situation was in HCh > HLu > HCa, which in fact is not a true. The impact of ecosystem was reflected mainly on the coefficient of vulnerability of soil structure (Kv). The lowest values of Kv were in natural ecosystems (forest, meadow) > urban (grass vegetation) > agro-ecosystem. The higher, a more qualitative, and stabile inputs of SOM were, the more favourable was soil structure. From the mentioned parameters, as the most suitable for the evaluation of soil structure seems to be Kv and WMD. ***Acknowledgement:*** This work was supported by the Slovak Research and Development Agency under the contract No. APVV-14-0087.

Organic matter transformation in mountain peatland soils under influence of human activities – example of Upper San river valley (Western Bieszczady Mts.)

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Organic soils are changed due to the impact of natural (hydrology, microclimate, geomorphology) and anthropogenic conditions. The effects of organic soils degradation process is transformation of the organic matter accumulated in peat bogs. Our study aimed to determine the effect of drainage works on the chemical properties of the soil organic matter accumulated in mountain organic soils on example of peatlands located in Upper San river valley (Western Bieszczady Mts.). Field studies were conducted in June 2015 and were included complete 5 soil peat cores and collected 50 samples of disturbed soil. The type and structure of peat material were described on field moist samples. In laboratory, the pH, ash content, degree of decomposition (fibre volume method), carbon and nitrogen content were analyzed, also the analysis of optical properties (in 0,5 M NaOH extracts) and characteristic of organic matter using FTIR spectrometer were performed. Soils were classified on the basis of FAO--WRB soil classification (WRB 2015). The results of research indicate that mountain peatland soils in Western Bieszczady Mts. were transformed to varying degrees as a result of anthropopressure. Advanced morphological changes of organic material has been identified, due to moorsh forming process. Further transformations were conducived by currently formed soil structure typical for moorsh and aeration of topmost part of the soil. Chemical properties of organic matter were changed. In degraded soils the increase in soil pH, increase in ash content, decrease in the carbon concentration and increase in the concentration of nitrogen were noticed, which resulted in highly distinct change in the C/N ratio. Also, changes were observed in the degree of condensation of soil organic matter extracted in an alkaline solution (humus) and FTIR spectra of studied peatland soils.

Potential mobility of chromium in soils: comparison of anthropogenically polluted and naturally enriched sites

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Chromium is relatively common potentially risk element in soils and its toxicity is strongly dependent on its oxidation state and concentration. While the trivalent form is an important micronutrient, less mobile and less toxic, hexavalent chromium is a known carcinogen, only weakly adsorbed by soil particles, soluble in the full pH range. This case study aims to assess parameters affecting chromium potential mobility, toxicity and leachability at examined anthropogenically contaminated (by production of piston rings) and naturally enriched (serpeninite soil) sites. To reach important data about the polluted and enriched soil, following analysis on geochemistry, soil properties and leaching experiments were done: non-destructive total element content determination by X-ray fluorescence spectroscopy (XRF) analysis, aqua regia (AQ) extraction to reach pseudototal content of elements, BCR sequential extraction to determine fractionation of present elements, cation exchange capacity, and column leaching experiments. Column leaching experiments were provided with simulated acidic rainwater and simulated root exudates. Redox potential and pH were measured for all collected soil samples and leachates from column experiments. Total content of elements in extracts and leachates was determined by ICP-OES. Speciation of chromium was done by means of ICS-500 with postcolumn derivatization. XRF analysis revealed higher concentration of chromium in comparison with pseudototal content reached via AQ determination. These findings indicate presence of silicates, spinels and minerals binding chromium, which are not released by AQ. Determined fractionation of anthropogenically polluted site showed that the highest content of chromium is bound in the oxidizable fraction, particularly in organic matter. Highest levels of chromium in naturally enriched soils were found in exchangeable fraction, corresponding with its higher mobility in leaching experiments. Depth and origin of collected sample, content of organic carbon and especially pH showed significant influence on leaching of chromium and thus its potential mobility and toxicity for the environment.

Effective soil management practices: tackling organic matter and nutrient loss

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Erosion on agricultural land often draws attention as one of the most visible and acute problems when soil degradation is discussed. Soil management practices that help to prevent erosion activity should be brought into use regularly.
Therefore, several soil management practices were tested in 2016 under field conditions using rainfall simulator, in order to assess their effect on soil loss volume. Testing took place at four different localities where experimental plots have been set for the very purpose. Three of the localities were used for maize production that year, whereas the last is permanently used as a hop field. The experimental plots had been regularly managed before the testing was carried out.
The effect of soil management practices was tested three times a year at different stages of vegetation cover, so the cropping factor would be involved. Altogether, three rainfall simulations were made at each locality during 2016.
Rainfall simulation is common technique used for understanding processes involved in water erosion. In this study, field rainfall simulator with large wetted area was used to create surface runoff. Apart from total soil loss, also volume of eroded organic matter and accessible nutrients was determined.
Results showed enormous efficiency of minimum tillage practices, such as strip-till and no-till technologies, where the surface runoff was often reduced about more than 90 % and sometimes did not even start.

Behavior and transport of four pharmaceuticals in the undisturbed soil columns

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The application of pharmaceuticals at the soil surface (due to their occurrence in farmland manure, treated wastewater etc.) causes the contamination of soil water followed by groundwater contamination. The extent of contamination depends on their behavior in soils (i.e., sorption and degradation), and also on the soil structure, which dictates the hydrological conditions that are diverse in different soil types, as well as in different soil horizons of any particular soil type. Seepage of four pharmaceuticals from undisturbed soil columns taken from different horizons was studied. A mixture of compounds was applied at the soil surface, and was then followed by ponded infiltration, which was performed either immediately or after 21 days. The lowest immediate mobilization was observed for trimethoprim, followed by atenolol, carbamazepine and sulfamethoxazole, which could be expected based on the compounds' known sorption affinities to soils. However, despite a large sorption of trimethoprim and atenolol in soils, due to preferential flow a relatively large amount of seepage of these two compounds was observed (together with carbamazepine and sulfamethoxazole) in samples with extensively developed soil structure. Degradation of atenolol and sulfamethoxazole resulted in a considerably reduced amount of these compounds in soil columns 21 days after their application. Thus, seepage of atenolol from soil samples also decreased considerably. Interestingly, seepage of sulfamethoxazole was comparable to the relatively large seepage of carbamazepine, which remained largely non-degraded during the 21 day period. The high seepage of sulfamethoxazole was attributed to its predominant deposition in the preferential pathways as compared to the distribution of other compounds in both, pathways and the soil matrix, and to decreased sorption due to the competition between compounds for limited sorption sites in macropores. Finally, seepage of trimethoprim decreased considerably, partly due to its degradation but mostly due to its very high sorption in soils.

Sorption of ionizable pharmaceuticals in different soil types

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Transport of human and veterinary pharmaceuticals in soils and consequent ground-water contamination are influenced by many factors, including compound sorption on soil particles. Batch sorption tests were performed for 7 pharmaceuticals and 13 representative soils of the Czech Republic. Sorption of ionizable pharmaceuticals was highly affected by soil pH. Sorption of trimethoprim, clindamycin, clarithromycin, metoprolol and atenolol, which depending on soil pH occurred in cationic form (atenolol, metoprolol, clarithromycin), and cationic and neutral (trimethoprim, clindamycin), was positively related to the base cation saturation and cation exchange capacity. The sorption of carbamazepine (neutral) and sulfamethoxazole (neutral and anionic) was positively related to the organic matter content and hydrolytic acidity, respectively. In addition an antagonistic but also a synergic affect of differently charged organic molecules (of atenolol trimethoprim, carbamazepine and sulfamethoxazole) on their simultaneous sorption to soil constituents was documented. While sorption affinities of trimethoprim and carbamazepine decreased slightly, sorption affinity of sulfamethoxazole in some soils increased. Decreases in sorption of the two compounds could be attributed to their competition between each other and competition with atenolol. A great increase of sulfamethoxazole sorption was attributed to elimination of repulsion between negatively charged molecules and particle surfaces due to cation sorption (atenolol and trimethoprim) on soil particles. A new study with other 3 pharmaceuticals fexofenadine (cation, zwitter-ionic, anion), irbesartan (cation, neutral, anion) and citalopram (cationic and neutral), and 7 soils was performed. Despite that forms of molecules of fexofenadine and irbesartan for pH of studied soils differed, the similar trends of sorption affinities with the respect to soil properties were observe. Sorption of both compounds was positively related to hydrolytic acidity and negatively to soil pH and sorption complex saturation (similarly to sulfamethoxazole). Sorption of citalopram was positively related to base cation saturation and soil pH (similarly to clindamycin and clarithromycin).

Discharge and root uptake of pharmaceuticals from sewage sludge applied in soils

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Sewage sludge usually contains vide range of chemicals including human pharmaceuticals. Pharmaceuticals may then contaminate soil and ground water and they can be up taken by plants. Study was therefore focused on: a) seepage of pharmaceuticals from soils mixed with sewage sludge, b) uptake of pharmaceuticals by plants planted in soils mixed with sewage sludge. Soil samples were taken from top horizons of seven different soil types. Sewage sludge samples were taken from two wastewater treatment plants. a) Soils mixed with sludge were packed in plastic columns and 14 days incubated under laboratory conditions. Next a ponded infiltration was applied and cumulative water outflow and solutes discharged at the bottom was measured. b) Spinach (Spinacea oleracea L.) was planted in soils mixed with sludge packed in plastic columns under greenhouse conditions. The amount of pharmaceuticals in plant parts (i.e., roots and leaves) was evaluated after harvesting. Compounds discharge as well as root uptake was soil and sludge dependent. In general mostly larger discharge was observed form the Regosol and Cambisols. Mobility of compounds depended on their sorption affinity to particular soil, but also on a dissolve organic matter in the seeping solution. Measured concentrations in spinach showed selective uptake of mobile pharmaceuticals in soil water. Sertraline, telmisartan, metoprolol, tramadol, venlafaxine, citalopram, carbamazepine and clarithromycin were found in the discharged solutions and also in spinach. On the other hand relatively large amount of diclofenac, valsartan, fexofenadine, irbesartan, clindamycine, venlafaxine, memantine and bisoprolol was found in the discharged solutions but very low or negligible in the spinach parts.

Sorption of three pharmaceuticals in aggregate interiors and their coatings

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There are several studies, dealing with a transport of organic compounds in undisturbed soils, which suggested that sorption of the compounds were strongly modified (usually decreased) in macropores due to coatings on macropore's walls. There are two reasons: 1. different composition of coating and soil matrix, 2. more compact structure of coatings in comparison to matrix structure. In addition sorption affinity of particular compound could be different if applied in mixture with other compounds. Therefore this study focused on sorption of 3 pharmaceuticals (atenolol, carbamazepine and sulfamethoxazole), which were applied separately and in mixture, on soil samples taken from the Bt horizon of the Haplic Luvisol. Batch sorption tests were performed on 3 samples: organic-clay coating (i. e. soil material removed from soil aggregates in this horizon), soil from the inner part of aggregates, and mixture of both. Resulting sorption isotherms were described using the Freundlich equation. Results did not prove a hypothesis that sorption affinity of particular compound will be strongly influenced by different composition of aggregate coatings and interiors. Only in the case of atenolol (in cationic form) sorption isotherm for coating indicated larger affinity to soil constituents for low concentrations (larger curvature) in comparison to those for aggregate interiors (smaller curvature). The average curvature of sorption isotherm was obtained for the soil mixture. No significant differences were observed between atenolol and carbamazepine (neutral form) sorption when applied separately and in mixture. Considerable increase in sorption when applied in mixture with other two compounds was observed for sulfamethoxazole (which was in anionic form). An increase of sulfamethoxazole sorption was attributed to elimination of repulsion between negatively charged molecules and particle surfaces due to cation sorption (atenolol) on soil particles.

Can soil degradation favor the occurrence of rare and protected species?

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The research was carried out on the area contaminated by liquid soda post-production wastes ($CaCl_2$ and NaCl) in the vicinity of Inowrocław (north-central Poland). The aim was to analyze the soil-plant relations in the saline meadows near the soda factory. Soil samples (0–25 cm) and phytosociological relevés were taken at seven sites along the selected transect. The obtained results revealed that due to the leakage from waste ponds (Solvay's process) and unfavorable hydrogeological conditions, the studied soils were affected by human-induced salinity (ECe 15–61 $dS \cdot m^{-1}$) and sodicity (SAR 11–22). This led to exclusion from the agricultural production of over 100 ha of land and the formation of the technogenic soils. On the other hand, changes in soil properties has been influenced the increase of biodiversity. Thus, the succession of rare and protected halophytic plants such as *Aster tripolium*, *Triglochin maritimum*, *Spergularia salina* and *Salicornia europea* is currently observed. They usually grow in various zones of intertidal salt marshes and semiarid areas. The statistical analysis showed that species patterns were significantly correlated with the spatial variability of soil salinity. *Salicornia europaea* occurred at three sites with the highest salt load. Taking into account the species composition, this area is unique in Poland.

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Degradation monitoring and assessment

Upgrading of the soil units system in agricultural land of Slovakia in the context of the identification of soil degradation

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Soil is a key natural resources and economic and social potential of each country. The concept of sustainability in the use and protection of land must comply with an interest about the future not in conflict with the human right to safe food and all the other benefits of using the land. Use of agricultural soil is frequently linked with soil degradation processes. In Slovakian conditions soil degradation represents actual societal problem regardless of all the attention it receives. Reducing the size of agricultural land takes place every year, with daily losses still moving around 12 hectares. At present, in the SR are available 0.4389 hectares of agricultural land per capita, but only 0.2594 ha of arable land per capita. Now is necessary update the system of soil ecological units which are used in Slovakia in a variety of mutations more than 40 years. During this period there were significant changes in parameters, especially concerning agricultural soils, the soil classification system has changed. Even soil research itself advanced to the extent that the present system can no longer respond flexibly to the increasing demands of practice and whole society. Based on the analysis of the possibility of changes of the current code list of soil units, spatial delineation the anthropic soils, spatial delimitation of colluvial soils and their inclusion into the identification system. The data from this system form the basis for the system of protection of agricultural land against the degradation integrated into the legislation about the protection and use of agricultural land of Slovakia.

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Conditions of soil cover on Permo-Carboniferous rocks in the Český Brod area 45 years after afforestation

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Afforestation of agricultural soils is an important tool for improving the landscape structure and its ecological stability. The aim of the study was to evaluate the effect of changes in landuse on Stagnosol properties. The study area lies 45 km to the southeast of Prague, Czech Republic, and is characterized by the Chýnov Member consisting of sandstone and arkose. The research was performed on arable soil and plots with birch and pine 45 years after afforestation. The results revealed differences in the properties of upper part of soils after a change in landuse. The duration of afforestation positively affected the humus state of forest soils. These soils have higher contents of Cox and Nt than agricultural soils. Qualitative parameters of organic matter were evaluated on the basis of granular-density metric fractionation. Storages of free organic matter (LFfree) of forest soils are elevated by 3–42 % compared to arable soils. Positive impact of the change in landuse corresponds to the Cunstable/Cstable ratio, which decreased from 6.2 (arable soil) and 2.8 (birch forest) to 1.3 (pine forest). Agricultural soils have a weakly acid reaction in the upper part of profiles. The upper part of the profile in birch forest showed an acid reaction and that in pine forest a very acid reaction. Forest soils showed more favorable physical properties (e. g., bulk density, porosity) in the A horizons. Macromorphological and micromorphological analyses showed a preservation of some original pedofeatures even after the change in landuse.

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Assessment of infiltration and soil erosion after 12 years of conservation tillage in Hungary

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Improper agricultural practices lead to severe land degradation all over the world due to accelerated soil erosion and unfavourable water management, accompanied by nutrient and organic carbon loss. Our research compared Conservation Tillage (CT) with conventional mouldboard Ploughing Tillage (PT) filling a gap in long-term, field-scale (4*1200 m^2) experiments under a continental sub-humid climate on Luvisol. Our results are based on the data of a 12-year-long (2004–2015) investigation. Runoff and eroded sediment were collected, measured and sampled after each precipitation event, and soil organic carbon and nutrient contents of both were determined. A significant effect of tillage and crop type and their interaction with yearly amount of runoff, soil loss and organic carbon and nutrient content of the sediment was demonstrated by our statistically analysed data. Rainfall simulation studies were conducted to determine how infiltration and soil erosion rates vary in field plots under PT and CT practices after winter cover crop during a growing season (2016). At each time, five different rainfall intensities were applied to the plots and the infiltration rate calculated as function of rainfall intensity. The highest infiltration rates were observed on the plot under CT when it was under the cover crop. When the soil was prepared as a seedbed, higher infiltration rates occurred when rainfall intensities were less than 80 mm/h. However, when the rainfall intensities were more than 80 mm/h, water infiltration rates were higher when the soil was covered in stubble. Overall, CT resulted in much lower soil erodibility values for the same soil under extremely heavy precipitation events. Support of the Hungarian Scientific Research Fund – PD112729, the Bolyai János Research Scholarship of the Hungarian Academy of Sciences (for G. Jakab, B. Madarász and A. Tóth) and the Syngenta Hungary Ltd. are gratefully acknowledged.

The use of Digital Relief Model (DRM) to assess the potential water erosion hazard

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Water erosion study includes a geoinformation analysis of the terrain, where erosion processes are taking place. The priority direction of this method is creation of a digital relief model (DRM) for an area under the threat of erosion, which allows us to analyze the hydrological network and establish the basic erosion properties of soils. DRM data also makes it possible to take into account the thickness of the soil profile, which varies according to the slope length and the relative height of the slope as well, as its exposure that determines the profile curvature. Also, through the characteristics of the slope we could take into account the amount of solar energy given by the angle of sunlight incidence to determine the microclimatic features of the site, namely – temperature, transpiration and humidity of the upper layers of the soil and features of vegetation cover, etc. Such indicators of runoff and transition can be used as: orientation of soil surface, its horizontal and vertical curvature, direction of possible runoff, hydrological length of slope and places of moisture concentration. DRM based on a topographic map with scale 1:10,000 and data of radiolocation wereanalyzed with Esri® Map Viewer. Coordinates of pixel were calculated automatically on a base of topography information. This method called is D8, and have been proposed by O'Kallahan and Mark in 1984 year. Result of methods application is a raster, each pixel of which is taking into account all surface features and shows a possible direction of soils particles movement with waterflow. We can conclude – if the area of horizontal curvature on topography have positive values, then the convex surface areas posses divergent drain line (divergence); if negative one-surface and concave sections pairing convergent lines (convergence); if the value is zero – flat surface.

Changes in extent and topography of vineyards and estimation of its influence on historic soil loss in Eger Wine Region using GIS methods

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Water erosion is considered as one of the most serious environmental risk of vineyard cultivation. The rate of soil erosion is extremely affected by the type and duration of land farming. Inappropriate land use practices and agrotechnics can increase erodibility. In this study, we examined the historic changes of the vineyards extent, in order to estimate the duration of cultivation. On other hand soil erosion rates using Revised Universal Soil Loss Equation (RUSLE) were calculated and the calculated data extended for all recent vine producing areas of Eger Wine Region applying GIS. The changes of vineyards extent were examined based on historic maps depicting four periods as 1806–1869; 1869–1887; 1944 and 2011. The content of maps were digitalized and the main morphological properties (e.g.: aspect, slope, elevation) were defined based on DEM. According these data the cultivated vineyards of each investigated periods were classified and the long-term vine producing sites identified. For the implementation of the RUSLE model topographic maps, primary soil data and thematic map's data were used. The RUSLE factors (soil erodibility, LS, cover-management and support practice factor) and estimated soil loss were calculated in GIS environment. With the calculated erosion rates, and the estimated duration of cultivation, the soil loss caused by historic erosion due vineyard cultivation were estimated.

Degradation monitoring and assessment – Main Soil Unit 08

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The Soil Quality Evaluation Update – Assessment of the Soil-Ecological Units according to Act. No. 327/1998 Coll. and Act. No. 546/1998 Coll. is a crucial for 1. Determination of basic rates of official prices of the agriculture land (Act. No. 441/2013 Coll.), 2. Assigning of average prices of agriculture land to particular cadastres (Act. No. 298/2014 Coll. , Act. No. 432/2016 Coll.), 3. Land valuation and assessment of the land consolidation requirement according to Act. No. 139/2001 Coll. , Act. No. 13/2014 Coll.), 4. Definition of land conservation classes (Act. No. 48/2011, Act. No. 150/2013 Coll. – proceeding law No. 334/1992 Coll. , No. 41/2015 Coll.). The basic evaluation tool – the soil-ecological evaluation unit (BPEJ) is represented by five digit numeric code (1 – climatic region, 2 – main soil unit (78), 3 – slope and exposure, 4 – content of rock fragment and soil depth). Main Soil Unit (MSU) 08 includes the eroded soil. The degraded soil represented by MSU 08 includes soils developed on loess, loess layers, loess loam or slopes (7–12°) with a surface erosion. MSU 08 includes such areas where we can find more than 50 % of typically washed off soils. For MSU 08 is a typical cultivation of transition soil horizon (h/P – A/C) or parent material (especially loess). Soils with code 08 were classified as medium heavy (texture – loamy, sandy – loam), with no debris or low content of debris, with admixture of terrace gravel and represent the Genetic soil classification unit – Haplic Chernozems (CH), Haplic Luvisols (ha LV), Albeluvisols (AB), Luvic Cambisols (lv CM). The total area of MSU 08 in the Czech Republic (after updating) is 106 915 ha.

Optimization of methods for the assessment of vulnerability to wind erosion and proposals of protective measures in intensively exploited agricultural countryside

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Due to the intensification of the occurrence of extreme meteorological phenomena, we can expect the intensification of the wind erosion in the areas with the highest risk of the presence of drought. The wind eroison can thus become a significant factor influencing agricultural crop production, increasing drought of the area and last but not least the life quality in these areas. It is necessary to determine the criteria to setting of the conditions of the farming in these areas as with the water eroison in the DZES principles. By this project the issue of the risks of the wind eroison development will be dealth with from the viewpoint of the analysis of phenomena influencing the wind erosion development (pedoclimatic conditions, land using) and from the viewpoint of resolving the efficiency of the measure against its negative effects in the context of climate changes. The novelty of this resolving is in the using of the new mobile and aerial imaging technologies for the assessing of the line elements influence on the surrounding agroecosystems and the using the new air flow monitoring and carrying particle method. The assumption is the creation of SW modul of planning proposals of the comprehensive – agrotechnical, technical and organizational – measures. The application output is the implementation of the acquired knowledge to the SW projects enabling the assessing the level of the area erosive threat, the proposing of appropiate measures and assessing of the efficiency with regard to predicted climate developments including the methodologies applicable to landscape planning (landscapping, territorial plans). For facilitation of access to information and the achieved results (underlying maps, SW application) there will be created special portal for the designers, expert public and research needs on the SOWAC-GIS website.

Evaluated soil-ecological units and their significance for soil and landscape

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In the 1970s, a system of assessment and mapping of agricultural land resources was established in Czechoslovakia using evaluated soil – ecological units (ESEU). In the 1970s and 1980s, all agricultural land was mapped to „soil quality“ maps at a scale of 1:5000. This classification is still used in the Czech Republic with minor modifications. The map database is in vectorized form and is constantly updated. The evaluated soil – ecological unit gives detailed information not only about the soil production quality of the area but also about the soil – genetic, soil – ecological, soil – retention, geological, morphological, climatic and hydrological characteristics of the habitat. It is possible to derive the potential soil retention capacity, the capacity of the soil to bond contaminants, carbon, etc., soil filtration capacity for various substances, erodibility (which is essential in terms of environment, water management and economy), degree of erosion, evaluated soil – ecological unit is used for land appraisal and land use, land-use planning, real estate management, transfer and valuation, ensuring public interests in the territory, designing activities (eg land adjustments, adaptation to climate change, etc.) restitution, forensic, research and strategic purposes. ESEU helps creating conditions for soil protection, property rights correction, landscape improvement and adaptability, thus contributing to the creation of a functional and sustainable landscape.

Data collection and methodology design for drought prediction in Zahorska lowland

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As part of the project APVV-15-0489„Analysis of drought by multi-criteria by statistical methods and data mining from the viewpoint of prevention structures in a landscape“, soil moisture monitoring was established in Záhorská lowland. In Záhorská lowland, the following monitoring sites were selected in the Morava River basin: Veľké Leváre, Kostolište, Jakubov and Vysoká pri Morave. The locations were selected according to the soil texture and depth of groundwater level under the terrain. During the vegetation period, the monitoring interval was 14 days and out the vegetation period, the monitoring interval was monthly. To improve the calibration of the neutron method used for soil moisture measurements, soil samples were taken for gravimetric determination of soil moisture. Disturbed and undisturbed soil samples were taken to determine the hydro-physical properties of the soil. In 2016–2017, saturated water conductivity, retention curves and soil texture distribution were determined. The results of the monitoring during the year will be processed into tables and the water storage in the soil will be evaluated for each individual soil horizon. A database of annual soil moisture, soil water storage and groundwater depths will be created from the results. Based on the results of the measurements, some economical irrigation technologies will be designed to provide enough water for plants during the growing season.

Investigation and remediation of contaminated sites by means of geophysical methods

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Contamination, in relation to land, water or a site, means having a hazardous substance present in land, water, at above background concentrations that presents, or has the potential to present a risk to human health, the environment or any environmental value. In order to identify, record, manage and clean up the contamination sites it is needed to identify the primary sources (i. e., original release location), release mechanism (e. g., leaching, volatilization, etc.), secondary sources (e. g., high concentration areas that represent continued subsurface hazardous sources) and exposure mechanism (e. g., ingestion, inhalation) to actual or potential receptors. Next steps are needed: (1) Identification of primary source of contamination, (2) specification of hydrogeological setting of the site, (3) determination of exposure pathways and receptors, (4) and elaboration of conceptual site model diagram in order to (5) manage the risk at contaminated site. Survey of contaminated areas calls for (a) Information about subsurface properties of the territories of interest and its spatial distribution to characterize the basic physical properties/parameters needed for decision making process, (b) simple, available, reliable, fast and cost/effective methods to supply such an information's and, c) non-invasive and not-direct methods of survey/site investigation. The geophysical methods, such as electrical resistivity (ER) and ground penetrating radar (GPR) to gain information of direct value to required hydrological models, as they to bridge the „point" with larger scale information. But, we cannot use geophysical imaging alone, but geophysical data fusion with other data is needed via Inversion, interconnection (calibration with standard local scale hydrogeological/soil physical parameters) to provide quantitative and qualitative spatial information, which enable to elaborate conceptual site model. This contribution is the result of the project implementation APVV-15-0176 awarded by the Research and Development Agency.

GHG mapping over cultivated fields in ground and aerial measurements – project assumption

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Soil CO_2 emission is strongly depended on many factors such as temperature, moisture, carbon content, but also vegetation. In consequence, the fluxes of this gas show seasonal fluctuations. Commonly used agricultural practices influence the CO_2 emission. One of them is tilling the soil before planting which has to take into account many factors such as micro-climatic parameters (soil temperature, precipitation), soil organic carbon content, soil texture, crop type, duration of no tillage, nitrogen fertilization, crop residue management, and crop rotation. One of the objectives of the project entitled "Elaboration of innovative method for monitoring the state of agrocenosis with the use of remote-sensing gyro system in terms of precision farming" is to elaborate remote-sensing methods to evaluate spatial distribution of GHG concentration over the fields under varied agricultural practices. Through analysing the observational data from gyrocopter we will be able to ascertain the distribution of CO_2 and CH_4 at field scale, and acknowledge how the sources and sinks of these gases vary with seasons, years, and locations. Vertical profiles of CO_2 and CH_4 will be measured with a cavity ring-down spectrometer (CRDS) on a gyrocopter from near ground level up to the upper height of the boundary layer (determined individually for actual surface and meteorological conditions). The proposed method will be calibrated and validated by point measurements of CO_2, CH_4 and N_2O fluxes using dynamic chambers and ultra-precise greenhouse gas analysers (Los Gatos Research, USA). The presentation is co-financed by the National Centre for Research and Development under the program BIOSTRATEG, contract number 298782 „Gyroscan."

Magnetism of soils applied for estimation of erosion at an agricultural land

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Soil erosion is one of the major concerns in sustainability of agricultural systems in different areas. Therefore there is a need for suitable innovative indirect methods of soil survey. One of this methods is based on well established differentiation in magnetic signature with depth in soil profile as a result of „in situ" formation of strongly magnetic iron oxides. The concentration of this "pedogenic" component varies with the depth of the soil profile, reflecting changes in microenvironmental conditions due to profile development. Values of magnetic susceptibility, measured on regular grid directly in the field, can be used to estimate soil loss as a result of soil erosion. The aim of this study is to evaluate suitability of magnetic method to assess soil degradation and construct maps of cumulative soil loss due to erosion at morphologically diverse area. Dominant soil unit in the investigated locality in Southern Moravia is Chernozem, which is gradually degraded on slopes to regosols. The site was characterized by a flat upper part while the middle part, formed by a substantive side valley, is steeper (up to 15°). Here the original topsoil was strongly eroded and mixed by tillage with the soil substrate (loess). Differences between susceptibility values in undisturbed soil profiles and magnetic signal after uniform mixing of soil material as a result of tillage and erosion are fundamental for the quantification of soil loss. Our map of cumulative soil erosion shows maximum removal of soil material around 100 cm in the steepest parts of studied locality. The magnetic method is very well applicable especially at Chernozem areas. In this case represent useful and fast technique for quantitative estimation of soil erosion.

The effect of postdisturbance management on soil microorganismus at the windthrow plots in Tatra Mts. (Slovakia)

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Climate change may considerably affect terrestrial ecosystems because of natural disturbances such as flooding, fire, windthrow, bark beetle damage, etc. The present study focuses on the responses of soil microorganisms to the different post-disturbance management of windthrow plots during the 10-years period. The study was performed at four research plots – a) reference plot with spruce stand not affected by windthrow; b) windthrow plot with extracted fallen trees; c) windthrow plot damaged by wildfire; d) windthrow plot without extraction of fallen trees left for spontaneous succession. Soil samples were taken from the A-horizon during the vegetation periods 2006–2014. In soil samples, standard physico-chemical characteristics and characteristics of microbial community (microbial biomass, basal respiration, SIR, N-mineralisation, richness and diversity of microbial functional groups based on Biolog assay) were determined. The results indicate a gradual recovery of microbial community at all windthrow plots. Ten years after the disturbance we observed still significant differences in microbial characteristics between the plot affected by fire (FIR) and the other plots with higher microbial activity at the FIR, while no significant differences were found among the extracted and non-extracted plots. The results showed that at a higher altitude the effect of fire on soil microorganisms is more distinct than removing or not removing of fallen trees and persists even over a decade. Richness and diversity of microbial functional groups did not differ between plots, but they exhibited clear temporal shifts. Abundances of some microbial functional groups as measured by specific substrate utilisation also showed temporal trends: while the utilisation of α-cyclodextrin declined from year to year, the utilisation of other substrates (L-arginine, L-asparagine, D-mannitol, etc.) increased with time. ***Acknowledgement:*** This study was supported by the grants no. APVV-15-0176 and APVV-14-0087.

Effect of liming onto soil biological parameters

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Soil reaction, soil organic matter stability, basal soil respiration and respiration induced by substrate (N/B, G/N ratios) were studying after liming of Dystric Stagnosol under permanent grassland. Field experiments were conducted during the period 2014–2016 on the experimental plots of Mendel University in Brno, locality Kameničky, Czech Republic. Vaisala GMT 222 device was used for basal soil respiration measurements. Total organic carbon content was determined by oxidimetric titration method. Fractional composition of humic substances was determined by short fractionation method. Soil pH was measured by potentiometric method. Results showed that studied biological soil properties were highly affected by soil reaction. Soil reaction was strongly acid. Lower acidity was typical after liming. High content of total organic carbon and low content of total nitrogen was determined. Content of humic substances was high but their quality was low. Ratio of humic and fulvic acids was less than 1. Humification degree was low. Higher physiological utilization of nitrogen was achieved after liming. Results also indicated low quality and stability of humic substances, lack of nitrogen and high intensity of mineralisation after liming of acid soils under permanent grassland soils.

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The effects of tree species and substrate on biological soil properties and carbon sequestration in reforested post-mining soils

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The effects of tree species and parent material (substrate) on carbon and nitrogen stock and soil biological properties, such as fauna activity (described based on soil thin section), bacterial and fungal community (phospholipid fatty acid – PLFA, and ergosterol content) and soil respiration, were studied. Three post-mining sites from Poland on the following substrates: mixed quaternary sands and neogene clays in Piaseczno; quaternary loamy sands and loams in Szczakowa; and neogene acidic sands in Bełchatów were investigated. Sites were afforested within monocultures of pine, birch, oak, and alder. The samples were taken from the fermentation layer (Oe) and mineral soil layer (from 0–5 cm beneath the Oe – A layer). In both studied layers, mentioned biological properties and basic soil properties such as: pH and C, N contents were analysed while soil texture and faunal activity were determined in A layer only. In the Oe layer, fungal decomposers play a lead role, and their activity and soil respiration were affected both by tree species and soil substrate. In A layer most of the biological properties was affected by soil substrate. In A layer, however, bacteria activity was predominated and was affected by tree species and substrate. C stock in A layer were positively correlated with bioturbation caused by soil macrofauna. In contrast, C stock was negatively correlated with the fungal to bacterial ratio (F : B ratio). Fauna activity was the best predictor of C stock and it was also positively correlated with total microbial biomass and negatively correlated with F : B ratio. Bacterial biomass was the best predictor of N stock.

Detailed analysis of land cover changes as a factor of soil organic carbon storage dynamic in arable land

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Soil organic carbon (SOC) is important soil constituents having impact to many soil and ecosystem processes. In agricultural land, in addition to the quantity and quality of biomass and the crop management, the land cover types and its changes between cropland and grassland, strongly affect the overall dynamic of organic carbon in the topsoil. Determination of the total SOC storage in the agricultural land and its time changes is thus conditioned by the knowledge of the spatial temporal changes of the land cover not only within the agricultural land but also conversions between the agricultural and non-agricultural land cover types must be considered. In this study we are reconstructed state of land covers and its changes in Hanušovce nad Topľou cadastral area in North-East Slovakia during 1950 –2016 time period. For land cover evaluation in 1950, 1955, 1970, 1980,1983,1987 and 1995 historical military aerial photographs were used. Combination of aerial orthophotos and national Land Parcel Identification System database (LPIS) are source data for land cover reconstruction after 2000. All period of land cover was digitalized into vector data format in geographic information systems (GIS) environments. We have analysed the area representation of agricultural land, the relationship of arable land and grassland and also conversion between agricultural and non-agricultural land. Detected changes were quantified, and the spatial distribution of land cover types will be used as a data source for SOC stock modeling using RothC 26.3 turnover model.

The effect of organic matter manipulation on soil humus carbon content (Síkfőkút, Hungary)

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We examined the effects of litter input on soil humus carbon content and soil dynamic processes in a Quercetum petraeae-cerris forest in northeastern Hungary, at the Síkfőkút DIRT experimental site. The main objective of DIRT is to explore how changes in the quality and quantity of detritus inputs affect SOM composition and content. We applied Control, in Double Litter plots the amount of leaf litter was doubled. In No Litter the aboveground detritus, in No Roots the living roots, and in No Inputs plots both the aboveground detritus and living roots were totally removed. According to our results the total humus carbon content was the highest in the DL treatments and the lowest in the NL treatments compared to the Control. Additional litter input increases the total humus carbon content of soil, while total humus carbon content of soil decreases as a consequence of litter removal. The larger amount of light fraction of humin acids-C (haC) and fulvic acids-C (faC) were measured in the soil of DL plots. The smallest amount were measured in the NL plots but the NR and NI plots showed similarly low values. The heavy fraction of haC were the larger value in Co plots, in the DL plots were measured lower value. In withdrawal plots were the lowest the heavy fraction of haC content in soil samples. In NI plots the withdrawal of aboveground and belowground litter caused the turned around of the humic acid: fulvic acid ratio, and the amount of fulvic acid were higher than the amount of humic acids. Litter thickness can reduce the effects of soil temperature extremes and moderate minimum and maximum temperature values. These differences in soil microclimate may have a highly significant, but unrecognized effect on soil carbon balance through effects on microbial processing of litter and soil carbon.

Soil organic carbon stock change at the forest-grassland border zone

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Results of a case study aimed at assessment of soil carbon stock change related to land use change are presented in the contribution. Change of grassland to forest land is rather common land use change in Central Europe. This change can be a natural process if extensive pastures or meadows are abandoned. Rather specific and usually neglected is slow expansion of forest even if the neighbouring land parcel is managed as meadow. Due to technique of the mowing, the grassland just next the forest stand edge is not mown and seedlings of trees can survive and grow. In this way forest edge can shift several meters or even tens of meters within the decades of years. Soil samples were taken from transections across the margin of forest stand (hornbeam, oak, lime tree) in Central Slovakia. Two sampling points were in old forest stand (forest remaining forest), two in the zone of forest margin in former grassland (grassland changed to forest) and two in the grassland (grassland remaining grassland). Results of C concentration as well as SOC intensity show trend of soil carbon stock increase in the transition zone. Values of SOC in soil to the depth of 10 cm (which can by most strongly influenced by vegetation) in transition zone were very similar to the stock in forest and significantly higher than in grassland. The total calculated SOC density in soil (0–10 cm) was 46.3±11.9 $Gg.ha^{-1}$ in forest, 45.4±8.5 $Gg.ha^{-1}$ in transition zone (expanded forest area) and 34.2 ± 12.9 $Gg.ha^{-1}$ in grassland. The stock of organic carbon in the overlaying organic layer is 3.5 ± 1.0 $Gg.ha^{-1}$. According to the available information, the process started about 50 years ago. This means that the annual SOC accumulation rate is about 0.28 $Gg.ha^{-1}$.

The impact of flood event in year 2013 on the contamination of the agricultural soils

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Alluvial soils (fluvisols) along the rivers usually belong to the most fertile soils used for agricultural purposes. They are naturally formed by transportation of sediment and its deposition in floodplain areas during flood events. Floods could potentially act as a secondary source of contamination for the fluvisols. More frequent occurrence of stronger floods in Europe in recent years increases the need for the assessment of regularly flooded areas in order to understand and predict the possible toxicological and ecotoxicological consequences of such events. The present study aimed to define the impact of the flood event in year 2013 on soil characteristics and contamination in the agricultural soils in Bohemia regions in the Czech Republic. A total number of twenty-three soil samples from agricultural soil located in Bohemia regions in the Czech Republic were collected before (years 2011 and 2012) and after flood event in year 2013. Soil samples were characterized for physicochemical parameters, concentrations of heavy metals and persistent organic pollutants. The impact of flood on soil contamination varied among localities and both decrease and increase of contamination levels were observed. Prevention limit values for agricultural soils (Czech Decree no. 153/2016 Coll.) were exceeded at nine localities after flood event in 2013. Increased soil contamination was mostly connected to local sources, i. e. chemical facilities. The highest increase was recorded in case of PAHs and DDT. Moreover, flood had tendency to increase mobility of metals (As, Cu, Ni, Zn). At four localities, flood event decreased soil contamination below the prevention limit values (Czech decree 153/2016 Coll.). The results of this study show the importance of incorporation the fluvisol contamination in the risk assessment focused on flood effects.

Effect of logging residues processing and mechanical soil preparation on the content of selected elements in a forest soil as measured by X-ray fluorescence spectrometry

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Elementary composition of soil is an important factor of the behaviour of forest ecosystem and sustainability of forest production. It can be influenced by forest management. This contribution presents a comparison of different logging residues processing on the content of selected elements in a forest soil determined by X-ray fluorescence (XRF) spectrometry.
A field experiment was established on natural pine stands with sandy Podzol (Spodosol) soils in Central Bohemia. Four types of logging residues processing were applied after final harvest: (1) burning of logging residues in the terrain, (2) removal of logging residues, (3) bunching of logging residues into heaps, and (4) chipping of wood residues in the terrain. Large-scale soil preparation with forest plough was performed. A half of the plots were additionally fertilized with wood ash. Soil samples were collected three years after the treatment and planting new trees from the uppermost soil layer (0–5 cm); they were air-dried and measured with a portable XRF spectrometer Delta Premium.
Bunching of residues into heaps led to a decrease of As, K, Fe, Mn, Pb and Zn in soil. Burning of logging residues increased the content of As, Fe, Zn and Pb. Surprisingly, residues removal did not cause a significant decrease of most elements in the soil. Chipping of wood residues in the terrain did not led to a significant decrease or increase of the content of most elements. Additional fertilization with wood ash increased the content of most elements, except Si and Mo.
Management of logging residues was shown to be a crucial factor of soil element composition. XRF spectrometry proved to be a fast method for the determination of element content in soils. However, numerous elements were mostly under the detection limit of the instrument (including Ca and Mg).

Impact of sodium dodecylbenzene sulfonate (SDBS) on soil health deterioration

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Sodium dodecyl benzene sulfonate (SDBS) as an anionic surfactant is added to soil by application of sewage effluent/sludge as well as pesticides and negatively affects biological properties of the soil and therefore its health. The aim of this study was to assess the impact of SDBS on some biological indices including microbial respiration, microbial biomass carbon, microbial biomass nitrogen and microbial biomass phosphorus in a soil from Osku area. A factorial experiment with two factors including SDBS levels (0, 0.01, 0.05 and 0.25 %) and time intervals (2, 7, 15, 30, 60 and 90 days) with three replications was conducted. Soil microbial respiration decreased over time in each level of SDBS and the corresponding values were significantly lower at 0.01 and 0.05 % of SDBS than those at zero and 0.25 % of SDBS. This trend was also observed for soil microbial biomass carbon. Being soil microbial community under stress at 0.01 and 0.05 % of SDBS and induction of tolerance at 0.25 of SDBS could explain these results. Soil microbial biomass nitrogen on the second day of incubation increased with increasing the SDBS level and decreased over time in all levels of SDBS (expect control). Increasing microbial nitrogen biomass in the SDBS treated soils might be due to increasing the activity of Azotobacters or other nitrogen-fixing bacteria which are less sensitive to SDBS and are able to feed through it. The highest values of microbial biomass phosphorus were related to SDBS treated soils on the second day of incubation, but the values severely decreased after one week and then the changes were negligible. Regarding the phosphate solubilization potential of Azotobacters, most probably it is possible that the stimulated growth of these bacteria in response of SDBS application could be responsible for solubilization of soil insoluble phosphates and their incorporation into the microbial biomass.

Available microelements in agricultural soils in Czech Republic

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Due to high yields per hectare carry away from the soil, in addition to large quantities of macroelements, also a greater number of microelements. There is an increased risk of passive soil micronutrient balance in soils poorly supplied with a particular natural element, in soils degraded for its absorption and also in the case of perennial crops, where the habitat is permanently and unilaterally deprived of a certain element specific to the crop. Conversely, there may be an increased level of such elements in the soil, which poses a potential risk of harmfulness or even toxicity to higher animals and plants. For both animals and humans, molybdenum (Mo) and copper (Cu) are primarily toxic. Generally, solubility increases in more acidic environments leading to better absorption of iron (Fe), manganese (Mn), zinc (Zn), Cu and boron (B). Conversely, absorption of Mo decreases. The reason for performance of regular samplings is requirement to assess a state of soil elements and to consider changes in a long-term period and also to consider risks for the environment and food chain. For this study was selected plots on different agricultural soils in the Czech Republic by Central Institute for Supervising and Testing in Agriculture (ÚKZÚZ). 214 representative plots compose monitoring network called Basal Soil Monitoring System (BSMS). The plots are located on arable land, grassland, orchards, vineyards and hop gardens. Soil samples are taken in regular six-year periods since 1995. There are analysed available contents of boron (B), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn).

Application of magnetic susceptibility as an indicator of physical and chemical degradation caused by dust deposition

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The forest topsoil is subjected to physical and chemical degradation due to deposition of urban and industrial dusts and landfilling as well as physical disturbances being a relict of former cultivation, clear cutting and afforestation methods. These disturbances are observed in all natural and semi-natural forests across the Europe but most intensively in urban forests surrounding the cities and industrial areas. Soil magnetometry is an innovatory method used to determine the level of industrial and urban dust deposition together with relevant potentially toxic elements (PTEs) as well as for precise location of pollution "hot spots". Technogenic magnetic particles (TMPs) included in different kind of anthropogenic dusts deposited on the soil surface increase magnetic susceptibility of polluted topsoil. This effect can be easily measured "in situ" by applying geophysical (geomagnetic) technique – soil magnetometry. This technique can be performed inexpensively and fast with high spatial resolution in local (for individual trees, for areas around point pollution sources) or regional scale (for whole regions or countries). Application of combined magnetic-chemical analyses together with geostatistical methods (co-kriging) can deliver a more significant results of the spatial distribution of pollution than chemical testing alone. High correlation coefficients between magnetic susceptibility and PTEs contents explained in the form of Pollution Load Index improve significantly the precision of estimation of potentially polluted forest topsoils. The study revealed that in every case when the κ value is over 100×10^{-5} SI magnetic units the concentration at least one of element exceeds the threshold value. The knowledge about the quality of forest topsoil and use of the tool for precise delineation of areas with considerably high anthropogenic physical and chemical disturbances. In such areas κ value is a good parameter to estimate the thickness of contaminated layer and assess a spatial range of polluted area.

POSTERS

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Revitalization measures

Evaluation of ecological effects of land consolidations

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After the year 1989 state and cooperative farms were disbanded and the soil came back into private hands in the Czech Republic. To excite new private agricultural business and farming it was necessary to clear up the land ownership, consolidate fragmented and narrow parcels, make blocks of fields accessible. For this purpose the process of the land consolidation started. Soil, water and environment conservation is an important and publicly needful aspect of every complex land consolidation. Hence land consolidation creates a space for the designing and realization of the erosion and flood control measures. Land consolidation designs are supported by the state and the EU funds are used for the realization of protective and ecological measures. Although the land consolidation process does not advance as quickly as would be requisite, it brings unquestionable positive results. Finished and running projects are aimed at cadastres with highest interest of farmers to manage their business on available consolidated plots. But it is only one of the points of views. Land use adjustment projects aims simultaneously at the areas of the significant erosion and flood threat, where societal interest is to enforce and build measures of soil and water conservation. A method of multicriterial analyse was used to evaluate complex effect of implemented measures of land consolidations. Both technical efficiency and affection of landscape functions were considered. Evaluation involved factors with different character: efficiency in reduction of soil erosion and flood risk, influence on landscape ecological stability, aesthetic and patency. The developed method was tested on 25 model cadastres with finished land consolidation. Obtained results demonstrate that effect of implemented measures in the soil and water conservation is very good and its influence on chosen landscape non-production functions is positive.

Dimensioning of contour and riparian buffer strips

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Localization, width, and vegetation cover of buffer strips depend on their planned purpose. Anti-erosion contour buffer strips, as their name says, are often placed in the direction of contour lines. The distance between them, or distance of the first contour buffer strips from watershed divide may not exceed so-called critical slope length – Lcr, which we calculate with using of the USLE equation. In the Slovak Republic, we use two equations for the calculation of the minimum width of CBS-s – Dmin, which were derived by Čablík-Jůva (1963) and Antal (1986). In the first equation is CBS width a function of the Lcr, design rainfall intensity, infiltration capacity of soil in a bonded slope and infiltration capacity of soil on CBS. In the second equation is the CBS width a function of Lcr, height of design rain, the value of the CN of bonded slope CN and the CN value of CBS. Consideration that the localization of RBS is already determined by location of the stream, it is necessary to dimension their width, eventually propose vegetative species cover. Currently is used no formula to calculate the width of the RBS Slovak Republic. There are only recommended values of RBS width, where a minimum value of RBS width is 4.5 m and maximum recommended value of RBS width, which is grassing, is 26 m, depending on the inclination of the slope and on the erosion intensity of the adjoining slope (Muchová-Vanek et al, 2009). Nowadays we are working on the equation for calculation of the minimum RBS width – Dmin, which takes into account not only the characteristics of adjoining areas (e. g. length, slope and slope exploitation, intensity and duration of design rainfall, soil hydrologic properties...), but that would take into account the required RBS functions (e. g. required reduction of soil).

The efficiency of vegetative buffer strips in water pollutants control

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Vegetative buffer strips contain a special plant species being passed by the flow before getting into the water bodies. The main aim of this study is to evaluate the impact of three different types of vegetative buffer strips including vetiver grass, native turf grass and combination of vetiver--turf grass to reduce the surface water pollutants including nitrate and phosphate in Mazandaran province, Iran. Twelve 1×10 m experimental plots were used affected by two artificial runoff rates equal to the runoffs generated by a precipitation with 25 and 100 years return period, during one-year data collections. The results indicated that the efficiency of vegetative buffer strips containing both vetiver grass and turf grass affected by the runoff rate. The results indicated that runoff generated by 25 years return period precipitation was higher than the buffer strips affected by the runoff rate equal to the runoff generated by 100 years return period precipitation. Also, it was found that the maximum efficiency of nitrate removal was seen in the treatment of vetiver grass. The treatment of turf grass showed a weak performance in phosphate removal compared with the two other studied treatments. As a final result, two studied plant species including vetiver grass and native turf-grass also showed different performances to reduce water pollutants.

Ecological farming – one of the methods to archieve zero soil degradation

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The natural property of each ecosystem is to be in balance with the other environmental compartments. This is the ideal harmonic state that human activity can easily disrupt. In the past, soil has not been considered as an integral part of the environment and it has been understood as a means of production. Only when improper land use has led to soil degradation or complete change in its properties, mankind has begun to deal with soil protection. Soil is exposed to a number of degradation impacts. The cause of soil degradation processes lies directly in the way it is used, which affects its ecological functions and consequently the stability of soil properties. Ecological farming using soil cultivation in circles, so called Agrokruh system is the way to grow healthy crops without heavy machinery and chemicals, how to live healthily in harmony with nature. It is better to invest in long-term into sustainable use of land growing healthy crops and producing tasty food. Ecological farming has positive impact on soil properties, especially on the physical properties of the soil. When comparing with traditional cultivation the differences are mainly visible in soil structure quality. Amount of agronomically valuable structure is higher in the soil from Agrokruh in the whole profile in comparison with soil with traditional cultivation. Amount of microaggregates (<0.25 mm) shows that soil with traditional cultivation has the highest portion of such aggregates in the depth from 20 to 40 cm. This is due to lower aggregates stability in water and can be result of soil cultivation by ploughing. Preliminary results of the nutrient regime assessment show that ecological type of cultivation in comparison with traditional one has sufficient nutrients level, despite the non-use of fertilizers. The main pros of this ecological farming are sustainable use of soil, protection of soil properties and soil biodiversity, as well as low energy consumption and low emissions production.

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Degradation of forest soil in the Český les Mts.

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The acidification of forest soils as the type of soil degradation have been occurred as the consequence of industry emission. The acidification is connected especially with the early 1980s. Increased tree productivity, possibly resulting from high N deposition and from the global increase of atmospheric CO_2, has led to higher nutrient demand of trees. As the soil supply was not always sufficient to meet the demands of faster growing trees, this could partly explain the deterioration of tree mineral nutrition and related soil acidification in terms of elevated aluminium and/or base cation leaching from the forest ecosystem. The very low values of available phosphorus in Mehlich III extract, which are within or below detection limit (3 $mg.kg^{-1}$) are detected very often through the survey of forest nutrition. To analyze the effect of low phosphorus in soil on forest health status, a method of Principal component analysis (PCA) including pH $CaCl_2$ value, total Cox and N content, available contents of P, K, Ca, Mg, Al, Fe and S in Mehlich III extract for organomineral horizon, contents of Al, B, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, N, Ni, P, Pb, S, Zn in the spruce needles in the natural forest region the Český les Mts., were used. Based on this analysis, using spatial kriging, aggregated maps depicting areas from low to high values of these parameters in soil and needles were built. Comparing with the forest health map it was found that, the degraded forest health status was connected with low-value stands of available phosphorus in the soil. As for phosphorus content in needles, the situation is not so clear, but we can find damaged stands with both low phosphorus in the soil and in the needles.

Impact of the revitalized network of channels on the dynamics of groundwater in the floodplain forest

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The floodplain forests are an important landscape-forming element in the South Moravian region. High biodiversity is caused by natural conditions, particularly by the soil layer made of fertile sediments of rivers' streams, by the favorable hydrological conditions and the humidity dependent on groundwater dynamics and by the specific climate. All of this has been affected for a long time by anthropogenic activities interfering with the hydrological and moisture regime of soils. After the construction of the water reservoirs„Nové Mlýny" on the Dyje River (Thaya), the water-management regulations of the Morava and Dyje rivers followed in the early 1980s. The previously almost regular inundations have been limited and the level of groundwater in the surrounding floodplain decreased by deepening of the newly created riverbeds and by their new bank barriers. The scrubbing of some forest stands caused by partial moisture stress was attempted by foresters in the early 1990s – they implemented the proposed revitalization measures. The channel system has been cleaned and modified to control their filling with water. In the case of low water levels in the channels there is no significant leakage of water into the subsoil due to the extremely low soil permeability of the bottom of the channel. By field experiments, it has been demonstrated that seepage of water in the canal occurs only at a higher state of„surface water" through relatively more permeable channel walls. The range of water leakage into the subsoil has been monitored and recorded over a time period of several days. The revitalization measures carried out by the Židlochovice Forestry Enterprise have proved to be important for maintaining the conditions for the sustainable development of floodplain forests, which are still among the most endangered forest ecosystems.

Soil erosion mitigation with native wood strand mulches

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Wood-based mulches are a preferred erosion control technique for forest lands because they can be constructed from biodegradable native wood products; however, research is needed to verify the effectiveness of new products prior to application. We use laboratory rainfall simulations (20-min, 50 mm/h) to investigate the effectiveness of two types of native (Iran) wood strand mulches (by products of *Alnus glutinosa* and *Fagus orientalis*) in reducing runoff and soil loss on treatments of different cover percentages (bare, 30 %, 70 %) and strand dimensions (16 and 4 cm in length; 1.5 cm wide). All applications reduced runoff and soil loss compared with the bare plots. The most effective application treatment was a 70 % coverage of the 4-cm shreds of either product. Shorter shreds were most effective because they maintained a diverse orientation by adhering to the surface during simulated rainfall, whereas the longer shreds realigned in the direction of flow, thereby limiting their ability to retard flowing water. The small shreds also facilitated the creation of micro-dams that blocked flow and promoted infiltration. Although the *Alnus* shreds were slightly more effective than the *Fagus* shreds at reducing runoff rate and soil loss, both were deemed effective native erosion control products when small shreds were applied at high cover rates.

3D Soil moisture interpolation with ArcGIS software

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Adaptation to climate change demands the optimal and sustainable water management in agriculture, with an inevitable focus on soil moisture conditions. In the current study we developed an ArcGIS 10.4. platform-based application (software) to model spatial and temporal changes in soil moisture in a soy field. Six SENTEK soil moisture sensors were deployed in an experimental field of 4.3 hectares. Soil moisture measurement at each location were taken at six depths (5, 15, 25, 35, 45 and 55 cm) in 60-minute intervals. Our application is a relatively simple and cost-efficient 3-dimensional soil moisture visualization software which is suitable to present the moisture dynamics of multiple soil layers and horizons in real time. The model is capable to spatially interpolate monitored soil moisture using the kriging technique. The time sequence change of soil moistures can be tracked by a Time Slider for both the 2D and 3D visualization. Soil moisture can be temporal changes can be visualized in either daily or hourly time intervals, and can be shown as a motion figure. Horizon average, maximum and minimum values of soil moisture data can be identified with the built-in tool of ArcGIS. Soil moisture spatial distribution can be obtained and plotted at any cross sections, whereas an alarm function has also been developed for tension values of 250, 1,000 and 1,500 kPa.

The effect of tree species on physico-chemical and biological soil properties

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The objective of the present study was to evaluate the effect of different tree species on physico-chemical and biological properties of soil at the locality Vrchdobroč (Central Slovakia). The study was performed in the pure stands of spruce (*Picea abies*), Douglas fir (*Pseudotsuga menziesii*), maple (*Acer pseudoplatanus*) and beech (*Fagus sylvatica*). Soil samples were taken in three stands of each tree species from the O- and A-horizons in five replications. Soil samples were analysed for basic physico-chemical (soil water content, soil reaction, carbon, nitrogen and base cation contents) as well as microbial (microbial biomass carbon, basal and substrate-induced respiration, N-mineralisation, catalase activity, richness and diversity of functional groups of soil microorganisms) characteristics. We found a significant effect of different tree species on most soil properties. While Douglas fir showed the most distinct effect on soil attributes in the surface O-horizon, soil properties in the A-horizon were affected mainly by maple. In Douglas fir stands we also observed the most distinct decrease of microbial activity from the O- to A-soil horizon in comparison with other tree species. The presented results indicate that the effect of tree species cannot be divided simply on the effect of broadleaves and conifer trees because within each group the tree species influence soil properties in a different way.

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Soil dehydrogenase activity at windthrow area with secondary succession

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Microbial enzyme production in the soil environment is essential for the decomposition and conversion of soil organic matter. Soil enzymes are important for maintaining soil ecology and soil parameters thus effect also soil health and quality and can be used as an indicator of shifts in soil quality or environmental stress. Activity of enzyme dehydrogenase (DHA) can be adopted as an indicator of microbial activity due to the presence in every viable microbial cell and participation in respiration metabolic pathways. The aim of the study was to evaluate soil organic matter content as a loss of ignition and soil DHA at plots with secondary succession and different vegetation cover. Soils were sampled at windthrow site in the Tatra National Park. Soil reaction pH (H_2O) at plots varied from 3,64 to 4,23. The highest DHA values were measured in the soil samples under blueberries (*Vaccinium myrtillus*) with an average value of 293 µg INTF/g dry soil/48 h. Soil sampled under raspberries (*Rubus idaeus*) showed an average DHA value 216 µg INTF/g dry soil/48 h and spruce (*Picea abies*) 194 µg INTF/g dry soil/48 h. The differences observed among the DHA and organic matter content proved the significant role of vegetation cover on the soil enzymatic activity.

Biofertilizer inoculation improve biochar effect on sandy soil with maize

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Application of biochar products is part of sustainable agricultural systems, still there is a discrepancy in literature about its positive and negative effects. Regarding the soil microflora an efficient protection is provided by the large surfaces, additional microbial inoculation therefore could enhance the positive and diminish the potential negative effects. The impact of increasing biochar doses was studied in pot and field experiments of using corn (*Zea mays*) FAO 370-es DKC 4490 (Monsanto) hybrid at slightly humous sandy soil. There were 3 different biochar doses (1–5–10 %) mixed into the soil with 4 replicates in the pots. Among field conditions the 4 and 10 t/ha biochar doses were applied. The abundance and activity of some physiological groups of soil-microorganisms was assessed by the most probable number (MPN) and fluorescein diacetate enzyme activity (FDA) methods. We found that doses between 5–10 % of biochar had positive effect for the soil microbial abundance and the soil-enzyme activity. Significantly higher yield had been produced also if we combined the biochar doses with a phosphate-mobiliser *Leucobacter* sp. plant-growth-promoting rhizobacteria (PGPR) strain, as biofertilizer inoculation. It is assumed also, that the optimal doses of biochar at any soil-plant ecosystems are highly dependent on several soil characteristics, i.e. soil humus content, cation exchange capacity, pH and soil-water level. Biochar proved to be valuable soil amendment in combination with beneficial bioeffector treatment. Supported by the EU-Fp7 BioFector (GA 312117) and the Piac-13 Biochar projects.

Effect of sewage sludge compost extract on the lupine-Rhizobium symbiosis

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Nitrogen (N) plays significant role in the development of plants as the main limiting factor of plant growth. Sandy soils usually have nitrogen deficiency however the nitrogen fixing microorganisms can fix the atmospheric N2. Production of artificial N-fertilizers has high energy demand therefore the sustainable agricultural methods pay attention to satisfy the plant nutrient demand without chemical fertilizers. The huge quantity of N_2 in the atmosphere could not be directly utilized by plants. So, the biological nitrogen fixing organisms, like plant symbiotic bacteria, play important role in supplying plants with nitrogen. Therefore, increasing the effectiveness of N_2-fixing symbiotic bacteria without decreasing the plant vitality could contribute to the sustainable agriculture. Nowadays, many effects of the sewage sludge compost extract are known from the literature: it can be used against plant pathogens or for increasing the plant production. We studied the effect of sewage sludge compost water extract in a pot experiment on the lupine-Rhizobium symbiosis in acidic sandy soil. The extract was produced under aerobic conditions and 5 treatments were used: 2 weeks before sowing, one week before sowing, at sowing, one week after sowing and 2 weeks after sowing. The compost dose was equivalent to 500 Lha^{-1} (1.57 ml pot^{-1}), in each treatment. In our work we present the effect of compost extract on the green weight, dry weight, the number on the roots nodule and the yield weight of white lupine (*Lupinus albus*). Our results show the stimulating effect of sewage sludge compost on the development of nodules.

Sorption and (bio)availability of DDE in soils amended with biochar

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Biochar (pyrolized biomass) has a high remediation potential for contaminated soils but due to alteration of soil properties, negative effects on soil biota may occur. To reveal the primary (remediation) and secondary (ecotoxic) effects following biochar amendment, sorption and bioavailability of p,p'-DDE in laboratory and field contaminated soils were assessed by polyethylene (PE) passive samplers, bioaccessibility was estimated using the XAD extraction method and ecotoxicity was determined following the ISO standardized Folsomia candida (springtail) toxicity test. Two biochars (wood and rice husk) originating from different sources and pyrolysis methods were tested at doses 0, 1, 5, and 10 % in soil. The two tested biochars showed similar sorption towards p,p'-DDE with the Freundlich sorption coefficients (KF; µg/L)n of 5.42 ± 0.24 for wood biochar and 5.43 ± 0.08 for rice husk biochar. In comparison to soil (KF of 4.00 ± 0.25), biochars sorbed the tested pollutant much more effectively. This suggests that biochars can be used for remediation of contaminated soils. Along with the sorption data, bioavailability and bioaccessibility of p,p'-DDE were measured. Both parameters decreased with increasing biochar doses as a result of p,p'-DDE sorption to biochar. Risk assessment was performed on biochar-soil mixtures (biochar dose up to 10 %) using springtails and measuring reproduction as an endpoint. Reproduction was observed to both increased and decreased upon biochar amendment of p,p'-DDE contaminated soils in comparison to non-amended p,p'-DDE soils. F. candida benefited from the reduction of p,p'-DDE bioavailability upon 1 % and 5 % biochar addition to contaminated soils while at 10 % dose, these positive effects were nullified by biochar-induced toxicity. The findings confirm the potential adverse effects biochars may have on soil organisms and the necessity of introducing soil toxicity tests into the biochar safety assessment.

Comparative evaluation of communal sewage sludge in pilot scale and industrial scale based on vermicomposting

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The proper management of communal sewage sludge is a priority aim in today's environmental protection. The vermicomposting means organic waste management, where we use worms in the conversion of organic material. Organic matter in the dewatered and digested sewage sludge including the conversion of *Eisenia fetida* worms are possible. The worms due to their metabolic processes use the old bacterial cells from the sludge, thus newer bacterial colonization can develop contributing to the acceleration of composting processes. The result is improved by vermicomposting the treated sludge nitrogen, phosphorus and potassium content, and reduces the number of pathogens. Determining these parameters in terms of additional importance for agricultural use. Previous 15-weeks for laboratory experiment based on the results of vermicomposting series pilote scale and industrial scale experiments were carried out under various environmental conditions. We examined the processes in pilot scale composting conditions in case of an open series and a closed environmental conditions. We examined the processes in industrial composting conditions in case of an open series of experiments covered and uncovered with straw and covered with geotextile. At the start of composting, half-time and end of the experimental period samples were taken, we determined the most important physical and chemical characteristics (pH (H_2O), dry matter content, organic matter content, total salinity, total nitrogen, total phosphorus content (P_2O_5), potassium content (K_2O) calcium, magnesium, humus content (H%), quality of humus, dehydrogenase enzyme activity). Twice a week the boxes checked for temperature and redox potential values characteristic of the oxidation-reduction conditions. In our poster presentation the pilot and industrial scale results are described.

Dynamics of chemical properties in the mine technogenic soil in five years reclamation

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The research of agro-technical and biological phases of soil reclamation by seeding and growing different agricultural crops was conducted on technogenic soil in Stanari coal basin. The aim of this survey refers to implementation of reclamation of technogenic soil in Deposol-plant-Rekultisol system on plateau at internal disposal area for overburden from Raskovac open pit in „EFT – Rudnik i Termoelektrana Stanari" (Republic of Srpska, Bosnia and Herzegovina). The survey task refers to examination of the dynamics of main chemical properties in the technogenic soil through five-years period reclamation (2011–2015). The analyzed chemical properties in technogenic soil are as follows: organic matter content, humus content, N, P_2O_5, K_2O. Biological reclamation is carried out by establishing the vegetation in two directions: seeding perennial grassland, and growing of annual arable crops. The research was conducted in a direct type of reclamation of the sandy-loamy Deposol adverse physical and chemical properties. Application of agromeliorative measures and techno-pedogenesys process in five-years has resulted in forming Rekultisol with improved chemical properties. The initial process of humification and mineralization are started in Rekultisol formed. The content of organic matter in surface layer of Rekultisol (at 20 cm) has the average increase by 2,9 times. From the initial zero value of humus content in the end of the survey amounted to 0.36 %, content N 0,022 %, and content P_2O_5 2,17 %. The content of K_2O has the average increase by 7,15 times. Technological fertility of Rekultisol represents the result of implemented measures of reclamation and agrotechnic that, depending of time distance, with the leading climatic impact, affect the technogenic parent substrate.

Changes of soil organic matter in land transformed from arable to forest

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In Arboretum Mlyňany were investigated changes in selected soil organic matter characteristics in 0.0 – 0.2 m layer of Stagni-Haplic Luvisol, which was long term used as arable, but in year 1964 it was afforested. Selected characteristics of soil organic matter were studied under dense growths of thuja trees and Chinese junipers and compared with adjacent soil, which remained used as arable (control). It was found, that growing of exotic trees on land that was previously used as arable had resulted to the significant (by 1.7 times under thuja trees and 2.3 times under junipers) increase of total organic carbon compared to arable land. $KMnO_4$ oxidisable labile organic carbon (CL) and hot water-soluble carbon (Chwl), even more indicated the differences between cultivated and afforested soil. CL was 2.2 and 3.1; and Chwl was 3 to 4.5 times higher in soil under thuja and juniper trees than on arable land. The conversion of cropland to forest led to lowering of soil organic matter quality, what is typical for forest, compared to cultivated soil. On the other side, the humus quality between examined sites differed only minimally. The results of the work suggest that vegetation type and land uses significantly influenced studied soil organic matter properties.

Risk assessment of biochar: a novel soil amendment and remediation tool

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Biochar is a carbonaceous material obtained by pyrolysis of organic waste materials that provides an abundance of surface functional groups and a high surface area, the combination of which makes biochar an efficient and important sink for a variety of dissolved contaminants in soils. It has been proposed as a soil management strategy to mitigate global warming, to improve crop productivity and to prevent soil degradation. Apart from the effect on pollutant immobilization and reduction of pollutant bioavailability, biochar application to soil influences physical-chemical properties of soils (pH, sorption capacity, water holding capacity, porosity, nutrient availability), greenhouse gases emissions, and nutrient leaching. Moreover, there is currently a lack of data concerning the effects of biochar on soil fauna.Therefore, the risk assessment was performed with the soil organisms (nematodes). A maximum application dose (MAD) of biochar to be added to soil without compromising its suitability for nematodes was established following the addition of biochar at up to 20 % dose to control (Lufa) soil and p,p′-DDE-contaminated cambisol, at adjusted and natural pH conditions, and at low (LBD) and high (HBD) bacterial densities. Growth decreased in the order: LufaHD ≥ CambisolHD ≥ LufaLD > DDE-cambisolHD > DDE-cambisolLD and was negatively influenced at biochar doses ≥ 5 % especially in combination with low bacterial density. DDE caused significant toxicity to nematodes in terms of both growth and reproduction. Reproductive toxicity was efficiently reduced in the high--bacterial density treatment upon the addition of biochar at 1 % and 5 % while porewater concentration of DDE significantly decreased at biochar doses ≥ 5 %. Our data suggest that biochar cannot effectively counteract pollutant toxicity at limited food supplies and at doses increasing 5 % due to biochar-induced secondary toxic effects not related to pH effects.

Properties of technogenic soils (Technosols) developed from ashes from lignite-fired „Bełchatów" thermal power station, Poland

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Technogenic soils (Technosols) developed on the surface of ash disposal site of the „Bełchatów" thermal power station, Poland were studied in order to identify transformations of soil properties within 30 years of pedogenesis. Fresh (unweathered) fly ash (FA) and bottom ash (BA), as well as three soil profiles differing in age (from a few months up to about 30 years) were examined. Standard pedological methods were applied in order to determine the properties of the studied samples. "Fresh" ashes were characterized by high pH (11.0 – FA, 8.7 – BA), low content of carbonates (1.5 % in both ashes), variable concentrations of TOC (1.2 % – FA, 6.9 % – BA), and very low contents of total nitrogen (0.04 %). Electrical conductivity (EC) was 2.6 and 2.1 $dS \cdot m^{-1}$ in FA and BA, respectively. Young Technosol (age: several months) had the pH 9.2–10.0, contents of carbonates were in the range 2.4–3.3 %, TOC 1.3–1.7 %, and total nitrogen less than 0.04 %. EC in young Technosol was in the range 2.7–4.0 $dS \cdot m^{-1}$. There was no plant cover present on that soil, and no well-developed genetic horizons were distinguished in the profile. Old Technosols (age: from a dozen up to 30 years) had lower pH (form 7.9 up to 9.1), and, in general, higher contents of carbonates (from 1.5 to 7.9 %, 4.3 % on average) than fresh ashes and the young Technosol. Old Technosols contained high concentrations of TOC (up to about 38 %) and total nitrogen (up to 0.9 %) in the topsoil, where O and A horizons developed due to accumulation of soil organic matter. EC in old Technosols was in the range 0.8–1.5 $dS \cdot m^{-1}$. The results indicate that 30 years of pedogenesis led to the decrease of pH, increase of contents of carbonates, TOC, and total nitrogen, as well as decrease of salinity in studied Technosols.

The assessing of nutritional and hygienic status of some grazing areas of the Mohelno Serpentine Steppe – Preliminary results

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The scope of work is an assessing of nutritional and hygienic status of soil and respective above-ground forage grown within some areas of Mohelno Serpentine Steppe Protected Area. In framework of this research, specific biogeochemical and other environmental factors have to be taken into account, influencing the parameters of both soil and plant material being tested. First of all, the bedrock of this area is serpentine rock so respective soil evolved here are at most so-called serpentine soils. These are generally deficient in plant essential nutrients such as nitrogen, phosphorus, potassium, and sulfur; have a calcium-to-magnesium (Ca/Mg) molar ratio of less than 1; and have elevated levels of heavy metals such as nickel, cobalt, and chromium. Therefore, it seems eligible to assume that, as a result of transport processes, the properties of the above-ground vegetable matter in terms of both nutritional and hygienic parameters will be significantly affected by the soil parameters. These are crucial, since Mohelno Serpentine Steppe has been undergoing sheep and goat grazing since 1997 as a measure to preserve the original environmental diversity of this territory. From this point of view, soil material was analysed on the bioavailable forms of P, K, Mg and Ca and the content of some risky elements, including Co, Cr and Ni by Aqua Regia. Respective plant material was analysed on some macro-and microelements including Co, Cr and Ni. None of these elements exceeded the values set by the Czech Decree No. 153/2016. On the other hand it was found some disbalancing relations within plant material studied, namely insufficient ratio Ca/Mg and K/Na, respectively. The grass tetany factor in any case does not exceed the value of 1,2. This work has been financially supported by Ministry of Agriculture of the Czech Republic by its Decision No RO2017 of 21 February 2017.

The respective influence of soil variables in the plant species distribution

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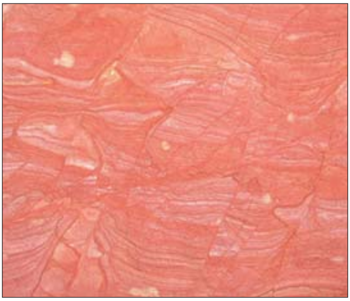
Soil is the main source of essential minerals for growth of organisms. Changes of the soil physical and chemical properties are affected by the climatic and the type of vegetation that occurs. The purposes of this study were to investigate the ability of prediction soil variables based on variables such climatic and topographic in species distribution models and also the importance of the soil variables in the models. During the spring and summer of 2014, 350 vegetation plots, 1 m^2 in size, were chosen using a random stratified sampling procedure. Ecological characteristics of plants were classified based on three traits including soil humus, pH and nutrient content. Species distribution modeling was carried out using generalized linear regression models. The results of the importance of the variables were shown between variables; slope and soil silt had utmost importance at modeling with 0.102 and 0.067 values respectively. The importance of soil organic carbon as the least effective variable had 0.059 value. The ecological criteria, humus in category 2, nutrient content in category 3 and soil acidity in category 3 had most portion of the silt variable. The results of variable importance of organic carbon in plant performance characteristics suggest that soil organic carbon by dry matter had most relationship. Organic carbon was an important predictor variable for explaining the species distribution in our study. Also, this variable should not be neglected in the construction of species distribution models in areas with contrasting edaphic conditions.

❖ EXHIBITION ❖ **Irena Ráček – COLORS OF THE EARTH**

Irena Ráček, a native of Slovakia, is a painter, illustrator, art teacher and curator of art and cultural projects. Between1963 and 1968 she studied at the Secondary School of Applied Art in Brno and Uherské Hradiště (Czech Republic). In 1968 she emigrated to Austria. Ráček became famous as an illustrator of children's books. About 40 years ago she moved from Vienna to the southern Austrian district of Sitzendorf an der Schmida and began to intensively focus on the issue of painting with natural pigments. Ráček collects coloured clays herself, from around Austria and abroad, and mixes them with natural binding agents. She became involved in soil science through the project «Painting with the colours of the Earth». The organisers of this project wanted to address children and young people and stimulate their interest in soil conservation. They therefore asked Irena Ráček to teach youngsters to work with her much-loved natural pigments in creative competitions. The project's work with these materials expanded beyond the Austrian border. At joint events in the Czech Republic, Slovakia and Hungary, and at Danube nations conferences, the artist met a wide range of teachers and listened to their presentations. In consultations she gained answers to various questions. As Ráček says: "What links me with soil scientists is an interest in the environment in which we live. Every one of us, in our own way and by our own means, is looking for a way to contribute to soil conservation». The «Degradation and Revitalization of Soil and Landscape» conference in Olomouc will definitely be a positive help in this dialogue.

Variegated Moldavite-bearing sands and gravels of the Pliocene Vildštejn Formation (about 2 Ma) (Dřenice Pit near Cheb)

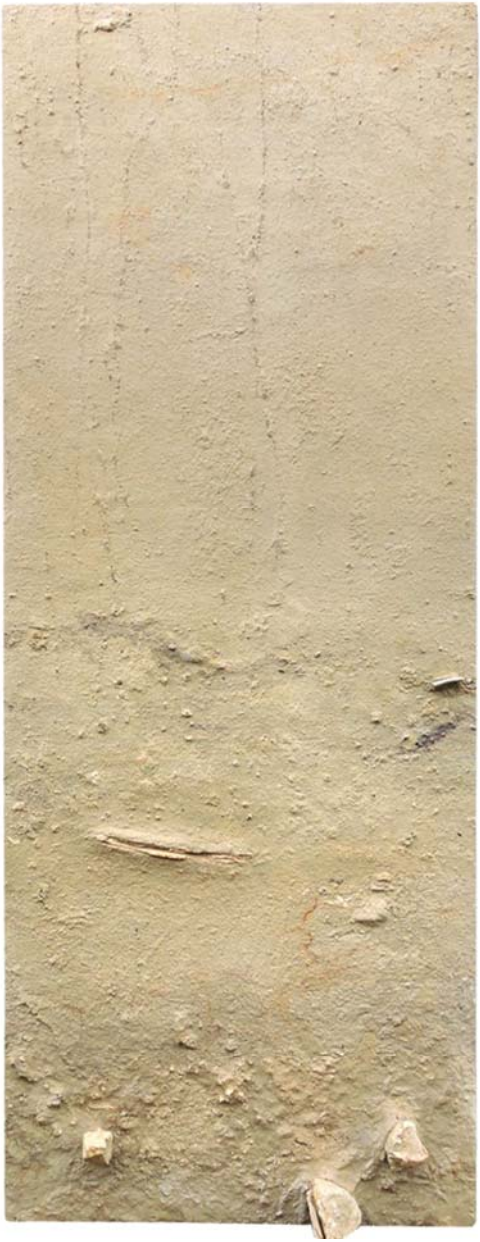


Unique system of microtectonics and faults developed in the Lower Cretaceous Rudice Beds (about 130 Ma) (Rudice Pit near Brno)

❖ EXHIBITION ❖ **Ivan Doležal – GEOPICTURES**

Our special process makes it possible to lift "images," known as rock peels from loosened-material (unconsolidated soil, clay, sand, gravel, peat, and debris or deposits formed by erosion) profiles. These profiles come from the walls of pits, the walls of natural land formation and the walls of excavations. The process is quite simple. We first smooth a selected section of a wall profile. The profile is then sprayed with diluted penetrative lacquer. This hardens the material without affecting its texture, colour, or mineral composition. The penetrative lacquer is applied a second time, hardening further the wall surface. During this second hardening process a thin cloth is applied. When completely dry, the cloth is carefully removed with a thin screen of the lacquer-hardened soil. This screen or image is an exact representation of the original wall with all of its features. The area of the image ranges from seve-ral dm^2 to as few as one or two m^2 in surface. The completed image is then fastened to a board, framed and is ready for hanging. Rock peels are used to document: geologically significant sections of deposits, e.g., tectonic disturbances, rock boundaries, lithologic variations etc.; overlying rock and bedrock, e.g., eluvia, sands, loams, volcanic rocks etc.; materials mined, e.g., glass sands, foundry sands, brick loams, kaolin, peat, diatomaceous earth, bentonite, little coal seams etc. Also, a rock peel will document the occurrence of minerals (e.g. moldavite) or fossils in situ. Rock peels have a wide range of applications, serving geologic, paleontologic, pedologic or archaeologic purposes. They are used as documentation material in geology or archaeology, objects of study for educational purposes, wall decorations or as original works of art. Rock peels are suitable for offices, *conference rooms, and entrance halls. Mining companies have used them both as demonstration of formation, decorative displays and even for trade shows. Many peels have been purchased by, or donated to, scientific centers, schools and museums. Rock peels are sure to please scientists, collectors and laymen alike. Each rock peel is an original, true and permanent representation of a piece of nature having both scientific and decorative qualities. Thanks to this documentation method one can admire the artistry of nature.*

More details can be found on www.dolmat.net.



Impression of a geological profile with a Gravettian cultural layer (Pavlov)

EXCURSION – SOUTH MORAVIA

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1. **Soil profiles changes during erosion and deposition (cadastral area Brumovice)**

2. **Experimental base for hydrological research and soil erosion monitoring and antierosion measures – bench terrases (Hustopeče – Starovice)**

3. **Soils in floodplain forest (Janohrad)**

1. South Moravia – cadastral area Brumovice (Czech: Jižní Morava)

Southern Moravia ranks among the earliest human settlements in Central Europe and it has been under uninterrupted agricultural use since the middle of the Holocene. In the Neolithic period, the region was mostly a mosaic of steppe, forest steppe and open forest. The early Neolithic farmers (dating to 5700 BC–5000 BC), are presumed to preserve the prevailing steppe character of the area. Strip farming was the main cultivation method adopted since the High Middle ages until the late 1950s. Despite the small area of the plots, soil erosion was significant, since the majority of the fields were oriented down-slope and were tens to hundreds of meters long (Fig. 1). Extremely intensive erosion took place after political changes in the 1950s, which implicated forced collectivization of agricultural land resulting in spatial enlargement of fields to the extent of several hundreds of hectares and the destruction of landscape elements with an anti-erosional effect.

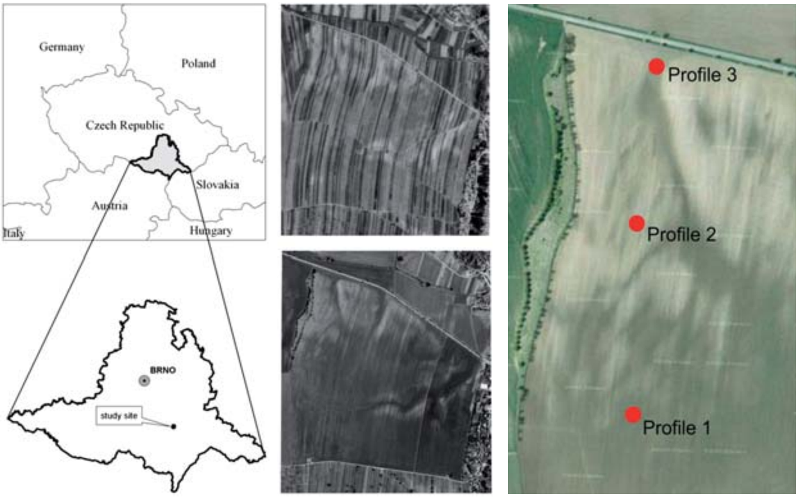

Figure 1. Aerial photographs of the area in 1953 (top) and 2011 (bottom).

The area is formed by upper Eocene molasse facies and Oligocene sandstones covered by a Pleistocene loess layer with variable depth. Calcic

Chernozem (Profile 1) is the original dominant soil unit in the region, nowadays progressively transformed into different soil units along with intensive soil erosion and deposition. The agriculture plot is characterized by a flat upper part (slope 0–0.5°) while the middle part, formed by a back slope and tributary valley, is steeper (up to 23°). The mean slope of the plot is 12.7°. The tributary valley represents a major line of concentrated runoff emptying into a colluvial fan. The concave base-slope is interrupted by a road dividing the slope from the floodplain of the Haraska river. An extremely diversified soil cover resulted from the erosion. Areas with minimal slope (0–2°) are covered mainly by Calcic Chernozem (Profile 2), areas with increasing slope (2–8°) by its eroded forms, and the steepest parts (8–15°) of the slopes by Regosols/Calcisols. Colluvial Phaeozems, Chernozems and Regosols (Profile 3) with deep humus horizons are formed in slope depressions (Zádorová et al., 2013).

Calcic Chernozem

Figure 2. Soil profile nr. 1 – Calcic Chernozem (Aric, Pachic, Siltic)

0–25 cm: colour very dark grayish brown (10YR 3/2), slightly moist, strong medium (2–5 mm) granular structure, texture silt loam, none rock fragments, slightly calcareous – no visible carbonates, firm consistency, common roots and earthworms channels, abrupt (0–2 cm) horizon boundary
Horizon Ap (plough, mollic)

25–50 cm: colour very dark brown (10YR 2/2), slightly moist, strong medium (2–5 mm) granular structure, texture silt loam, none rock fragments, slightly calcareous – secondary carbonates in form of pseudomycelia, firm consistency, common roots and earthworms channels diffuse (>15 cm) horizon boundary
Horizon Ac (mollic)

50–80 cm: colour light yellowish brown (10YR 6/4), slightly moist, weak very coarse (>50 mm) blocky structure, texture silt loam, none rock fragments, strongly calcareous – secondary carbonates in form of pseudomycelia, firm consistency, few roots channels and earthworms channels
Horizon C (calcic, loess) 0–25 cm: co

Table 1: Analytical data Profile 1

Horizon	Depth (cm)	Clay (%)	Silt (%)	Sand (%)	pH_{water} (%)	$CaCO_3$ (%)	SOC (%)	P ($mg.kg^{-1}$)	K ($mg.kg^{-1}$)	$DDT_{tot.}$ ($mg.kg^{-1}$)
Ap	0–25	22,8	55,4	21,8	7,0	0,1	1,65	20	168	10
Ah	25–50	21,9	54,1	24,0	7,1	0,1	1,34	24	77	5
Ck	50–80	22,3	53,8	23,9	7,6	18,0	0,05	0	55	0

Haplic Calcisol

Figure 3. Soil profile nr. 2 – Haplic Calcisol (Aric, Ochric, Siltic)

0–25 cm: colour brown (10YR 5/4), slightly moist, weak medium (2–5 mm) granular structure, texture silt loam, none rock fragments, strongly calcareous – secondary carbonates in form of pseudomycelia, friable consistency, common roots, abrupt (0-2 cm) horizon boundary
Horizon Ap (plough)

> 25 cm: colour light yellowish brown (10YR 6/4), slightly moist, weak very coarse (>50 mm) blocky structure, texture silt loam, none rock fragments, strongly calcareous – secondary carbonates in form of pseudomycelia, firm consistency, few root and earthworms channels
Horizon Ck (calcic, loess)

Table 2: Analytical data Profile 2

Horizon	Depth (cm)	Clay (%)	Silt (%)	Sand (%)	pH_{water} (%)	$CaCO_3$ (%)	SOC (%)	P ($mg.kg^{-1}$)	K ($mg.kg^{-1}$)	$DDT_{tot.}$ ($mg.kg^{-1}$)
Ap	0–25	23,8	52,9	23,3	8,1	15,1	0,79	10	73	14
Ck	> 25	25,4	54,3	20,3	8,2	18,3	0,24	0	50	5

Table 3: Analytical data Profile 3

Horizon	Depth (cm)	Clay (%)	Silt (%)	Sand (%)	pH_{water} (%)	$CaCO_3$ (%)	SOC (%)	P ($mg.kg^{-1}$)	K ($mg.kg^{-1}$)	$DDT_{tot.}$ ($mg.kg^{-1}$)
Ap	0–25	23,4	49,6	27,0	8,1	7,2	0,85	27	113	0
Ah1	25–260	22,0	51,6	26,4	8,2	4,5	0,74	22	86	250
Ah2	260–330	21,9	49,3	28,8	8,1	1,0	1,20	0	77	52
bAh	330–390	21,4	50,1	28,5	7,8	0,2	1,40	0	48	12
bAC	390–410	22,8	51,6	25,6	8,2	9,4	0,14	0	41	20
bCk	410–440	23,0	51,4	25,6	8,4	13,0	0,02	0	42	18

Colluvic Regosol

Figure 4. Soil profile nr. 3 – Eutric Colluvic Regosol (Aric, Ochric, Siltic)

0–25 cm: colour dark yellowish brown (10YR 4/4) slightly moist, weak medium (2–5 mm) granular structure, texture silt loam, none rock fragments, moderately calcareous – no secondary carbonates visible, friable consistency, common roots, abrupt (0–2 cm) horizon boundary, ploughed colluvial material
Horizon Ap

25–260 cm: colour dark yellowish brown (10YR 4/4) slightly moist, weak medium (2–5 mm) granular structure, texture silt loam, none rock fragments, moderately calcareous, in some depth intervals visible secondary carbonates (lublinite), friable consistency, common roots and earthworm channels, diffuse (>15 cm) horizon boundary, colluvial material with no stratification features
Horizon Ah1

260–330 cm: colour very dark brown (10YR 3/3), moist, structure not observed, texture silt loam, none rock fragments, slightly calcareous – no visible concentrations, gradual (5–15 cm) horizon boundary, colluvial material with no stratification features
Horizon Ah2

330–390 cm: colour black (10YR 2/1), moist, structure not observed, texture silt loam, none rock fragments, slightly calcareous – no visible concentrations, firm consistency, gradual (5–15 cm) horizon boundary
Horizon bAh (fossil mollic)

390–410 cm: colour brown (10YR 4/3), moist, structure not observed, texture silt loam, none rock fragments, moderately calcareous – secondary carbonates in form of psudomycelia, firm consistency, gradual (5–15 cm) horizon boundary

Horizon bAC (fossil)
> 410 cm: colour light yellowish brown (10YR 6/4), moist, structure not observed, texture silt loam, none rock fragments, strongly calcareous – secondary carbonates in form of pseudomycelia, firm consistency
Horizon bCk (fossil calcic)

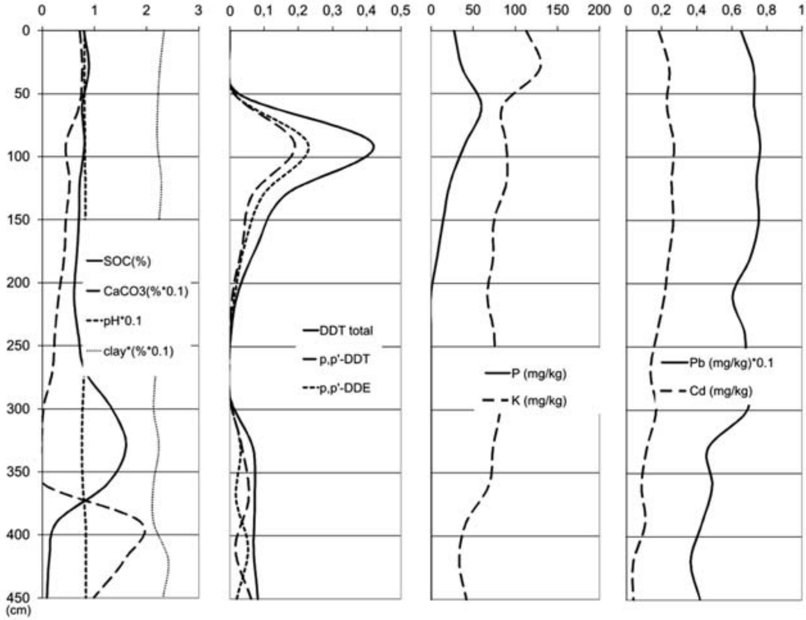

Figure 5. Stratigraphy of selected soil properties in the colluvial soil profile.

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Localities were selected and prepared by:

Vít Penížek and Tereza Zádorová, Department of Soil Science and Soil Protection, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague.

2a. Experimental base in cadastral area Hustopeče-Starovice

Natural conditions

The area of interest is located in the part of the. Hustopeče cadastral area and part of c.a. Starovice in district Břeclav, region of South Moravia. Climatically it belongs to a warm and dry area with mild winters. The annual average temperature is 9.2 °C. Regarding the wind regime, the south-east, the northwest and the east wind direction prevails. Total precipitation reaches an average of 563 mm per year with a maximum in July and a minimum in February.

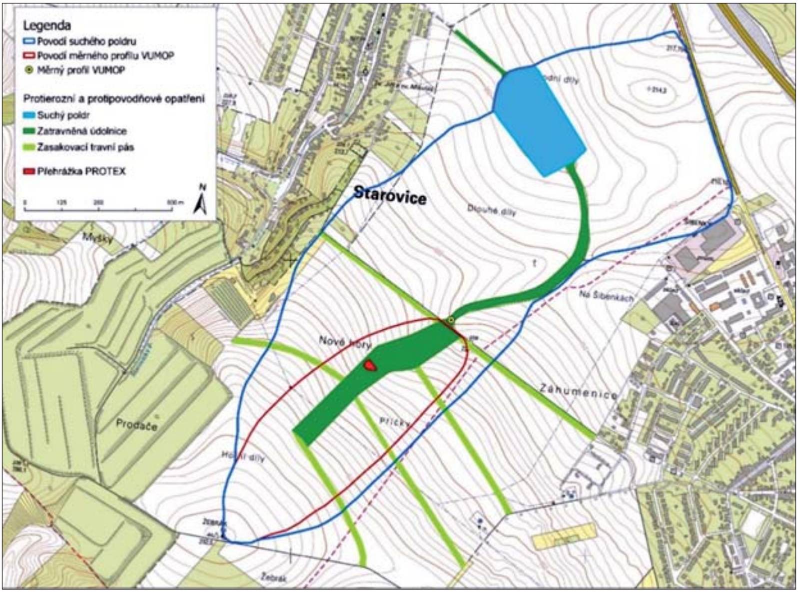
Hustopece upland, where the area of interest is located, belongs to the Moravian part of the Carpathian System, which is created by flysh range. The altitude of the area of interest is 222–275 m. The geological base consists of the alternation of paleogenic and neogenous claystones and sandstones. These were covered in the Quaternary by a layer of loess. However, as a result of erosion, the bedrocks were locally uncovered. On the loess, carbon Chernozems, Chernozems, and carbonate Phaeozems were formed. Chernozems on the slopes are largely washed by water surface erosion, sometimes so that they have to be reclassified to cambisols.

Designing, implementing and research works in the experimental area

Experimental area was established in 2007 after the realization of a channel-terrace and a flood release basin. A specific profile (Thomson triangular spillway) was built within the construction. The profile is equipped with a US Flow Probe, an Automatic Sampler of suspended solids, a rain gauge and data logger for data logging and archiving (Figure 1).

Figure1. Technical equipment of experimental area

The objective of the experimental field research is to monitor the development of precipitation-flow processes depending on the management in the area and the sonsequent evaluation of the effectiveness of the erosion and flood control measures. Above the gauging section is slope heavily endangered by erosion (G_{av} = 10.6 t . ha^{-1} $year^{-1}$). Extreme precipitations in the year 2000 caused a massive runoff and consequently flood damage in the Hustopeče and Starovice areas. In order to reduce the negative impacts of soil erosion and runoff in the future, a land consolidation was launched in 2001. The area covered by the land consolidation was 292 ha. The subject of the solution of erosion control and flood protection was a catchment area of 110 ha, with a thalweg length of about 1500 m, the average slope of the area is 6 %. As a part of the plan of the common facilities, the above mentioned channel-terrace and a flood release basin were designed, then the grassing of the thalweg over the channel-terrace and the system of six seepage grassed channels leading into the grass thalweg. The measures were implemented successively. The present state is shown in Figure 2.



In 2007, only the implementation of a seepage grass belt along the road, channel-terrace and a flood release basin under the road were carried out.

The basin is a dry retention tank with a maximum volume of 56 000 m^3 (Table 1). The measurements in gauging profile started in 2008, so a set of comparative data from the period prior to the implementation of the measures over the profile is available.

Table 1: Basic technical data on Hustopeče basin

Start of construction	26. 4. 2006
End of construction (occupancy permit)	12. 3. 2007
Total cost	460 827 €
Length of the dam	216.7 m
The height of the dam above the bottom	3.7 m
The width in the dam crest	4.5 m
Volume of the dam	5 421 m^3
Area of maximum level	45 851 m^2
Water volume at max level	56 070 m^3
Max. The inflow into the dam Q_{100}	10.1 $m^3.s^{-1}$
Transformation to a safe drainage	6.7 $m^3.s^{-1}$
Length of trench	824.9 m
Emankment in the length	255 m

Since 2014, in the frame of the project TA04020886 named: New technologies to address flood protection from torrent precipitation has been developing implementation of the remaining components of common facilities in the experimental catchment area. In 2015, in a part of the catchment area, there was grassed the thalweg and built up erosion control dyke using PROTEX technology. Measure consists of three textile bags filled with an environmentally acceptable mixture (utilization of local sources of aggregate) placed pyramidal, covered with geotextiles and covered with soil, sown with grass mixtures (Table 2, Figure 3). The maximum height of the dyke is 1.1 m, the safety spill is stabilized by a stone stopper and is located on the left side of the dyke. The minimum water holding capacity is 0.67 m. At higher level the water passes through the spillway up to the height of 100-year water (max. 0.94 m) at a flow rate of 2.71 $m^3.s^{-1}$.

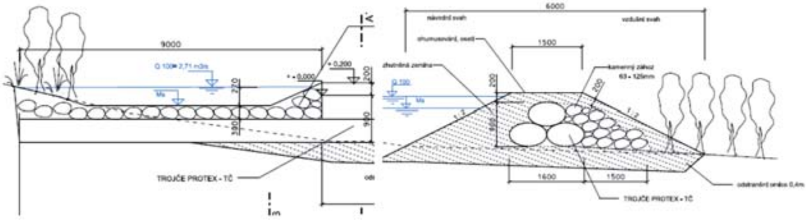


Figure 3. Prototypal longitudinal and cross section of the dyke

Table 2: Technical parameters of the dyke

Location	Starovice
Length of erosion control dyke [m]	28
Height of erosion control dyke [m]	1.1
Maximum water flow Q100 [m3/s] (100 – years water)	2.71
Type and dimensions of bags Ø – L [m]	2 ks, triple 3 × Ø 0.68 – 9.5 m, 1 ks twin 2 × Ø 0.68 – 9 m
Min. the strength of the mixture in the solid state [Mpa]	5
Specific solid bulk density [kg/m^3]	cca 2 000
Filling volume [m^3]	cca 30.00
Formula of the filling mixture	Mixture based on local – natural materials + cement + mixing water
Approximate financial costs, including earthworks [CZK]	cca 300 000 CZK (11 540 EUR)

In 2016, the implementation of common facilities on the experimental basin was completed by a system of four grassed seepage belts. These were based on the position of the originally designed channels. The total area of grassing (grass thalweg and grassed belts) is 7.6 ha. Of this, the grass thalweg occupies 5,4 hectare and four 20 m wide belts occupy an area of 2.2 hectares (Figure 2).

Analysis of precipitation-runoff episodes

The monitoring of rainfall events and the content of suspended solids carried by the rising part of the flood wave is performed continuously since 2008, within the framework of the research intentions MZE0002704901, MZE0002704902, and the project of the instit. support of the MA for the development of VO (RO0214-0216).

In the monitored period 2008 to 2016, the most significant recorded event was in June 12, 2012, when the intensive rainfall caused a maximum runoff of 431 l s^{-1}, and during the flood wave rising, the profile of almost 11 t of suspended solids was passed. High transport of solids was elicited by episodes of snow melting in 2009 and 2013. As can be seen from Figure 4, erosion from snow melting has created a deposit body above the culvert. The measurements showed that at the foot of the slope 34.6 t of soil particles were settled and 7.6 t in were caught in the measuring profile. When sum these values with the data of the transported particles in the runoff, 67.7 tons of soil particles were eroded, which means the soil loss of 2.4 t per ha.

Figure 4. The effects of melting snow in 2013

Analysis of changes in soil properties due to long-term erosion
Using the Universal Soil Loss (USLE) and GIS Methods, the erosion was simulated before and after the implementation of the system of erosion and flood control measures (Tab. 3).

Table 3: Differences in erosion washout from the experimental catchment

Erosion control measures	Erosion washout t.year^{-1}
Before the implementation of measures	2 253
After implementation of measures	430

The results of the repeated pedological survey unambiguously confirmed soil degradation due to long-term massive erosion washout: loss of humus horizon, changes in physical and chemical properties. Figure 5 shows the results of the evaluation of soil quality in 1978 (the red color lines) and the evaluation in 2013 (green lines). The evaliuation was carried out by using the system of evaluation of soil ecological units, developed in Czech in 1960s. It is evident the movement of the area of Chernozems to the Cambisols.. For example, the ESEU area with soil type 08 (Chernozems eroded , degrading phase of soil type 01) before the update of ESEU was less than 12 % of the land area, after the update it increased to almost 44 % (see Tab. 4).

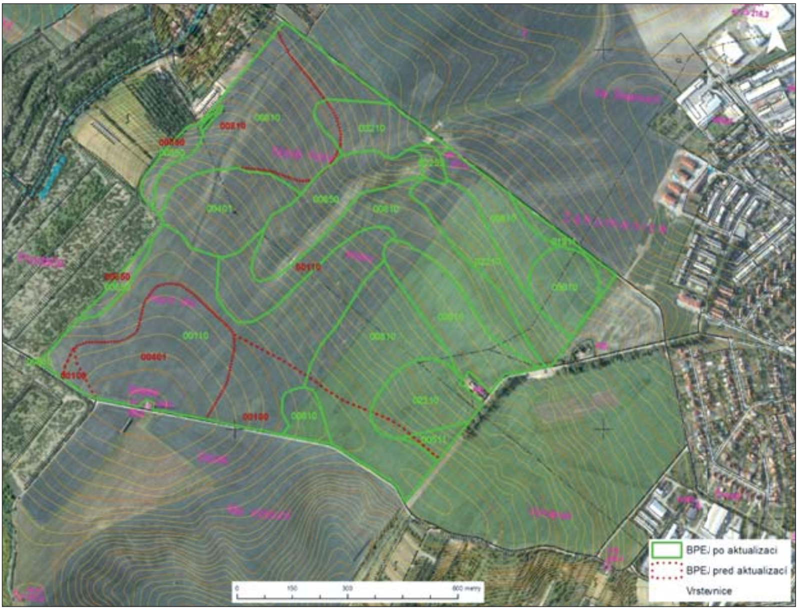


Figure 5. A map of the arable land surveyed with BPEJ marked before (red) and after updating (green)

Table 4: Soil characteristics identified in the locality Hustopeče-Starovice

	ESEU	Description
1978	0.01.0.0 0.01.1.0	Flat and moderately sloped Chernozem, soil with thick Phaeozem humus horizon, with crumb to granular structure, developed from loose carbonate substrates, deep soils
	0.04.0.1	Arenic flat Chernozem, lighter dehumidified soil, deep to medium deep
	0.08.1.0	Washed-off (eroded) Chernozem with cultivated substrate covering more than 50 % of moderately sloped area
	0.08.5.0	Washed-off (eroded) Chernozem with cultivated substrate, in sloped terrain
2013	0.01.1.0	Modal flat and moderately sloped Chernozem, soils with thick Phaeozem humus horizon, with crumb to granular structure, developed from loose carbonate substrates, deep soils
	0.04.0.1	Arenic flat Chernozems, lighter dehumidified soils, deep to medium deep
	0.05.1.1	Modal carbonated Chernozems on highly permeable bedrock, medium heavy to lighter
	0.06.1.0	Pellic Chernozems, heavy to highly heavy, on heavy bedrock
	0.08.1.0	Washed-off (eroded) Chernozems with cultivated substrate covering more than 50 % of moderately sloped area
	0.08.5.0	Washed-off (eroded) Chernozems with cultivated substrate, in sloped terrain
	0.19.1.1	Modal pararendzinas, medium heavy to heavy
	0.22.1.0	Arenic cambisols at lighter, dehumidified, non-water-retaining substrates
	0.22.5.2	Arenic cambisols at lighter, dehumidified, non-water-retaining substrates, in sloped terrain

Another factors investigated in the experimental catchment area are changes in the hydrophysical properties of soil due to erosion processes. Within NAAR projects QJ 1230066 and QK 1720303, measurements of infiltration properties are carried out in different parts of the erosion slope – in the eluvial (infiltration) position, the transport part and the accumulation part, by using the compact infiltrometers and portable McQueen rain simulator. At the same time he undisturbed soil samples are taken and the hydropedological properties of the soil are analysed (Tab. 5)

Table 5: Hydrophysical properties of soil samples

locality/depth	bulk density reduced [ρd]	porosity [P]	capillary pores [% vol.]	semicapillary pores [% vol.]	noncapillary pores [% vol.]	airiness [VZ]
accumul. part – 10	1,47	41,08	23,01	9,98	9,40	24,62
accumul. part – 30	1,61	38,71	23,89	6,56	8,27	22,23
transport part – 10	1,45	48,22	26,83	7,59	13,80	29,19
transport part – 30	1,55	42,43	27,89	7,51	7,03	25,49
eluvial part – 10	1,36	48,48	26,57	8,09	13,81	30,60
eluvial part – 30	1,49	42,86	25,01	6,94	10,91	24,02
Sum	**1,49**	**43,60**	**25,53**	**7,78**	**10,51**	**25,99**

Compact infiltrometers were carried out in 2012–2016 for a total of 12 measurements in each selected part of the slope, always after harvesting the main crop.

The highest cumulative infiltration value is in the eluvial part of the slope (median = 76.67 cm), in the transport part the values are lower (median = 34.33 cm). The lowest cumulative infiltration was measured in the accumulation part of the slope (median = 13.58 cm).

By using the McQueen simulator, infiltration, surface runoff and suspended solids measurements were performed at that time. The measurements were carried out with the simulated rain intensity 2.1–2.4 $mm.min^{-1}$, duration 35 minutes, total precipitation 75–86 mm. Total infiltration, flow factor (ratio of prec. volume to runoff volume) and suspended solids concentration in individual zones were determined.

The evaluation of the measurement shows the trend of the highest soil loss in the transport part (0.2–8.5 $t.ha^{-1}$) in HPJ 08 (Chernozem eroded), lower in the accumulation part (0.4–5.2 $t.ha^{-1}$) in HPJ 22 (cambisol arenic), and the lowest values in the eluvial area (02.6 $t.ha^{-1}$) in HPJ 01 (Chernozem modal).

2b. Bench terraces in the cadastral area of Starovice

The system including 23 bench terraces, which covers an area of cca 65 hectares, was built during the 1980s. Bench terraces are effective soil conservation measures used on the sloping lands to reduce the soil loss. The bench terraces have an conservation function and also have a flood control function and protect the built-up area of the village from the adverse effects of the concentrated surface runoff. Terraces were created on Chernozem soils with deep loess subsoil through the cut and fill proces. In designing bench terraces, the width of the bench platform – flat part – needs to first be determined according to width distance rows of trees in orchards or wineyards, tillage tools, and other individual requirements.

The gradient of platform bench terraces sloping 5 percent outward. The width of the terraces is from 30 to 80 m and the length from 250 to 500 m, the gradient of the terraced slopes is 80 percent (1:1.25), the height of the terrace slopes is from 6–10 m. The net area is the area of flat strips which is used for cultivation. The net area of platform can be mostly 75 percent, slope area 25 %.

The terraces were designed using the top-down construction method. During the technical reclamation section, the topsoil and subsoil were removed to a depth of 40 cm, the topsoil was deposited on the depots and, after the end of the earthworks, was again spread out on the terrace platforms. New anthropogenic soil pedons horizons have been built.

The main benefits of bench terracing include:

- to minimize soil erosion and reduce run-off and its velocity
- to increase soil moisture and soil fertility and contribute for water infiltration in the soil
- to achieve e more intensive land use for orchard a wineyards
- to promote better orchards and wineyards grow and development on the platforme

Figure 1. Bench terraces in Starovice cadastral area

Bench terraces are much more cost-effective if there is potential for growing high-value orchards and wineyards.

Design bench terraces such that the volumes of cut and fill are to be equal for minimizing construction cost.

Three years of biological reclamation and planting of apricot orchards were carried out on them.

Deep ploughing, or subsoiling is needed to improve the structure of the soils on the cut part of the bench terraces. Green manuring, and compost (Vitahum) application was used in the initial period in order to increase soil fertility.

The terraces should be protected at their risers and outlets and should be carefully maintained, especially during the first several years.

Figure 2. Bench terraces as an important flood protection measures

After cutting a terrace, its slopes have to be shaped and planted with grass as soon as possible.

Localities 2a and 2b were selected and prepared by:

- Jana Podhrázská, Jana Konečná, Petr Karásek and Josef Kučera from Department of Land Consolidation, Research Institute for Soil and Water Conservation, Brno
- Miroslav Dumbrovský, Institute of Landscape Water Management, Faculty of Civil Engineering, Brno University of Technology, Brno
- Bořivoj Šarapatka, Department of Ecology and Environmental Sciences, Palacký University in Olomouc

3. Locality Janohrad in floodplain forest (South Moravia)

The excursion will be arranged in the area close to the Czech-Austrian-Slovakian border in the floodplain forest at locality **Janohrad** near to Lednice.

The largest complex of floodplains forests in the Czech Republic is situated above the confluence of the Morava and Dyje/Thaya rivers. Natural conditions, which affected natural floodplain ecosystem for a long time, were markedly disturbed by man in the ’70s of the 20th century. After extensive water-management measures both rivers including their local tributaries were channelized and diked. Formerly regularly repeating short-term floods were eliminated and the ground water level was decreased. However, its important annual dynamics has been preserved. The impaired water balance resulted in the local die-back of mature forest stands of the floodplain forest in the period of a climatic dry spell.

Historical overview

Locality Janohrad/Johannsburg – historically the private manor of the noble family of Liechtenstein (Johann I. from Liechtenstein). Janohrad/Johannsburg, which is a real imitation of a medieval burg, was built in 19th century and was used during hunting period. Today there is an exposition of hunting and ornithology museum of State Heritage Institute – see Figure 1.

Figure 1. Locality Janohrad/Johannsburg

Figure 2. Floodplain forest ecosystem

Until 1971 – locality represents a native floodplain forest, very little affected by the man activities. The native ecosystem was yearly flooded, usually by repeating short-term floods. Figure 2 shows floodplain forest ecosystem. Schema of the typical floodplain soils profile and terrain configuration is given in Figure 3.

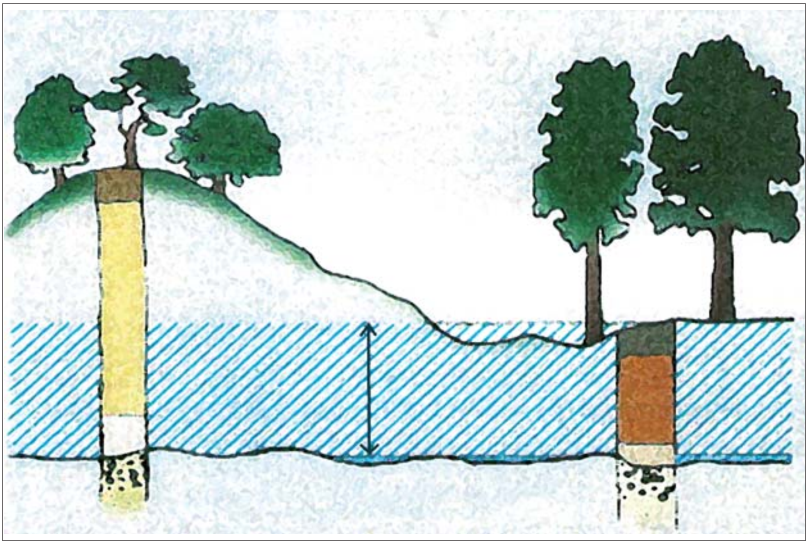


Figure 3. Typical soil profile of inundation floodplain

In 1972 the extensive water-management measures took place. Dyje/Thaya river was straighten, deepen and diked with aim to protect this area against floods (against 100 years water). The former water balance was disturbed. Thus, floods have been eliminated and the dynamics of groundwater level partly reduced, as well as the annual import of fine textured materials (1–5 mm) decreased.

During 1973–1982 the groundwater level has been gradually decreasing and so the dynamics of spring and autumn groundwater minimum level did. Floods periods were reduced or eliminated and practically no inundation material has been brought anymore.

During 1980–1990 the floodplain forest ecosystem has been suffering from drought as a result of groundwater level decreasing. The local dieback of mature forest stands took place. As it is obvious from Fig. 4, the groundwater level in spring time is more than 50 cm – 130 cm deeper to compare with the period before 1972.

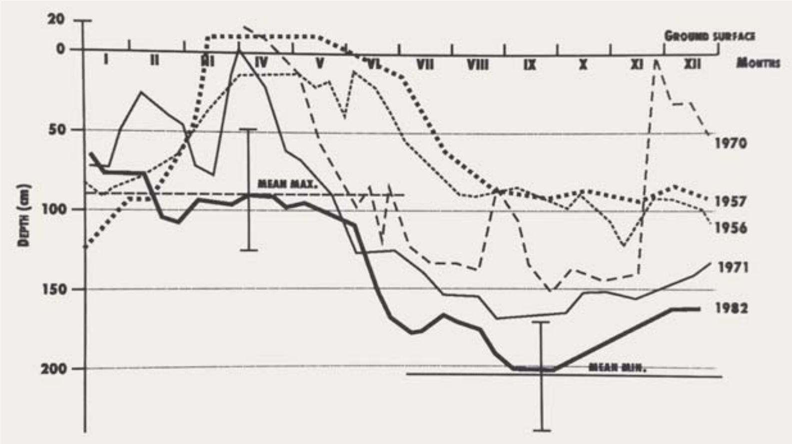


Figure 4. Changes in groundwater level during 1970 –1980

In 1991 began the revitalization. Forest Enterprise Židlochovice (state enterprise) implemented the gauging stations for soil moisture regime observation. The project of revitalization of area named "Kančí obora" also included the construction of 21.6 km of drainage channels and permanent pools (wetlands) – see Figure 5.

Figure 5. Drainage channel in floodplain forest

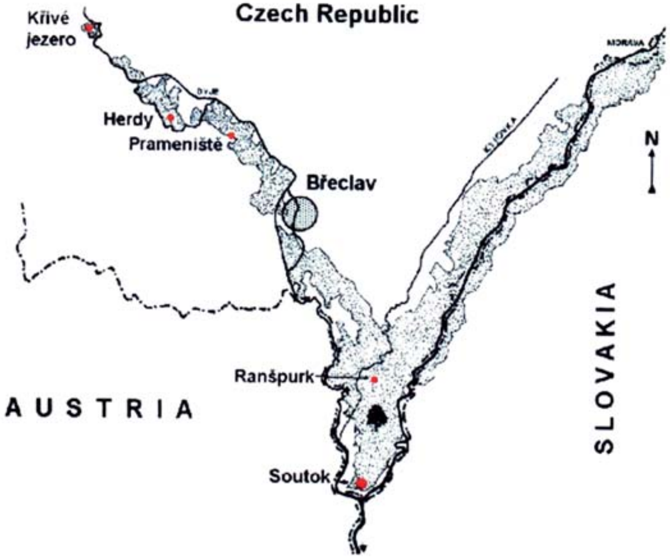


Figure 6. Monitoring of groundwater level along Dyje/Thaya river

In 1997 and 2009 – only some periods of these two years were very specific and after intensive precipitations and high level of water in Dyje/Thaya river the floodplain forest was flooded.

In 2005 – after the accomplished revitalization (2005 and 2006) more favourable conditions for this ecosystem were established. Firstly, the most important phenomenon has been preserved: the groundwater level dynamics. The fact that its fall to the level of underlying gravel-sands is only of short term, and virtually does not mean moisture stress for main commercial species of the floodplain area. Distribution of measuring stations is showed in Figure 6. Data of groundwater level elevation during field experiment in 2009 are given in Figure 7.

Research activities today

Excursion on September 13, 2017 in floodplain forest, which is under water regime regulation by watering by drainage channels, is aimed at demonstration of revitalization of these ecosystem. There is a permanent monitoring of physical and hydrophysical soil parameters because the water balance is a key factor of preservation of floodplain forest ecosystem. Basic characteristics of soils are given in Tab. 1 and 2. Labora-

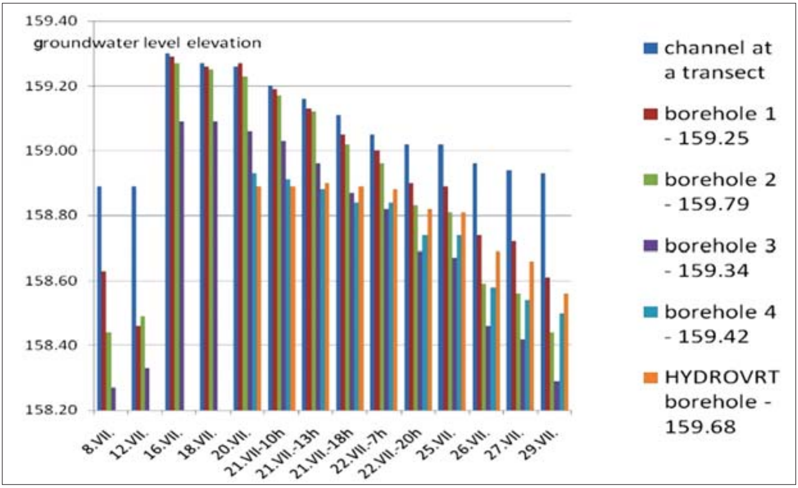


Figure 7. Groundwater level elevation in floodplain ecosystem

tory determination of the filtration coefficient was carried out according to the ČSN 72 1020 Standard (suitably adapted method F) at the set of 2×8 undisturbed fully saturated samples, which were gradually subject to a various energy gradient (virtual slope). Resulting measured values $K_s = n.10^{-7}–10^{-8} m.s^{-1}$ define bed (2) clay-loamy soil of low volume weight and the absolute predominance of capillary pores as limitedly permeable to impermeable. Loamy soil from the slope (1) is more permeable because of higher values of $K_s = n.10^{-5}\ m.s^{-1}$, and higher abundance of preference pores and non-capillary pores. Consequently, it is possible by manipulation of water level in drainage channel to water the soil approximately 50 m from channel to both side.

Soil profiles of *Gleyic Fluvisol* and *Arenic Chernozem* are given in Figure 8 and 9; soil horizons description is done by J. Němeček 2011: The Czech Taxonomic Soil Classification System.

Table 1: Basic soil properties
(Where: profile 1 slope – channel slope; profile 2 bed – channel bed)

Set No.	Sample No.	Clay %	Silt %	Sand %	C_{ox} %	Humus %	Soil textural classes
1* slope	15	14	64	22	2.78	4.79	Loamy
	25	11	60	29	2.73	4.71	Loamy
	27	12	62	26	2.67	4.61	Loamy
	28	15	63	22	3.39	5.84	Loamy
	77	13	68	19	2.92	5.03	Loamy
	85	16	65	19	2.76	4.76	Loamy
	238	14	65	21	2.89	4.98	Loamy
	249	15	64	21	3.75	6.46	Loamy
2* bed	17	18	66	16	6.37	10.98	clay-loam
	66	18	65	17	5.17	8.91	clay-loam
	67	19	66	15	5.97	10.29	clay-loam
	76	19	64	17	5.77	9.94	clay-loam
	147	18	66	16	6.60	11.38	clay-loam
	153	16	63	21	5.08	8.75	clay-loam
	154	17	64	19	5.00	8.62	clay-loam
	167	12	63	25	6.66	11.45	Loamy

*Notes:
1 – the set of 8 undisturbed samples on the channel slope;
2 – the set of 8 undisturbed samples sampling about 10 cm under water from the channel bed; clay d < 0.002 mm; silt d = 0.002–0.06 mm; sand d = 0.06–2.0 mm; C_{ox} – oxidisable carbon content.

Table 2: Hydrophysical soil parameters (Where: profile 1 slope – channel slope; profile 2 bed – channel bed)

Set No.	Sample No.	θ_{mom}* % vol.	θ_{sat}* %	MKK_{2h}* % vol.	HP* %	SP* %	KP* %	P* %	ρ_d* $kg.m^{-3}$	K_s* $m.s^{-1}$
1* Slope	15	39.49	60.3	50.1	6.4	7.1	46.9	60.4	1036.7	$9.5.10^{-6}$
	25	45.7	62.4	52.6	6.2	7.5	48.9	62.6	975.8	$3.7.10^{-5}$
	27	39.9	57.1	46.7	5.9	8.6	43.3	57.8	1112.9	$6.2.10^{-5}$
	28	40.8	60.9	49.8	6,8	9.8	47.0	63.6	911. 4	$7.8.10^{-5}$
	77	40.7	58.7	45.3	10.4	9.3	41.9	61.6	959.2.	$9.7.10^{-5}$
	85	44.0	61.3	52.9	6.9	6.2	48.7	61.8	955.1	$9.6.10^{-5}$
	238	43.7	63.3	55.4	5.6	6.1	51.6	63.3	958.9	$1.3.10^{-5}$
	249	36.6	62.3	49.1	8.8	8.9	45.1	62.8	908.8	$6.6.10^{-5}$
2* Bed	17	78.8	78.9	76.2	1.6	7.5	69.8	75.1	657.9	$2.7.10^{-7}$
	66	74.2	74.3	73.0	0.5	4.2	68.6	69.9	775.1	$1.0.10^{-8}$
	67	73.6	73.6	71.7	1.2	4.5	67.9	73.74	640.7	$1.8.10^{-8}$
	76	75.2	75.2	73.5	0.8	5.5	68.9	69.8	785.9	$4.1.10^{-8}$
	147	80.5	80.5	78.7	3.1	8.7	68.7	76.4	590.8	$2.3.10^{-6}$
	153	78.9	79.0	76.5	2.0	7.8	69.2	73.8	654.4	$1.7.10^{-7}$
	154	74.7	74.8	72.7	1.1	6.9	66.8	73.6	660.6	$9.5.10^{-7}$
	167	75.7	75.8	74.7	0.1	6.8	68.9	71.8	745.2	$1.5.10^{-8}$

* Notes: MKK – maximum capillary moisture capacity; ρ_d – volume weight; θ_{mom} – actual moisture; HP – coarse pores; SP – semicapillary pores; KP – retention water capacity; r_s – specific density of soil; θ_{sat} – maximum moisture; P– porosity; Ks – coefficient of hydraulic saturated conductivity.

Figure 8. Profile of Gleyic Fluvisol

Gleyic Fluvisol

Horizon Ol
0–2 cm: Litter prevailing leaves, occurrence of undecomposed material, decomposed material form is mull;
Horizon Ah
2–30 cm: Black gray, highly decomposed organic material, fresh wet, high root occurrence, clay-loamy textured;
Horizon M1(G)
30–110 cm: Brown gray, wet, low root occurrence clay-loamy textured soil, wet, typical gleyic processes;
Horizon M2G
110–150 cm: Yellow gray sand, wet, with addition of clay and pebbles, groundwater level in the depth of 150 cm.

Arenic Chernozem

Horizon Ol
0–2 cm: Litter prevailing leaves, undecomposed material, decomposed material form is mull;
Horizon Ac
2–40 cm: Gray to black humic horizon, freshly wet, high root occurrence, sandy textured;
Horizon C
40–150 cm: Light-yellow soft sand.

Figure 9. Profile of Arenic Chernozem

Localities were selected and prepared by:

- Alois Prax, Ľubica Pospíšilová, Vítězslav Vlček, Vítězslav Hybler from Mendel University in Brno, Faculty of AgriScience, Institute of Agrochemistry, Soil Science, Microbiology and Plant Nutrition, and
- Jiří Kulhavý and Miloš Kloupar from Mendel University in Brno, Faculty of Forestry and Wood Technology, Institute of Forest Ecology.

EXCURSION
MORAVIAN-SILESIAN BESKIDS

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1. **Wallachian Open-Air Museum in Rožnov pod Radhoštěm**

2. **Forest soils in The Moravian-Silesian Beskids**

3. **Experimental ecological study site of Bílý Kříž**

1. Wallachian Open-Air Museum in Rožnov pod Radhoštěm

www.vmp.cz

- the oldest and largest open-air museum in the Czech Republic
- founded in 1925
- over 100 buildings over an area of 80 hectares

Little Wooden Town

The Little Wooden Town forms the oldest part of the museum. Its founding fathers wished to save and preserve the relics of folk art and handicraft skills of earlier generations which were slowly disappearing from the daily life of Wallachian villages and towns. The museum was meant to serve as their permanent reminder. That is why the founders assembled the last timbered houses from the town square of Rožnov pod Radhoštěm – the town hall and a burgher's house. The Little Wooden Town was later completed with a church, a village mayor's house, two timbered pubs, granaries, barns and a distillery. Nowadays, the area serves as a venue for several international folklore festivals and a number of ethnographic and cultural events.

Water Mill Valley

The newest part of the museum gives us an insight into the use of water as a driving force for running technical constructions. There is a saw mill, a fulling mill, an iron mill and a flour mill powered by water, and also an oil press, smithy, depot and a homestead of a forest worker. The buildings exhibited in the Water Mill Valley are unique documents of human resourcefulness, respect towards natural materials as well as the ability to use the laws of nature. Almost all technologies can be seen in operation. The aim of the museum is not merely to collect artefacts and exhibit them. The Wallachian Open-Air Museum is a living museum.

Wallachian village

While walking around the Wallachian village we can see how the inhabitants of different parts of the region would have lived in different historical periods, from 1750s until 1948. Apart from the dwelling of a landless person and several farmsteads of different sizes, we can visit a house of a rich farmer as well as a mayor's house, a windmill or an Evangelical church. The Wallachian village presents the way of life and sustenance of local inhabitants, it teaches us about different trades and crafts, it demonstrates different ways of traditional building including respect towards the natural hilly terrain and the character of the Wallachian landscape. An important part of the Wallachian village life is mountainous farming and cattle and sheep breeding.

2. Forest soils in the Moravian-Silesian Beskids (Czech: Moravskoslezské Beskydy)

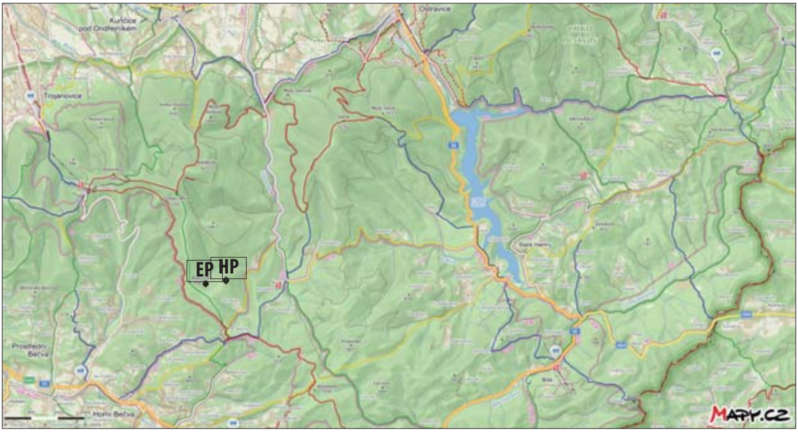
The Moravian-Silesian Beskids are a mountain range in the Czech Republic with a small part reaching to Slovakia. It lies on the historical division between Moravia and Silesia, hence the name. It is part of the Western Beskids, which is in turn part of the Outer Western Carpathians.

The mountains were created during the Alpine Orogeny. Geologically, they consist mainly of flysch deposits. These are particularly Godula sandstones of the Cretaceous period and in places claystones, marlstones, conglomerates and shales (Demek et al. 1987). In the north, they steeply rise nearly 1.000 m over a rather flat landscape; in the south, they slowly merge with the Javorníky. In the south-west, they are separated from the Vsetínské vrchy by the Rožnovská Bečva valley; in the north-east, the Jablunkov Pass separates them from the Silesian Beskids.

The highest point is Lysá hora mountain at 1.323 m, which is one of the rainiest places in the Czech Republic with around 1.500 mm of precipitation a year.

The Moravian-Silesian Beskids create the largest part of the Beskydy Landscape Protected Area (Czech: *Chráněná krajinná oblast Beskydy*). The mountains are 80 % forested, though mainly by plantations of spruce which were in some parts severely damaged by emissions from the Ostrava industrial region. Originally, the mountains were covered by mixed forest with dominant beech which are preserved in many places. Recently, permanent occurrence of all three large Central European carnivores: lynx, bear and wolf, have been confirmed in the area.

Cambisol is the markedly most widespread soil type. Podzols occur at the highest locations while Fluvisols are found in the environs of streams Both soil profiles are located in the massif of the National Nature Reserve (NNR) Kněhyně – Čertův mlýn, that is situated in the central part of the Moravian-Silesian Beskids.



Figue 1. Map showing the location of soil profiles

Figure 2. Soil profile – Haplic Podzol

Haplic Podzol

0–1 cm: slightly moist, formed from non-decomposed litter of beech and spruce (50:50), significant is also the share of predominantly spruce middle branches **Horizon Oi**

1–3 cm: partially decomposed litter from beech and spruce (60:40), without roots and biological features – **Horizon Oe**

3–5 cm: black (2.5Y2/1), moist, very friable consistence, none rock fragments, formed mainly by humified organic matter, with residues of needle and roots from spruce, leaves is low, roots < 2 mm only in the lower 4–5 cm horizon layer reaches common intensity (50–80 pcs . dm^{-2}), with smooth abrubt/clear (2 cm) horizon boundary – **Horizon Oa**

5–9 cm: brownish gray (7.5YR 5/1), slightly moist, very friable, medium (2–5 mm) granular structure, sandy loam, many rock fragments (30 %), in the form of medium (10–20 mm) and coarse gravel (20–50 mm), rarely stones (60–100 mm), non-calcareous, roots < 2 mm: few (25 pcs . dm^{-2}), roots > 2 mm: none, with smooth clear (3 cm) horizon boundary

Horizon Ah

9–29 cm: brownish gray (7.5YR6/1), slightly moist, very friable, medium (2–5 mm) granular structure, loamy sand, many rock fragments (30 %), in the form of medium and coarse gravel (10–60 mm) and stones (60–150 mm), non-calcareous, roots < 2 mm: very few (15 pcs . dm^{-2}), roots > 2 mm: very few (2 pcs . dm^{-2}), with clear (3 cm) smooth boundary

Horizon E

29–39 cm: dark reddish brown (5YR3/2), moist, very friable, fine/medium (2–5mm) granular structure + medium (10–20 mm) blocky angular structure, sandy loam, with many rock fragments (15–20 %), in the form of medium and coarse gravel (20–60 mm) and stones (60–100 mm), non-calcareous, roots < 2 mm: very few (15 pcs . dm^{-2}), roots > 2 mm: few (3 pcs . dm^{-2}), with clear/abrubt (3 cm) horizon boundary

Horizon Bhs

39–50 cm: bright reddish brown (5YR/5/8), moist, very friable, very coarse (50–80 mm) blocky angular structure + coarse/very coarse (10 mm) platy structure, sandy loam, many rock fragments (30 %) in the form of coarse gravel (20–60 mm) and stones (60–150 mm), non-calcareous, roots < 2 mm: few (35 pcs . dm^{-2}), roots > 2 mm: very few (2 pcs . dm^{-2})

Horizon Bs

50–60 cm: brown (7.5YR 4/6), moist, very friable/friable, fine (5–8 mm) blocky subangular structure, sandy loam, many rock fragments (35 %) in the form of coarse gravel (20–60 mm) and stones (60–80 mm), non-calcareous, roots < 2 mm: very few (15 pcs . dm^{-2}), roots >2 mm: very few (1 pcs . dm^{-2}), with clear (4 cm) smooth boundary

Horizon BC

60 cm ↓: yellowish brown (10YR 5/6), moist, very friable/friable, fine (2–5 mm) blocky subangular structure, sandy loam, many/abundant rock fragments (40 %) in the form of coarse gravel (50–60 mm) and stones (60–100 mm), non-calcareous, roots < 2 mm: very few (15 pcs . dm^{-2}), roots > 2 mm: none, with clear (4 cm) smooth horizon boundary

Horizon C

Figure 3. Soil profile – Entic Podzol

Entic Podzol

0–1 cm: slightly moist, non-decomposed organic matter formed by litter from beech and spruce (50:50) – **Horizon Oi**

1–2 cm: partially fermented organic matter formed by litter from beech and spruce (50:50), a small incidence of roots, especially herbs, well aerated **Horizon Oe**

2–6 cm: brownish black (5YR 2/1), moist, with residues of litter and twigs (mainly from beech), without rock fragments, with very friable consistence, roots < 2 mm: common (70 pcs . dm^{-2}) roots > 2 mm: none, without biological features, with smooth abrubt/clear (2 cm) horizon boundary **Horizon Oa**

6–12 cm: graysh brown (5YR 4/2), slightly moist, very friable consistence, structure blocky subangular (5–10 mm), sandy loam, many rock fragments (20 %), non-calcareous, roots < 2mm: few (30 pcs . dm^{-2}) roots > 2 mm: few (3 pcs . dm^{-2}), with smooth clear (4 cm) boundary – **Horizon Ah**

12–39 cm: brown (10YR 4/4), slightly moist, friable consistence, very fine (2–5 mm) subangular structure + very fine (1–2 mm) granular structure, sandy loam, many/abundant rock fragments, non-calcareous, roots < 2 mm: common (60 pcs . dm^{-2}) roots > 2 mm: few (4 pcs . dm^{-2}), with clear/gradual (5 cm) horizon boundary – **Horizon Bs**

39 cm ↓: yellowish brown (10YR 5/6), slightly moist, friable consistence, very coarse (10–30 mm) single grain + very coarse (10–30 mm) platy, structure, sandy loam, abundant rock fragments (70 %), mainly in the form of medium and coarse gravel (10–60 mm) and stones (60–150 mm), non-calcareous, roots < 2 mm: very few (2 pcs . dm^{-2}), roots > 2mm: very few (1 pcs . dm^{-2}) – **Horizon C**

Table 1: Basic chemical properties

Soil	Horizon	Depth cm	pH_{water}	pH_{KCl}	S mmol/kg	T mmol/kg	V %
Haplic Podzol	Oa	5–11	3,40	2,76	70	1243	5,63
	E	13–25	3,77	2,78	–	–	–
	Bhs	25–42	3,71	3,02	–	–	–
	Bs	42–65	4,08	3,45	14	198	7,07
	B/C	65–85	4,45	3,95	–	–	–
	C	85–110	4,43	3,94	–	–	–
Entic Podzol	Oa	5–10	3,46	2,83	32	830	3,86
	A	10–19	3,65	3,04			
	Bs	19–54	3,91	3,55	2	116	1,72
	Cr	54–65	4,20	4,06	–	–	–

S – exchancheable bases, CEC – cation exchange capacity, V – base saturation

Table 2: Soil organic matter

Soil	Horizon	C %	N %	C/N	C_{HA} / C_{FA}
Haplic Podzol	Oa	34,3	1,68	20,42	2,70
	E	1,76	0,07	25,14	1,08
	Bhs	4,85	0,35	13,86	0,55
	Bs	4,59	0,24	19,13	–
Entic podzol	Oa	24,5	1,85	13,24	1,29
	A	3,60	0,30	12,00	0,44
	Bs	3,32	0,28	11,86	0,25

C – carbon determined by the Walkley–Black method
N – nitrogen determined by the Kjeldal method

Table 3: The contents of iron and aluminum

Soil	Horizon	Fe t g/kg	Fe ox g/kg	Al ox g/kg	Fe ox/Fe t*100
Haplic Podzol	E	2,95	0,40	0,52	13,56
	Bhs	33,6	21,3	3,94	63,39
	Bs	29,9	17,4	6,16	58,19
	B/C	20,0	7,55	11,1	37,75
	C	28,6	2,81	4,29	9,83
Entic podzol	A	22,3	8,00	2,07	35,87
	Bs	21,7	7,94	3,76	36,59
	Cr	23,4	1,45	1,9	6,20

Fe t – total iron content
Fe ox – iron compounds extracted by an acid ammonium oxalate solution (pH 3)
Al ox – aluminum compounds extracted by an acid ammonium oxalate solution (pH 3)

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Localities were selected and prepared by:

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3. Experimental Ecological Study Site of Bílý Kříž
Global Change Research Institute, Czech Academy of Sciences, Brno, Czech Republic

Experimental ecological study site of Bílý Kříž (further EESS) is located in the region of the Moravian-Silesian Beskids Mts. (Czech Republic) and its coordinates are 49°30′ N and 18°32′ E. Geological subsoil is formed by flysch layer with dominant sandstones. In 1998–2013 the mean annual air temperature amounted to 6.8 ± 1.0 °C, mean annual relative air humidity to 84 ± 4 % and mean annual sum of precipitation to 1265 ± 216 mm.

EESS is a part of international measuring network FLUXNET. In 2007 EESS was included into significant infrastructures within ESFRI (European Strategy Forum on Research Infrastructures), project ICOS (Integrated Carbon Observation System).

The study site is operated by Global Change Research Institute CAS. EESS was established in 1986 within the framework of the project „Complex Research of Immission Impact on the Forests and Forestry of the Beskids".

Currently, multiple research teams operate at EESS applying various methods with different scientific aims. Among the most important initiatives belong 1) long-term monitoring of matter and energy fluxes; 2) ecophysiological research focusing on better understanding of photosynthesis, respiration and transpiration; 3) estimation of spruce stand productivity combined with forest management development that would improve its resilience and carbon capture; 4) remote sensing hyperspectral imaging for mapping of physiological characteristics with high spatial resolution; 5) integration of the acquired information in order to better understand the studied ecosystems and to predict their future response to changing climate.

Measurements are carried out at the following plots:

- climatological station
- spruce stand
- grassland
- cultivation glass domes
  - stand within cultivation glass domes with ambient CO_2 concentration
  - stand within cultivation glass domes with elevated CO_2 concentration

Climatological station

The altitude of the climatological station is 894 m above sea level and there are operational buildings, a meteorological booth and an automatic station for air quality measurement. There are sensors for incident solar radiation measurements placed on the roof of the operational building. Sensors for air temperature and relative humidity are placed inside the meteorological booth. Rain gauges are placed on the open space area and sensors for soil temperature measurement are placed in several soil depths. Automatic station for air quality measurement, whose owner is Czech Hydrometeorological Institute, is used for CO_2, NO_x, O_3, heavy metals, radioactivity and volatile particles measurements. The station is a part of measuring networks EUROAIRNET and IRIS

Spruce stand

Research in spruce stand started in 1994. Studied stand was established in 1981 using row planting of 4-year-old seedlings of Norway spruce (*Picea abies* [L.] Karst.) in planting spacing of 2×1 meter and row orientation in N-S direction. Stand belongs to forest site complex 5S – Nutrient-medium Fir-Beech. Stand consists of pure and evenaged Norway spruce. Forest growth stage is pole stand. The forest is geobiocenologically classified as Abieti-Fageta. There is a meteorological mast (height of 36 meters) placed in the stand. The altitude of the mast placement is 875 m above sea level. Mean slope of the stand is 13° with SSW exposition.

Geological subsoil is formed by flysch layer with dominant sandstones. Haplic and Entic Podzols are the soil types in the stand. The soil is moderately deep up to *Holcus mollis* shallow, from loamy-sand to sandy-loam with high content of soil skeleton in the low layers. The soil depth is maximum 60 – 80 cm. The densest root layer is 5 – 15 cm.

Grassland

The research in the grassland started in 2003. By 2008 the studied grassland was divided into two parts – mown grassland (mowing was done once during the growing season) and non-mown grassland. The originally mown grassland was formed by phytocenose of Nardus-Callunetea (dominating plants: *Festuca rubra* agg. L., *Nardus stricta* L., *Veronica officinalis* L., *Hieracium laevigatum* Froel.) and the originally non-mown grassland was formed by phytocenose of Molinio-Arrhenatheretea (dominating plants: *Rumex acetosa* L., *Hypericum maculatum* Crantz., L., *Achillea millefolium* L.). There is a meteorological mast (height of 6 meters) placed in the grassland.

The altitude of the mast placement is 860 m above sea level. Grassland is on the slope of 8.5° and it is exposed towards the south-east. Geological subsoil is formed by claystone. Soil type is Gleyic Luvisol.

Cultivation glass domes

Experiment determining influence of elevated CO_2 concentration started at EESS in 1992. In 1992–1995 open-top chambers were placed in the spruce stand for planting an individual tree of Norway spruce in elevated CO_2 concentration. Research of influence of elevated CO_2 concentration on forest tree stand has been carried out at EESS since 1996 using cultivation glass domes.

The platform of the cultivation glass domes is 9 × 9 meters. CO_2 concentration is maintained ambient in the first cultivation glass dome (A – ambient). Conditions expected in the second half of the 21st century are simulated in the second one (E – elevated) – it is approximately double CO_2 concentration in comparison to the concentration at the end of 20th century. At first there was spruce stand planted in cultivation glass domes, since 2007 mixed stand of spruce and beech has been planted.

Locality description:

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