

TRANSPORT OF WATER, CHEMICALS AND ENERGY IN THE SOIL – PLANT – ATMOSPHERE SYSTEM

in conditions of the climate variability

Book of Abstracts

**Edited by
L. Botyanszká
P. Rončák**

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P. Rončák
Editors**

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TURBULENT FLOW IN SURFACE WATERS: MECHANISMS AND IMPLICATIONS FOR WATER QUALITY

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ABSTRACT

Turbulence is a fundamental feature of fluid dynamics, characterized by chaotic motion, vortical structures, and enhanced mixing. While often studied in laboratories or numerical models, turbulence is equally vital in natural streams, governing the transport of heat, sediments, and dissolved substances. Among surface waters, turbulence in rivers and reservoirs strongly influences the distribution of basic indicators of water quality. In rivers, it arises from bed roughness, channel geometry, obstacles, and gradients of velocity in profiles, driving pollutant dispersion, sediment resuspension, and oxygen exchange. In reservoirs, turbulence is induced by inflows, outflows, wind forcing, and density currents, controlling mixing, stratification, and the transport of nutrients and other substances. These processes directly affect ecological balance and water quality, including algal blooms and water usability.

This work highlights the link between classical turbulence theory and its manifestation in rivers and reservoirs. By connecting flow mechanisms to water quality challenges, it emphasizes the need to integrate fluid dynamics and hydrology for effective surface water management.

Keywords: turbulent flow, surface waters, hydrology, pollutant transport, stratification

THE PERSISTENCE OF SOIL DEGRADATION DESPITE CONVERSION TO CONTOUR NO-TILL

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ABSTRACT

Contour no-till with strip cropping mitigates water erosion, yet pre-existing concentrated flow paths like thalwegs can remain a challenge. This study investigates the state of soil properties within a persistent erosion furrow, after the implementation of a contour no-till system. Study tries to highlight the limitations of this practice when applied to zones of severe, pre-existing degradation. In Kolíňany, Slovakia, in an agricultural field with a known history of water erosion, we compared an erosion furrow to adjacent, no-till crop strips with winter barley and corn. Analysis of undisturbed soil samples of medium heavy soil revealed that the furrow remained severely degraded. Compared to the control (corn strip), furrow zone had significantly lower total porosity (-6%), saturated hydraulic conductivity (-88%), and soil aeration (-63%), but a much higher volumetric water content (+113%). These poor conditions caused the crop failure and dominant weed cover. Our findings demonstrate that a single pass with a no-till seeder, even when following contours, is insufficient to disconnect the hydrology of an existent erosion furrow. Topographic runoff concentration can override conservation tillage benefits in these critical areas. Therefore, to restore productivity and control erosion effectively, broad-scale no-till must be supplemented with targeted interventions like grassed waterways or localized soil rehabilitation, especially when combined with managing uphill runoff sources.

Keywords: conservation agriculture, soil properties, water erosion, surface runoff, thalweg

Acknowledgement: This work was supported by the by the Slovak Research and Development Agency under contract number APVV- 23-0530, Scientific Grant Agency, grant number VEGA 1/0681/24 and the Cultural and Educational Grant Agency, grant number KEGA 006SPU-4/2024.

LAKES AND RESERVOIRS IN THE DANUBE RIVER BASIN: ECOLOGICAL ASSESSMENT, CROSS-BORDER MANAGEMENT AND FLOOD RISK REDUCTION

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ABSTRACT

Lakes and reservoirs represent key hydrological and ecological structures within the Danube River Basin, yet their classification and management remain fragmented across national borders. The LAREDAR project addresses this gap by developing a unified typology and assessment framework for standing water bodies, integrating hydrological, ecological, and land-use parameters. The Institute of Hydrology of the Slovak Academy of Sciences contributes to the project through the analysis of national datasets, refinement of classification criteria, and testing of flood attenuation models in selected pilot areas. Methodological approaches include GIS-based spatial analysis, ecological indicator integration, and scenario modelling under climate variability. The project aims to support basin-wide planning instruments such as the Danube River Basin Management Plan and the implementation of EU directives related to water and flood risk. Scientific outputs are expected to enhance transboundary coordination, inform adaptive management strategies, and strengthen institutional capacities for sustainable water governance in the region.

Keywords: Ecological assessment, Lakes and reservoirs, Flood risk mitigation, Transboundary water management, Danube River Basin

FUNCTIONAL EVALUATION OF TMS-4 SOIL MOISTURE AND TEMPERATURE SENSOR

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ABSTRACT

Soil moisture and temperature sensors for an affordable price could provide the necessary data for water conservation measures and sustainable use of water in agriculture. The TMS-4 sensor (TOMST, Czech Republic) provides soil moisture and soil temperature data, together with the information about air temperature close to the soil surface. Three TMS-4 replicates were calibrated and evaluated in the laboratory for three temperature levels (4°C, 20°C, and 35°C). Another set of three TMS-4 sensors was installed in the field, and their performance throughout the year was assessed. Contrary to the expectations, temperature changes had no significant effect on the quality of the measurements. On the other hand, significant variability was observed between sensors, leading to significant differences in measured soil moisture content during some periods (maximum detected difference in RAW counts was 850, which represents a difference in soil moisture content of 17% by vol.). In addition to that, own calibration equations determined in the laboratory could not be transferred to another set of sensors, suggesting that each sensor should be calibrated individually.

Keywords: TOMST, soil water content, temperature variations, measurement accuracy, testing

PHOTOSYNTHETIC AND PHYSIOLOGICAL RESPONSES OF MUNG BEAN (*VIGNA RADIATA* L.) TO MICROPLASTIC TREATMENTS

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ABSTRACT

Ecological research increasingly examines how plants respond not only to climate change but also to emerging anthropogenic stressors such as plastic contamination. Global plastic production and consumption have risen sharply since the 20th century, leading to massive plastic waste accumulation in the environment. Plastics persist in terrestrial, aquatic, and atmospheric systems, posing long-term ecological and potential health risks. Due to their persistence and resistance to degradation, microplastics accumulate in soils, contributing to lasting environmental pollution. This study investigated how three plastic types—HDPE (high-density polyethylene), PS (polystyrene), and PVC (polyvinyl chloride)—influence photosynthetic performance and chlorophyll content in mung bean (*Vigna radiata* L.) compared with untreated controls. A series of chlorophyll fluorescence parameters and pigment indices were measured to assess the impact of plastic exposure. The results indicate that PS treatment caused the most pronounced reduction in photosynthetic efficiency, whereas HDPE and PVC produced smaller or inconsistent effects. These findings suggest that microplastic exposure can alter the physiological status of mung bean plants, potentially affecting their growth and productivity under environmental stress conditions.

Keywords: microplastics, photosynthetic performance, physiological responses, mungo bean

Acknowledgements: The study was supported by the Slovak Scientific Grant Agency (VEGA) grant number 2/0037/24.

CLIMATE-INDUCED CHANGES IN ATMOSPHERIC HUMIDITY IN SLOVAKIA AND THEIR CONSEQUENCES

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ABSTRACT

The primary objective of this study is to examine the long-term development of atmospheric moisture conditions—specifically water vapor dynamics—in the context of climate change in Slovakia, and to assess their potential implications. To analyze air humidity, we used daily averages of air temperature, relative humidity, and water vapor pressure, based on measurements from the meteorological station in Hurbanovo. The analysis of selected humidity characteristics for the periods 1961–1990, 1991–2020, and 2011–2020 clearly indicates significant climatic changes. These are reflected in the increasing number of days with high water vapor pressure, low relative humidity, and elevated saturation deficit. Such changes suggest a shift toward more frequent occurrences of sultriness and dry conditions, which may adversely affect human health, thermal comfort, and especially agricultural productivity. The evapotranspiration deficit—an essential indicator for assessing regional water balance—shows a long-term increasing trend, particularly during the warm half-year and summer months, indicating a growing need for irrigation.

Keywords: Sultriness, saturation deficit, evapotranspiration deficit, climate change, irrigation demand

RESPONSE OF GREEN ROOF SYSTEMS TO COMPOUND PRECIPITATION EXTREMES: A CASE STUDY BRATISLAVA– TRNÁVKA

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ABSTRACT

The increasing frequency of compound climate extremes, particularly heatwaves and intense rainfall, poses a significant challenge for urban water management. Green roofs represent an effective adaptation measure capable of mitigating such impacts by reducing surface runoff and enhancing the retention capacity of impervious urban areas. This experiment aimed to analyze the effect of different precipitation event types on the retention performance of green roof systems. Measurements were conducted in the Bratislava–Trnávka locality between July and September 2025, a period characterized by extreme air temperatures and short, high-intensity rainfall events. Six experimental modules were constructed, varying in substrate depth, additive composition, and storage layer type. Runoff from each module was collected in storage containers, while substrate moisture and temperature were continuously monitored using sensors. The results demonstrated that short, high-intensity rainfall events produced significantly higher runoff compared to longer, low-intensity precipitation. Retention performance was not strongly influenced by substrate type and storage layer design. These findings highlight the importance of considering precipitation extremes and compound climate events in the design and implementation of green roof systems as an effective urban climate adaptation strategy.

Keywords: green roofs, retention capacity, runoff, rainfall

Acknowledgements: The study was supported by the VEGA grant project No. 2/0115/25 and the Programme for Motivation and Support for Increasing the Quality and Efficiency of Scientific Research Activities of Young Scientific Researchers (project: HYDROVEGE).

THE IMPACT OF BED SEDIMENTS ON THE CHANGE IN FLOW CONDITIONS ON THE CHOTÁRNY CHANNEL AS A RESULT OF ITS SILTATION FROM 1993 TO 2018

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ABSTRACT

The aim was to find out the consequences of the silting of the Chotárny channel (the channel network on Rye Island - ŽO) on the flow conditions in this channel. This paper deals with the evaluation of the results of field measurements on the Chotárny channel for the period from 1993 to 2018. ŽO is a flat area, the flow velocities in all channels of its channel network are very low and as a result, sediments settle mainly on the bottom of the channels. The cross-section of the channels decreases with increasing thickness of the bed sediments and due to permanent sedimentation processes, not only the cross-section of the channels, but also their longitudinal profile changes unfavorably. The volume of sediments also increases. Bed sediments, their thickness and texture have a significant impact on the interaction between surface water in the ŽO channels and groundwater in their surroundings. Since 1993, detailed field measurements of the thickness of bed sediments along the Chotárny channel have been carried out, the longitudinal distribution of bed sediments, the percentage of siltation of the flow area in this channel and the values of the volumes of bed sediments in the Chotárny channel for the monitored period (1993 - 2018) have been determined. The results of these measurements are summarized in all tables and figures of the paper, and their comparison indicates an increasing trend in the longitudinal siltation of Chotárny channel, as well as the volume of its bed sediments for the monitored period.

Keywords: channel network, bed sediments, interaction, percentage of silting up, volume of sediments

ANALYSIS OF SEASONAL DRYING IN INTERMITTENT WATERCOURSES

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ABSTRACT

This analysis examines drought periods in intermittent streams of the Slovak Republic during the 2022 hydrological year. The research aimed to determine the duration and intensity of minimum and zero flow conditions at 22 gauging stations, defined by discharges $\leq 0.001 \text{ m}^3 \cdot \text{s}^{-1}$. The analysis focused on spatial and temporal patterns of drought events and their links to climatic, pedological, topographic, and anthropogenic factors. Meteorological data on precipitation and temperature were collected from stations within 25 km of the profiles, while supplementary information included soil properties, slope gradients, and land use derived from the Corine Land Cover 2018 database. Results revealed a clear seasonal trend, with the highest incidence of dry days in summer, indicating a summer low-flow regime. Several catchments experienced extended drought periods, associated with shallow soils, steep terrain, low retention capacity, and rainfall deficits. The findings underscore the vulnerability of intermittent streams to climatic extremes and highlight the importance of hydrological, pedological, and landscape characteristics in identifying drought-prone areas. This research provides a foundation for future studies.

Keywords: zero discharges, intermittent watercourses, drought

APPLICATION OF THE CLIMAAX TOOLBOX FOR CLIMATE RISK ASSESSMENT OF HEATWAVE–DROUGHT EVENTS IN TRNAVA, SLOVAKIA

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ABSTRACT

This study focuses on assessing climate change impacts and related risks for the city of Trnava, with an emphasis on compound climate events, particularly the co-occurrence of heatwaves and drought. The assessment applies the CLIMAAX methodology, using harmonized European datasets and standardized workflows for Climate Risk Assessment. The heatwave risk workflow combined LST data (RSLab) with vulnerable population layers (WorldPop), identifying zones with critical heat risk levels where targeted adaptation measures (e.g., urban greening, cooling shelters) should be prioritized. Land Surface Temperature analysis for 2013–2024 confirmed persistent overheating patterns in the city centre and built-up areas. Results indicate an increase in heatwave days by more than 180 % under RCP 4.5 and up to 240 % under RCP 8.5 for 2036–2065, with the most affected areas in residential and industrial zones. The drought workflow applied the CLIMAAX agriculture drought module using Euro-CORDEX climate projections and crop-specific parameters to estimate yield reductions under future precipitation deficits. The analysis indicated potential yield losses of 30–42 % for maize and wheat, representing significant impacts on agricultural productivity in the Trnava region. These losses were translated into potential economic losses, which could have a major impact on local farmers and the regional food system, particularly if irrigation is not implemented and the projected climate scenarios materialize. The analysed compound events highlight increased risks to public health, urban comfort, and regional agriculture, with cascading effects on energy demand, water availability, and ecosystem services. The results also demonstrate the transferability of the CLIMAAX Toolbox to other medium-sized European cities, supporting knowledge sharing and scaling up adaptation practices. In future research, the study will integrate high-resolution local climate data provided by the Slovak Hydrometeorological Institute and vulnerability layers to improve spatial accuracy and support the update of Trnava's adaptation strategy and targeted nature-based solutions.

Keywords: Climate risk assessment, heatwaves, drought, CLIMAAX, adaptation strategies

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ACID MINE DRAINAGE IN THE SLANÁ RIVER: WATER POLLUTION AND POTENTIAL FOR RESOURCE RECOVERY

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ABSTRACT

Slovakia faces significant environmental challenges from numerous abandoned mining sites, where acid mine drainage (AMD) represents a major source of contamination due to its low pH and high concentrations of dissolved metals. At the Nižná Slaná site, AMD has been continuously discharging into the Slaná river since February 2022. This study investigates the potential of removal and recovery of iron and arsenic from AMD using biological iron oxidation coupled with targeted precipitation. Water samples underwent bacterial oxidation of Fe²⁺ to Fe³⁺ by naturally occurring bacteria, followed by pH adjustment to induce secondary mineral formation. Atomic absorption spectrometry revealed a reduction of iron from 1771 µg ml⁻¹ to 2.93 µg ml⁻¹ (>99.8% removal) and arsenic from 15.55 µg ml⁻¹ to 7.2 ng ml⁻¹ (>99.9% removal). These findings demonstrate the efficiency of combining biological and chemical treatments for AMD remediation and underscore the potential of mine waters as secondary sources of critical and strategic raw materials.

Keywords: Acid mine drainage, Nižná Slaná, Targeted precipitation, Secondary minerals

ENHANCING SANDY SOIL RESILIENCE TO DROUGHT THROUGH BIOCHAR

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ABSTRACT

Sandy soils, characterized by low water retention and high permeability, are highly susceptible to drought and climatic fluctuations. Soil water repellency (SWR), often induced by hydrophobic organic coatings, further reduces infiltration and limits plant water availability. To enhance the resilience of such soils, this study investigated the influence of hydrophilic biochar on key hydrophysical parameters of sandy substrates. Laboratory experiments systematically assessed how biochar application rate, particle size, and pyrolysis temperature affect water retention, saturated hydraulic conductivity (Ks), and SWR. Results showed that biochar application significantly increased the available water content (AWC), with the highest improvement (up to 168% over control) observed at the 40 Mg ha⁻¹ rate and with fine particles (<125 µm). Conversely, Ks decreased by as much as 90%, indicating improved water retention in the root zone due to reduced drainage losses. However, certain hydrophobic biochar types slightly increased SWR, highlighting the need to evaluate biochar surface properties prior to field use. Overall, the findings demonstrate that optimized biochar application—favoring higher rates, smaller particle sizes, and wettable feedstocks—can substantially improve soil water dynamics and mitigate drought stress. This research provides strong experimental evidence supporting biochar as a climate-smart strategy for sustainable agriculture in drought-prone sandy landscapes.

Keywords: hydrophilic biochar, sandy soil, soil water repellency, drought resilience, climate-smart agriculture

THE SIGNIFICANCE OF MICROCLIMATE MONITORING IN FOREST FIRE RISK ASSESSMENT

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ABSTRACT

On May 3, 2025, a forest fire occurred below the peak Mních (Western Tatras region), at an altitude of approximately 1,300 m a.s.l., in an unlogged area characterized by mature spruce stands. In the vicinity of the fire site, there is a research plot at Červenec (1,420 m a.s.l.), where forestry-hydrological research is conducted. This research also focuses on monitoring the influence of microclimate on the occurrence of meteorological fire danger. Meteorological fire danger refers to the probability of fire ignition and spread in the natural environment, which is conditioned by current meteorological variables and is determined by calculating a meteorological fire danger index. Based on the measurements obtained, we can confirm that the forest fire was preceded by warm, dry, and windy weather. On May 2, 2025, an extremely low relative air humidity (23.7%) was recorded, and on May 3, around 2 p.m., the air temperature culminated (22.0 °C). At the time of the probable ignition of the forest fire, we were monitoring a high (4) fire risk. The total burned area reached 6.1 hectares.

Keywords: meteorological fire danger index, microclimatic stations, spruce forest, firefighting operation, Western Tatras

Acknowledgement: This work was supported by the VEGA project no. 1/0392/22, 1/0443/23 and 2/0019/23 awarded by the Ministry of Education, Research, Development and Youth of the Slovak Republic and the Slovak Academy of Sciences; and the projects of the Slovak Research and Development Agency no. APVV-18-0347, APVV-19-0340, APVV-21-0224, APVV-23-0332 and APVV-24-0208. The authors thank the agencies for their support.

EVALUATION OF GROUNDWATER LEVEL AND SPRING DISCHARGE TRENDS (2014–2023) AND ASSESSMENT OF SIGNIFICANT DECLINING TRENDS AT SHMI MONITORING OBJECTS

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ABSTRACT

The main task was to assess the existence of significant declining trends in groundwater levels and spring discharges in groundwater bodies of Slovakia. A total of 1455 time series of annual averages and 1455 time series of annual minima were processed for the period 2014 – 2023 (including 1113 boreholes and 342 springs). To identify the presence of a significant declining trend, all time series were tested using the non-parametric Mann-Kendall statistical test. If the dataset followed a normal distribution, the parametric ANOVA method was also applied. The results were visualized using map presentation. If there was one significant declining trend found, groundwater quantity status was classified as being at risk. If there were two or more declining trends in one category (average/minima) found, the groundwater body was classified as having a poor quantitative status. Finally, 17 groundwater bodies were classified at risk and five groundwater bodies in poor quantitative status.

Keywords: significant declining trend, groundwater level, spring discharge, groundwater body

LONG-TERM MONITORING PERSPECTIVE ON DROUGHT IN THE MORAVA RIVER BASIN

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ABSTRACT

Smaller catchments are highly sensitive to hydrological drought and can experience complete drying during extreme conditions, which directly affects hydrological connectivity and aquatic ecosystems. In the Morava River Basin, we have analyzed long-term series of mean daily discharges from 14 gauging stations situated in catchments smaller than 50 km², with the objective of quantifying the occurrence of zero-flow conditions. Zero discharges were detected at 9 of the monitored stations. To evaluate their characteristics, we examined the temporal clustering of zero-flow days, identified the duration of drying episodes, and applied trend analysis to assess temporal changes. The results indicate that drying events were not isolated phenomena and zero discharges were recorded at 4 stations in 2017 and at 3 stations in both 2012 and 2022. Seasonal analysis showed that August, September, and October were the most affected months, corresponding to periods of low precipitation and high evapotranspiration. These findings reveal that smaller catchments in the Morava River Basin are vulnerable to repeated and extended drying episodes, with implications for future water demands, water quality and ecological resilience. The presence of zero-flow conditions across multiple years suggests that they may become more common in the region, especially under projected climate change scenarios that anticipate hotter and drier summers. The importance of long-term hydrological monitoring networks is in capturing the frequency and persistence of drying events and provides basis for understanding hydrological drought processes, evaluating ecological impacts, and supporting adaptation strategies in water resources management.

Keywords: hydrological drought, small catchments, long-term monitoring

ADAPTATION OF FIELD CROP SPECIES TO CLIMATE CHANGE IMPACTS

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ABSTRACT

Growth and development of field crops are determined by the physical conditions of the habitat. Climatic impacts may influence production patterns, the deterioration of quantitative and qualitative values of crop yields, inducing the hazard of food security and -safety. Agronomic measures may contribute to adaptation issues.

The IPCC's Sixth Assessment Report of 2021 presents five potential future scenarios for the physical science of climate change. These scenarios are based on complex IPCC modelling. The scenarios focus on the main climatic characteristics – the trends in temperature and water availability. An assessment study has been done at the MATE University, Gödöllő to evaluate and identify the main factors of field crop adaptability to climate change processes. VI vulnerability indices (Tarnawa et al 2012) of 12 field crop species were processed with PAI aridity indices (Pálfai 2010) projected to certain geographic sites of Europe modelled by IPCC 2021. In the research Wheat (*Triticum aestivum* L), Maize (*Zea mays* L), Winter and Spring barley (*Hordeum vulgare* L), Rye (*Secale cereale* L), Oats (*Avena sativa* L), Peas (*Pisum sativum* L), Sunflower (*Helianthus annuus* L), Oilseed rape (*Brassica napus* L), Alfalfa (*Medicago sativa* L), Sugar beet (*Beta vulgaris* L) and Potato (*Solanum tuberosum* L) were studied.

The results obtained suggest, that susceptibility of cereal species proved to be the lowest, however maize and potato were highly affected by aridity x vulnerability interactions. The strongest climatic influence could be detected in the case of alfalfa and sugar beet. Regional differences in aridity were detectable. Undesirable effects of climate change may be limited by changes in the cropping structure of crop species and varieties, improved water-management, adapted plant nutrition, protection and tillage practices

Keywords: climate change, field crops, adaptation, regionality

VÍZ24 MOBIL APPLICATION AS A TOOL FOR DECREASE RISK OF WATER DAMAGES IN SETTLEMENTS

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ABSTRACT

As a result of climate change, the annual average precipitation in the region has not shown significant changes in volume; however, its distribution throughout the year has become increasingly uneven. Extended periods of summer drought are often followed by intense rainfall events. In the Middle Tisza region, next to the heavy rain events the snowmelting coinciding with precipitation at the end of winter and spring, can result in localized water damage. While a well-developed forecasting system is in place for predicting river flood events—with clearly defined changes in water levels—there is currently no standardized system in Hungary for forecasting local water damage. Moreover, smaller municipalities often lack the necessary professional experts to implement effective protective measures. To support these municipalities, our Directorate has developed a mobile application designed to assist with water damage prevention. The VÍZ24 mobile application provides real-time notifications to users based on cloudburst alerts issued by Hungaromet. Additionally, information and organizational details related to water damage prevention plans for the settlements within the operational area of KÖTIVIZIG have been uploaded to the platform. Previously, a risk assessment system for local water damage affecting settlements was developed within KÖTIVIZIG's operational area. Under the framework of the HuT project, this risk assessment system has been further enhanced, now incorporating soil moisture data collected through the drought monitoring network. We are analyzing past water damage events to identify potential correlations with soil moisture levels. Our findings indicate a clear relationship between soil moisture conditions and the risk of local water damage in settlements. Elevated soil moisture levels were consistently observed prior to the occurrence of such events. While high soil moisture alone does not directly cause damage, it significantly increases the likelihood of it. As part of this effort, we have integrated a daily updated risk map—covering the entire Middle Tisza District Water Directorate's area of responsibility—into the VÍZ24 mobile application. It would be beneficial to expand the existing risk assessment methodology to include areas beyond the settlements.

Keywords: Flood, pluvial flood, heavy rain, climate change, mobile application, risk mitigation, water damages in urban areas

REGIME OF SUSPENDED SEDIMENTS OF THE DANUBE RIVER IN SLOVAKIA: LONG-TERM TRENDS AND IMPACTS OF HIGH-FLOW EVENTS IN 2024

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ABSTRACT

The suspended sediment load is defined as the total mass of inorganic and organic particulate matter that is transported in suspension by streamflow within a specified temporal interval. Its quantification is of fundamental significance in the context of hydrological research and water resources management, as well as in assessing and enhancing environmental protection measures. The systematic monitoring of suspended sediments constitutes an essential element of surface water quality surveillance and is mandated under the provisions of the European Water Framework Directive (2000/60/EC). This directive has been transposed into the national legislative framework through Act No. 364/2004 Coll., as subsequently amended (the Water Act), together with the corresponding implementing regulations. In this study, the suspended sediment regime was investigated at three water gauging stations along the Danube River, where long-term data of suspended sediment concentration have been maintained since 1993, with particular emphasis on the year 2024. Hydrological observations indicated that during the past year, the elevated water levels in January, June, and September led to a significant influence on the transport of suspended sediments in the river.

This work was supported by the Slovak Research and Development Agency under the Contract No. APVV-23-0332.

Keywords: suspended sediment load, sediment transport, Danube River, flood impacts

MONITORING QUALITY OF SURFACE WATER DEPENDING ON SOIL LEACHATE

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ABSTRACT

The hazard of heavy metals is in their ecotoxicity and cumulation in abiotic and biotic parts of the environment. Soil quality is an important characteristic for evaluating the balance of important soil ecological functions after anthropogenic and natural impacts. The acquired experience shows that the contents of heavy metals in weaker extractants will represent the potentially mobilizable forms (in HNO_3^-), actual mobilizable forms in (EDTA).and mobile forms (in CaCl_2). Biologically important microelements (e.g. Cu, Zn) or non essential chemical elements (Cd, Pb, Cr etc.). In the paper are discussed the total contents of Cd, Pb, Cu, Zn in 9 soils leachate as well as their determination. A major problem associated with Cd accumulation in soils is its relatively high mobility in relation to other metals, resulting in absorption by plants and subsequent translocation from roots to shoots.

Keywords: water quality, surface water, heavy metals

VALIDATION OF SENTINEL SNOW MONITORING BY IN SITU TIME-LAPSE PHOTOGRAPHY IN THE VICINITY OF SKALNATÉ PLESO OBSERVATORY DURING 2021-2025

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ABSTRACT

Snow is one of the most important meteorological and hydrological variables affected by climate change. The need for its monitoring is increasing due to its irreplaceable role in the hydrological cycle during the spring months, especially in mountainous regions. This study focuses on the validation of snow cover derived from the Sentinel satellite data using in situ observations in the vicinity of Skalnaté Pleso Observatory (1600–2000 m a.s.l.) in the High Tatras. Satellite observations analysed in this paper are represented by outputs of the Gap-filled snow cover (GFSC) product of the remote sensing programme Copernicus. In situ measurements were carried out using a trail camera equipped with a time-lapse function, covering the period from November 2021 to January 2025. Our results show that this GFSC product has certain limitations in mountain regions, such as the High Tatras. The methodology used to reduce cloud cover in GFSC data caused a considerable lag during periods of rapid increases or decreases in snow cover were observed under cloudy conditions.

Keywords: snow cover, camera, satellite

INTEGRATING SCIENTIFIC REGIONAL KNOWLEDGE IN SCHOOLS' CURRICULA CASE STUDY FROM THE ALTES LAND IN GERMANY

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ABSTRACT

Bringing scientific research results to pupils – explaining globally important phenomena and driving factors with a regional/local touch, that was the idea of the Merlin media package, “Cultural Landscape of the Altes Land” that was created for the NiBiS (Lower Saxony Education Server) within the framework of 2018 Sharing Heritage. It is accessible to all teachers in Lower Saxony, as well as to teachers from other German federal states through links to the German education servers. The media package explains the cultural landscape of the Altes Land, a river marsh landscape cultivated by Dutch hydraulic engineers in the 12th and 13th centuries. Numerous topics are addressed in today's geography lessons using this cultural landscape. The following subject areas of the Lower Saxony core curriculum for secondary schools, grammar schools, and middle and upper secondary schools in Lower Saxony are covered in the educational package “55501159 Cultural Landscape of the Altes Land”. The educational material contains films and interviews with local actors, tourists and inhabitants. It addresses several topics from the geography curriculum for different age groups and school forms.

Keywords: education, river, marsh, landscape

INTRASPECIFIC AND INTERANNUAL VARIABILITY OF STOMATAL AND LEAF TRAITS IN POPLAR CLONES

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ABSTRACT

Stomata play a crucial role in plant functioning as they regulate the exchange of water vapor and carbon dioxide between the plant and its environment. In this study, we analyzed morphological differences in stomata among 14 clones of poplar (*Populus* sp.). Leaves and stomatal imprints were collected during three climatically contrasting years. The aim was to determine whether the observed differences were primarily caused by environmental conditions or by intraspecific (genetic) variability. We evaluated stomatal density and size, and used the obtained data to calculate the stomatal potential conductance index. Also, we measured leaf area and specific leaf area was calculated. The results revealed that the variability of stomatal traits was influenced by both genetic predisposition of the clones and the climatic conditions of the respective years. Based on these findings, it is possible to identify the clones that showed the best adaptation to changing environmental conditions.

Keywords: *Populus*, stomatal density, stomatal size, leaf traits, genetic variability

Acknowledgement: This work was supported by the Slovak Research and Development Agency (APVV-21-0270, APVV-21-0224) and by the Slovak Grant Agency for Science (VEGA 1/0392/22).

TEMPORAL SHIFTS IN SEASONAL LOW FLOWS: UNRAVELLING CLIMATE-DRIVEN HYDROLOGICAL RECONFIGURATION IN THE CARPATHIAN BASIN

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ABSTRACT

The Carpathian Basin, a key transboundary watershed, is experiencing hydrological shifts due to climate change. This study analyzes 1931–2020 daily flow data from 16 gauging stations across the Danube, Tisza, Sava, and other tributaries. Kernel density estimates (KDEs) and statistical metrics, including mean and peak day-of-year (DOY) differences, assess changes in seasonal minimum discharge timing and magnitude, comparing 1931–2000 and 2001–2020 periods. Results show spring minima advancing by 2–5 days, driven by earlier snowmelt from warming Alpine and Carpathian temperatures, and summer minima delaying by 2–10 days, linked to intensified evapotranspiration and drought. Modal low flows have decreased 10–25% post-2000, with higher variability in smaller tributaries, reflecting climatic and anthropogenic influences like reservoir operations. These trends align with EURO-CORDEX projections of 10–30% basin-wide low-flow reductions. The study concludes that adaptive water management is essential to mitigate impacts on navigation, hydropower, agriculture, and ecosystems, urging integrated modeling and transboundary cooperation to bolster resilience in this critical region.

Keywords: Hydrological shifts, climate change, Danube Basin, seasonal minima, water resource management.

Acknowledgment: This research was supported by the “Streamflow Drought Through Time” project funded by the EU NextGenerationEU through the Recovery and Resilience Plan of the Slovak Republic within the framework of project no. 09I03-03-V04-00186.

MONITORING OF SNOW COVER IN SKALNATÁ VALLEY (HIGH TATRAS) USING TIME-LAPSE PHOTOGRAPHY

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ABSTRACT

Snow cover is a critical component of the hydrological cycle in mountain regions. Monitoring it has become increasingly urgent in recent years due to climate warming. To analyse snow cover dynamics, we complemented manual point measurements using a snow stake at the Skalnaté Pleso Observatory (1778 m a.s.l.) with a trail camera equipped with a time-lapse function and image transmission. In this study, we compared data from four winter seasons (2021–2025). During the 2021/22, 2022/23, and 2023/24 seasons, snow coverage reached 100 %, meaning the entire environment, including vegetation canopies, was completely covered with snow. In contrast, during 2024/25, coverage remained low, fluctuating around 50 % throughout the season. Such low snow cover in high mountain areas can have a wide range of consequences across ecological, hydrological, and geomorphological systems. Low snow cover reduces the insulating effect of snow, leaving vegetation exposed to sub-zero air temperatures, which can result in frost damage, winter desiccation, or abrasion by windblown ice.

Keywords: snow coverage, camera, image analysis

EXTREME PRECIPITATION EVENT IN SLOVAKIA IN SEPTEMBER 2024

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ABSTRACT

In mid-September 2024, Storm Boris brought heavy rainfall, flooding, and significant damage to Central Europe. This study analyzes the intensity, spatial distribution, and meteorological drivers of this extreme precipitation event using observational data from more than 600 precipitation stations across Slovakia. The event is placed in a historical context by comparing its maximum, multi-day, and cumulative precipitation totals recorded between September 11 and September 16, 2024, with previous extreme precipitation occurrences. Additionally, return period estimates and standard deviations [σ] were employed to assess the rarity of the event. The results indicate that the highest-ever recorded 2-day (267.3 mm in Borinka) and 5-day (379.8 mm in Pernek) precipitation totals in Slovakia occurred during this event. More than 20% of stations with available data recorded new maximum 2-day or 5-day precipitation totals, with multi-day totals surpassing the 100-year and 200-year quantiles. The extremity of the precipitation was most pronounced in 5-day totals, with some stations reporting values at or above the 6-sigma level.

Keywords: extreme precipitation, storm Boris, multiday precipitation, climate change, statistical analysis

WATER QUALITY OF THE VARÍNKA RIVER ASSESSED THROUGH PHYSICOCHEMICAL INDICATORS

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ABSTRACT

Physicochemical parameters of surface water quality play a fundamental role in regulating biological processes in aquatic ecosystems. In the context of climate change, alterations in the hydrological regimes of watercourses significantly affect water quality. This study focuses on the analysis of long-term data (1972–2017) on dissolved oxygen (DO), surface water temperature (Tw), acidity pH, and conductivity (EC) in the unregulated Varínka stream located in northern Slovakia. The aim is to identify significant changes in the development of these parameters and to analyze their monthly and annual trends. The results indicate a statistically significant increase in acidity pH and conductivity EC values. Regression and correlation analyses revealed notable relationships, particularly between water temperature Tw and dissolved oxygen DO. To predict future trends, the SARIMA autoregressive model was applied, demonstrating high effectiveness in modeling changes in selected parameters. This approach enables early risk identification and supports strategic management and protection of surface water resources.

Keywords: surface water quality, physicochemical parameters, climate change, long-term trends, autoregressive models.

ANALYSIS OF MODERN CHANGES IN THE FREQUENCY AND RECURRENCE PERIODS OF RAIN FLOODS IN THE TISZA RIVER BASIN WITHIN UKRAINE

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ABSTRACT

Rain flood frequency and recurrence periods statistics in the Tisza River basin were based on the use of historical data on maximum discharges for the observation period 1948-2019 from the gauging stations: Tisza River - Rakhiv city (catchment area 1070 km²); Rika River - Mizhhirya village (550 km²); Latorytsia River - Mukacheve city (1360 km²). Due to the peculiarities of physical and geographical conditions (mountainous terrain, significant amounts of precipitation, etc.), floods on rivers in the Tisza River basin are formed several times during the year. Therefore, series of partial duration were formed, which contain the maxima of all rain floods. To assess modern changes in the frequency and recurrence of rain floods, two equal periods (36 years) were considered – 1948-1983 and 1984-2019. To determine the periods of recurrence of floods of a certain magnitude, a formula was used that is the inverse of the Weibull formula. Combined graphs of the recurrence periods of rain floods for the two studied periods were constructed, which made it possible to analyze changes in the frequency and recurrence periods of rain floods on rivers in the Tisza River basin that occurred in the modern period.

Keywords: Tisza River basin within Ukraine, rain floods, maximum water discharge, series of partial duration, recurrence period.

WATER QUALITY IN THE DANUBE IN THE PERIOD 2014-2024

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ABSTRACT

Since 2007 the quality of surface waters is in accordance with the requirements of the Water Framework Directive and it is monitored through “Surface Water Monitoring Program”. The aim is to assess the ecological and chemical status of surface water bodies. Limit values for surface water quality are given in Government Regulation No. (398/2012) Coll. which amends Regulation No. 269/2010 Coll.

This paper is focused on the assessment of selected substances in the Danube River in Slovakia during the period 2014-2024.

Keywords: monitoring, surface water, general physical-chemical elements

WILL TRNAVA'S CLIMATE FUTURE BE MILD, MODERATE, OR EXTREME?

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ABSTRACT

Trnava's climate is already showing signals of change, but which trajectory will define its future, mild, moderate, or extreme? Using CMIP6 projections, this study explored the city's evolving temperature and precipitation patterns under three Shared Socioeconomic Pathways (SSP126, SSP245, SSP585, representing mild, moderate and extreme climate impact scenarios). Historical records (1991–2024) from three Slovak stations were compared with five IPCC AR6 climate models to determine to identify the best recent trends. Results consistently indicate that SSP245, most closely matches the observed climate behavior of Trnava. Over the past decade, both maximum temperature ($T_{\max}$) and daily precipitation extremes ($P_{\max}$) under SSP245 exhibited the highest correlation and lowest bias relative to measured data. This pathway suggests a continued rise in mean and extreme temperatures, more frequent heavy rainfall events and greater interannual variability, conditions that could strain local water infrastructure and increase flood risk. The evidence therefore points toward Trnava following a moderate but steadily intensifying climate pathway, where adaptation and mitigation remain equally critical.

Keywords: CMIP6 climate projections, Trnava, Slovakia, SSP245, Urban climate adaptation

AREAL REDUCTION FACTORS DERIVED FROM COSMO-REA6 REANALYSIS

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ABSTRACT

Design rainfall is typically expressed as Intensity–Frequency–Duration (IFD) data at point locations. However, for hydrological applications, particularly in larger catchments, point rainfall does not adequately represent the areal average rainfall. The ratio between areal and point design rainfall values for the same duration defines the Areal Reduction Factor (ARF). In this study, ARFs are derived from the COSMO-REA6 gridded reanalysis dataset (6-km spatial resolution, 1-hour temporal resolution) for a group of catchments in Slovakia covering areas up to 10.000 km². Areal rainfall series are constructed directly from grid-cell precipitation, and annual maxima are analyzed for durations of 1, 3, 6, and 24 hours. Uncertainty in ARF estimation is quantified using non-parametric bootstrapping, and seasonal differences are explicitly considered to capture seasonal variability in precipitation producing processes and their spatial extent across different parts of the year. The resulting ARF relationships provide regionally consistent estimates that enhance the translation of point-based IFD data into hydrologically relevant design rainfall for catchments of varying sizes.

Keywords: areal reduction factors, design rainfall, flood design, COSMO-REA6, nested catchments

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ESTIMATING RUNOFF COEFFICIENTS IN SMALL CATCHMENTS: SEASONAL DIFFERENCES AND METHODOLOGICAL APPROACHES

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ABSTRACT

This study investigates the estimation of peak runoff coefficients in small catchments of the Slovak Republic by comparing indirect and direct methods. In the first part, the indirect approach was applied to catchments with areas up to 50 km², using estimated concentration times (Nash and Kirpich formulae), digital atlas of rainfall intensity, and intensity–duration–frequency (IDF) curves derived from rain gauge stations. In the second part, the direct method was applied, based on hourly peak flow measurements. Flood wave parameters were obtained by substituting causative precipitation, and the data were statistically analysed using the Johnson probability distribution. For all catchments, the peak runoff coefficient corresponding to a 100-year return period was estimated separately for summer and winter seasons and compared with indirect results. The study shows that the runoff coefficient is influenced not only by the chosen estimation method but also by the season of occurrence, with higher values observed in winter than in summer. These findings contribute to a better understanding of runoff formation in small watersheds and provide a practical framework for applications in regions where precipitation–runoff data are unavailable.

Keywords: runoff coefficient, flood separation, rational formula, IDF curves

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ESTABLISHMENT OF A LYSIMETER STATION FOR URBAN WATER STUDIES

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ABSTRACT

Weighing monolith lysimeters enable precise measurement of water balance parameters, including infiltration, evapotranspiration, and deep percolation. At the experimental field of Biotechnical Faculty, University of Ljubljana, two monolith lysimeters were installed to study solute transport (e.g., nitrate pollution) and to measure evapotranspiration. Due to the deep soils and high saturated zone in the area, the lysimeter depth was limited to 1.5 m to avoid buoyancy issues. Here, we describe the establishment of the lysimeter station, which became non-operational following floods in 2016, as well as the subsequent renovation, troubleshooting, and adjustment of the lower boundary conditions to ensure accurate measurements. The lysimeter station now enables the study of soil water balance in the peri-urban area of a pre-Alpine climate.

Keywords: weighting lysimeter, boundary conditions, evapotranspiration, water, measurement

DIURNAL STREAMFLOW FLUCTUATIONS AS AN INDICATOR OF EVAPOTRANSPIRATION IN THE VYDRICA CATCHMENT

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ABSTRACT

This study focuses on the quantification of evapotranspiration in the small forested Vydrica catchment (Little Carpathians, Slovakia) through the analysis of diurnal streamflow fluctuations. High-frequency water level measurements with a 15-minute resolution, conducted during a rainless summer period in 2025, revealed a distinct daily runoff cycle. This cycle, expressed as regular streamflow oscillations, directly reflects water loss through vegetation transpiration within the catchment. A consistent time lag of approximately six hours was identified between maximum daily air temperature and minimum streamflow. The mean daily runoff loss attributable to evapotranspiration was estimated at 3.45 mm, with maximum daily values exceeding 7 mm. These findings highlight the crucial role of riparian vegetation as a biological water pump and confirm that the analysis of diurnal streamflow fluctuations provides an effective method for estimating vegetation water use in small forested catchments, particularly under hydrologically dry conditions.

Keywords: evapotranspiration, small catchment, diurnal discharge fluctuations

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IMPACT OF SEVIRI RADIANCES AND VARBC ON REGIONAL PRECIPITATION FORECASTS IN CENTRAL EUROPE

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ABSTRACT

Satellite observations provide high-resolution, frequent measurements essential for improving regional numerical weather forecasts. Systematic errors (biases) in satellite radiances can degrade the quality of data assimilation and subsequent forecasts. This study applies the Variational Bias Correction (VarBC) method within the ALADIN/SHMU model to dynamically estimate and correct biases in SEVIRI radiances. Two independent cycling strategies were tested, starting from a zero initial state: updates at every assimilation step and daily cycling. Passive assimilation over a two-month period allowed assessment of coefficient stabilization. The daily cycling strategy achieved faster stabilization of bias coefficients and better alignment of model forecasts with observations. A case study of the low-pressure system Boris (September 2024) demonstrated the practical impact of VarBC on initial state analyses and 24-hour cumulative precipitation forecasts. Overall forecast improvements were modest, but the results highlight the potential of VarBC for enhancing regional hydrometeorological predictions.

Keywords: Data assimilation, satellite measurements, variational bias correction, ALADIN/SHMU model

INTEGRATING LAND-USE SCENARIO MODELING AND MACHINE LEARNING TO MITIGATE DROUGHT RISKS IN DEGRADED LANDSCAPES

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ABSTRACT

Land-use change accelerates environmental degradation and increases drought risk in vulnerable regions. This study analyzes drought dynamics in the South Malang Plateau, East Java, by integrating Sentinel-2A remote sensing data and the Random Forest (RF) algorithm. Three land-use scenarios were developed: Business-as-Usual (BAU) projected for 2030 using the CA-ANN model, Participatory Mapping (PM), and Land Capability Classification (LCC). A total of 175 field points and 25 predictor variables, including climatic, topographic, and anthropogenic factors, were used to train and validate the RF model, which achieved an overall accuracy of 92.57%. Results show that between 2017 and 2023, multistrata agroforestry declined by nearly 50%, natural forest cover decreased by 27.6%, while settlements more than doubled. Under the BAU scenario, forest area is expected to drop to 9,195 ha by 2030. Drought severity analysis indicated a reduction in “Severe Drought” from 18.1% (2019) to 3.1% (2030), but “Extreme Drought” slightly increased in deforested areas. The integrated LCC-PM approach showed the greatest potential to reduce drought vulnerability and land degradation. This integrative scenario is recommended to enhance landscape resilience and support sustainable land management.

Keywords: remote sensing; land-use change; machine learning; drought risk; sustainable landscape management.

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EVALUATING SOIL CHARACTERISTICS AND VEGETATION COMPOSITION IN DIFFERENT LAND USE CATEGORIES IN THE MÁTRA WINE REGION IN HUNGARY

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ABSTRACT

Small parcels dominate the Mátra wine region. We aimed to investigate the difference between soil characteristics and vegetation composition of land uses (vineyard, fallow, fallow with perlite, orchard, scrubs forest). We hypothesized that sites under cultivation have higher soil nutrient and those without treatment would have lower soil nutrient and higher soil organic matter and water content. Soil samples were collected from the 0–20cm. Soil properties were measured by a near-infrared device (Agrocares Ltd.) and compared. Vegetation was examined using 1×1 m quadrats, coverage of each plant species was recorded. Our results suggest that soils under regular cultivation are exhausted, and the soil of natural habitats is richer in nutrients. The application of some winemaking by-products (e.g. perlite) can help improve the nutrient content of the soils. Based on the vegetation, it is clearly visible that the entire area has been used for viticulture before. However, the relatively high proportion of natural species and the small presence of invasive species indicate that this land structure can be a sustainable way both from a farming and ecological point of view.

Keywords: vineyard, orchard, fallow, soil nutrient, weed species, invasive species

MAXIMIZING ECOSYSTEM SERVICES THROUGH LEGUME-BASED FARMING: HUNGARIAN PARTICIPATORY FARMING TRIALS

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ABSTRACT

The environmental and health benefits of legumes are receiving increasing attention in agriculture and food production. It is well known that legumes can contribute significantly to addressing today's greatest challenges – climate change, biodiversity loss, and food security – but accurately measuring and monitoring these benefits remains difficult. The LegumES project aims to change this by collecting, integrating, and testing scientific and practical experience in order to optimize legume-based production systems and maximize the ecosystem services they provide. The four-year project was launched in January 2024 with the participation of 22 partners from 11 countries. In Hungary, three sites were selected for participatory farming trials: one arable field in Nyalka with chickpea production, one arable field in Kiskunmajsa with cowpea production and one horticulture field in Kóspallag with common bean production. Agronomic data of the production, data on soil characteristics, decomposition and pollinators were collected on-site to estimate ecosystem services of the legumes. Preliminary results of the assessment show that legumes can contribute to the on-farm ecosystem services provision in many ways.

Keywords: agroecology, sustainable farming, sustainable agriculture, decomposition, nature-based solutions

ANALYSIS OF THE HEAVY SOIL WATER REGIME AFTER TO GYPSUM APPLICATION

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ABSTRACT

Climate change has increased the frequency of droughts, emphasising the importance of measures that support water retention in the soil. Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) is a widely used soil amendment that improves the soil aggregate stability and infiltration. This study assessed the effect of calcium sulfate dihydrate application on soil volumetric moisture using two experimental approaches. A short-term experiment in the surface layer (0–10 cm) did not show significant differences in average soil moisture. The higher application rates led to greater variability and the occurrence of extreme values. Long-term monitoring of the 0–30 cm soil profile demonstrated a positive and gradually increasing effect of gypsum on water retention, particularly at the rate of 4 t ha^{-1} , which maintained moisture within the optimal range available to plants throughout the growing season. Comparisons with hydrolimits showed that gypsum application extended the period during which soil water was available to plants. The results suggest that gypsum amendment can be an effective ameliorative measure for improving the soil water regime and increasing resilience to drought under Central European conditions.

Keywords: calcium sulfate dihydrate, soil moisture, hydrolimits, soil profile, water retention, drought resistance

EFFECT OF DISPARATE FRACTIONS OF POLYLACTIC ACID ON HYDRAULIC PROPERTIES OF THE SATURATED SANDY LOAM SOIL

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ABSTRACT

In recent years, there has been a growing recognition of microplastics as significant pollutants, however, our understanding of the ecological effects of microplastics in soil ecosystems is still limited. Some studies on the effects of microplastics on soil hydraulic properties confirm that the effects are related to the proportion and size of microplastics in the soil. Here, we have compiled impact of polylactic acid (PLA) in different fractions (small <100, medium 100–200 and large >200 µm) on saturated hydraulic conductivity of the sandy loam soil. An automatic laboratory system KSAT (METER Group GmbH, Munich) was used to measure saturated soil hydraulic conductivity of the soil. The results show, that small PLA particles mixed with soil reduced saturated hydraulic conductivity by 46%. On the contrary, large particles increased saturated hydraulic conductivity in the soil by 71%. Medium PLA fractions (100–200 µm) have no significant impact on the hydraulic properties of the soil.

Keywords: microplastics, polylactic acid, saturated hydraulic conductivity

Acknowledgements: The study was supported by the Slovak Scientific Grant Agency (VEGA) grant number 2/0037/24.

CHANGES IN SATURATED HYDRAULIC CONDUCTIVITY AFTER BIOCHAR APPLICATION IN WATER-REPELLENT SOIL

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ABSTRACT

Saturated hydraulic conductivity (K_s) is a fundamental hydrophysical parameter of soil. Its values tend to be particularly high in sandy soils due to their coarse texture and the abundance of macropores, which facilitate rapid water infiltration into deeper soil horizons. Water-repellent soils, however, present a contrasting behaviour, where water infiltration is often severely limited at the surface layer. In this study, we investigated whether the application of biochar influences saturated hydraulic conductivity in sandy, water-repellent soils. Biochar was incorporated into the top 0–10 cm of soil at two experimental sites: one located in a pine forest and the other in a birch forest. Over the course of one year following application, soil samples were collected at regular intervals, and saturated hydraulic conductivity was determined using the falling head method. In control plots (without biochar), K_s values remained relatively stable over time. In contrast, plots amended with biochar initially exhibited higher K_s values compared to controls. However, a gradual decline was observed over time, averaging a 5% reduction in the pine forest and an 8% reduction in the birch forest. These preliminary results suggest that the application of biochar to sandy, water-repellent soils may contribute to a reduction in saturated hydraulic conductivity, particularly over time.

Keywords: biochar, water-repellent soil, saturated hydraulic conductivity

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A NEW APPROACH FOR LOW-COST LABORATORY MEASUREMENT OF SATURATED HYDRAULIC CONDUCTIVITY OF SOIL

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ABSTRACT

Laboratory device for simultaneous measurement of saturated hydraulic conductivity on intact soil samples. – a semi-automatic device was developed at VUMOP in 2023. The aim of this paper is to verify the quality of the new device by comparing the measured data with the results of the KSAT UMS device. Both measurements were performed on artificially prepared, homogenized soil samples from four locations in the Czech Republic. The results comparison of both devices showed a 75% match between individual pairs of samples. Once routine work is underway, the measurement of 12 samples should take 2 days for both devices. The disadvantage of the VÚMOP device was the final manual processing of data, which increases the risk of errors. The advantage of the existing VÚMOP device is its low purchase price. The risk of error at VÚMOP was resolved in 2025 with the design and implementation of a new fully automatic prototype device. The text includes a reference to the technical documentation of the semi-automatic VÚMOP device, as well as a database of competing devices.

Keywords: comparison of laboratory methods, soil permeability, variability of measurements, measurement automation

CHANGES IN HYDRAULIC CONDUCTIVITY OF FOREST SOIL

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ABSTRACT

Most infiltration methods measure the saturated hydraulic conductivity only one depth at or near the surface. Measurement results extend the theory of hydraulic conductivity of the soil at various depths. An organic horizon is created on the forest floor surface, which causes an increase in saturated hydraulic conductivity. Hydraulic conductivity with soil depth decreases, this claim applies to research sites 3, 4, 5 and 6. Research sites 1 and 2 differ in hydraulic conductivity. The impact of relief on saturated hydraulic conductivity at soil sampling point 1 in the dead arm of river, where saturated hydraulic conductivity increases at a soil depth 0.5 m. The increase in saturated hydraulic conductivity may be caused by soil erosion from the dead arm of river slope, which covered the organic horizon of the forest soil.

Keywords: saturated hydraulic conductivity, texture a structure of soil, relief, fluvisol, soil erosion