WMCEES 2025

9th WORLD MULTIDISCIPLINARY CONGRESS ON EARTH AND ENVIRONMENTAL SCIENCES

ABSTRACT BOOK

Czech Republic, Ostrava | September 8-12, 2025

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Preface

This volume presents the Abstract Collection of the 9th World Multidisciplinary Congress on Earth and Environmental Sciences, WMCEES 2025, comprising the abstracts of oral and poster presentations to be delivered in Ostrava, Czech Republic, from 8–12 September 2025.

The 9th WMCEES continues its mission of promoting a multidisciplinary approach that integrates innovative ideas and methodologies across Earth and Environmental Sciences and related disciplines. The congress provides an international forum for discussing current trends, emerging solutions, and pressing challenges, while fostering inspiration for future research and collaboration.

WMCEES is dedicated to introducing new perspectives and disseminating best practices across a wide spectrum of fields, including but not limited to: Atmospheric Sciences, Blasting and New Technologies, Climatology, Crystallography, Engineering Geology, Geodesy, Photogrammetry and Cartography, Geochemistry, Geophysics and Seismology, Geology, Geomorphology, Geosciences, Geotechnics, Geothermal Energy, Glaciology, Hydrogeology, Informatics, Geoinformatics and Remote Sensing, Medical Geology, Meteorology, Mineralogy, Mining and Mineral Processing, Modelling and Soft Computing in Earth Sciences, Natural Hazards, Natural Resources, Occupational Health and Safety, Oceanography, Oil, Gas and Coal, Physical Geography, Soil Science, Stratigraphy, Sedimentology and Palaeontology, Tectonics and Structural Geology, Urban Planning, Water Resources, Agronomy, Biodiversity Conservation, Biogeosciences, Ecology, Energy, Resources, Pollution and the Environment, Environmental Engineering, Environmental Legislation, Forestry, Geography, Geological Heritage and Geoparks, Green and Sustainable Science and Technology, Limnology, Marine and Freshwater Biology, Public, Environmental and Occupational Health, Zoology, and Urban Sociology.

The primary objective of the congress is to create a stimulating environment where experts, practitioners, and researchers from around the world can exchange knowledge, share experiences, and build collaborations. The event also serves as a valuable platform for early-career researchers to present their findings and engage in dialogue with established leaders in their fields.

We are grateful for the nearly 60 submissions received for WMCEES 2025, representing contributions from more than 17 countries worldwide. We sincerely thank all participants for their interest, commitment, and contributions. We hope you enjoy a rewarding experience at the congress, enriched not only by its scientific program but also by the unique industrial heritage and cultural attractions of Ostrava.

We look forward to welcoming you again at the 10th World Multidisciplinary Congress on Earth and Environmental Sciences, WMCEES 2026, which will take place in Ostrava, Czech Republic, from 7–11 September 2026.

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ADJUSTMENT OF A PRECISE LEVELING NETWORK WITH JACKKNIFE SELECTED WEIGHTS

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ABSTRACT

Many publications indicate no agreement between oceanographic, GNSS, and precise leveling data. The disagreement in the results, produced by different methods, is usually explained by the “mystic” systematic errors in the spirit leveling. All these studies processed the leveling data under the assumption of accumulation of leveling errors as a function of leveling lines. However, according to some recent findings, the length of leveling lines is not the most important factor for leveling uncertainty. Thus, it is likely that the classical weights used in the adjustment of precise leveling networks, which are inverse-proportional to the length of the leveling line, are not the best choice. To avoid any subjectivity in the choice of weights, we used a non-parametric approach for constructing our weights in the current research. We adjusted the Third Finnish Levelling Network 80 times using the Jackknife resampling. We skipped a different line in different adjustments and assessed the network accuracy. Based on these results, we formed our weights for each line in the network as a function of produced accuracy. If a skipped line leads to higher accuracy, we gave it a greater weight in the final adjustment. The comparison between the standard deviations of the adjusted benchmark heights produced by the proposed approach and an adjustment of the network with classical weights shows the supremacy of the non-parametric weights. The hypothesis of the equality of the means of the standard deviation samples, formed by both approaches, is rejected at a 99% confidence level by two independent, in their nature tests – the t-test Paired Two Samples for Means and non-parametric Wilcoxon Signed-rank test. All those facts mean that the systematic errors in the spirit leveling are not only in the measured elevations but also in the following observation data processing. The proposed weighting approach can be successfully applied to many geoscience data processing, e.g., terrestrial gravimetric networks, networks for recent Earth’s crust movements, sea level changes, etc.

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ANALYSIS OF PROCESS PARAMETERS IN ROTARY DRILLING OF ANDESITE

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ABSTRACT

For the purpose of exact identification of factors affecting the drilling process and their effects in in-situ conditions as well as identification of correlations between input and output parameters, it is important to examine the cutting process through the laboratory research. The article presents the developed analytical solutions of the correlation between torque and penetration depth as a function of thrust force. They are based on the processing of the data obtained from drilling andesite on an experimental laboratory stand using surface set core diamond drill bits. A large archived database facilitated analysing the correlations between the measured and model data. The analysis of the derived mathematical models for the torque and penetration depth also brought to light new information on the factors affecting the cutting process of rock and facilitated the identification of their effects on a drilling tool. The theoretical values of torque and penetration depth, which were calculated using the created analytical solutions, exhibited a very high level of correlation with the experimental data. It was found that the values for the torque and penetration depth were affected by the number of actively working diamonds and by their size. Penetration depth per unit of thrust force at the given contact surface strength exponentially decreased with an increasing drilled length. The ratio of coefficients α/κ proportionally increased with an increasing contact surface strength. In the chipping zone of rock cutting, there was a linear correlation between torque and penetration depth. The thrust force required to achieve chipping in a rock cutting process increased as the wear of drill bits increased.

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AN ASSESSMENT OF TOPOGRAPHIC AND MORPHODYNAMIC FEATURES OF BORVIZ VALLEY, BODOC LOCALITY, TRANSYLVANIA USING PHOTOGRAMMETRY

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ABSTRACT

Photogrammetry is a specialized technique essential for acquiring high-resolution 2D and 3D spatial data in a completely non-invasive manner. Its applications are particularly significant in terrain mapping and topographic analysis, where it serves as a complementary tool for geophysical and geological surveys. Additionally, photogrammetric data play a crucial role in monitoring landslides and erosion, particularly in valley-dominated landscapes, as exemplified in this study. Furthermore, photogrammetry is widely utilized in flood risk assessment and mitigation, as well as in infrastructure planning and land use management, contributing to more informed decision-making in environmental and engineering contexts.

In this study, we conducted a survey over an 83,000-square-meter area situated in Borviz Valley (that serves as a tributary to the Olt River), within Bodoc locality, in the historical region of Transylvania, Romania. The aerial photogrammetric data acquisition was carried out using a DJI Phantom 4 Pro V2.0 UAV system, supplemented by a Trimble R2 GNSS system and a network of nine ground control points (GCPs) to enhance geospatial accuracy.

The dataset, consisting of 436 images, was processed using specialized photogrammetric software, such as Agisoft Metashape, along with various Topographic and GIS tools, including ESRI ArcGIS and Blue Marble Geographics Global Mapper. This processing workflow resulted in high-resolution 3D models and 2D maps, represented by a range of photogrammetric products, including Digital Elevation Models (DEMs), Digital Terrain Models (DTMs), classified point clouds, and orthophotos (orthomosaics).

By generating classified elevation models that include only the terrain class while excluding vegetation, built structures, and other anthropogenic objects, we obtained a more detailed representation of the ground surface, allowing for a more accurate depiction of the valley's morphological characteristics. Furthermore, the orthophoto (orthomosaic), produced by integrating all photographic images acquired during the photogrammetric survey, provides a highly precise geospatial reference. This dataset can serve as a valuable resource for future survey planning across various domains such as topography, civil engineering, general infrastructure, utility construction, etc.

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AN UPPER CARBONIFEROUS TONSTEINS: GEOCHEMICAL APPROACH TO MAGMATIC PROVENANCE

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ABSTRACT

Tonsteins occur worldwide in coal-bearing strata in the form of thin clay-altered layers of volcanic ash, usually not exceeding a few centimeters. They represent a wide variety of mineral and chemical compositions and allow the reconstruction of the magmatic sources and stratigraphic position of coal beds.

The aim of this study was to investigate the mineralogical, petrographic, and geochemical characteristics of pyroclastic rocks accompanying coal seams Nos. 209 and 212 from the Upper Silesian Coal Basin (Poland), determining their provenance and the nature of the parent magmas.

In the present research, the investigation was performed on four representative tonstein samples from the Cracow Sandstone Series (CS) of Pennsylvanian age. The whole-rock concentration of the main components (Al_2O_3, CaO, Fe_2O_3, K_2O, MgO, Na_2O, SiO_2, TiO_2), trace (e.g. Sc, Zr) and rare earth elements (Sc, Y, La, Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu) was determined by inductively coupled plasma atomic emission spectrometry (ICP-OES) and inductively coupled plasma mass spectrometry (ICP-MS). Mineralogical and petrographic data were obtained by optical and scanning electron microscope (SEM) observations.

Based on upper continental crust UCC normalizations two types of rare-earth element and yttrium (REY) distributions were distinguished: M-type (medium REY) and H-type (heavy REY). Samples Jaworzno 209 and 212_2 suggest a predominance of uncritical M-type enrichment, whilst Jaworzno 212_1 and Ziemowit 209 are characterized by mixed M-type and excessive H-type enrichment. All of the studied samples show a week, negative Eu anomalies (Eu/Eu* = 0.80 to 0.87) and positive Ce anomalies (Ce/Ce* = 1.04 to 1.34) when normalized to chondrite values. The TiO_2/Al_2O_3 ratios of 0.04 suggest an intermediate character of the parent magma. The sample 212_2 probably comes from calc-alkaline, low-silica volcanic ashes, whilst a more silicic source is assumed for the rest of the specimens. Calc-alkaline character could be also supported by relatively high Zr contents (114–275 ppm). Scandium contents range from 2.4 to 5.7 ppm and indicate the origin from alkaline (average 2–3 ppm) and intermediate and siliceous (~4 ppm) rocks. SiO_2/Al_2O_3 ratios (1.15–1.19) point to an elevated clay content, which is associated with a microscopically observed increasing degree of kaolinitization (tonsteins from coal seam No. 209), whereas biotite relicts are well-preserved within the tonsteins from coal seam No. 212.

In summary, the geochemical ratios (e.g., TiO_2/Al_2O_3), REY concentrations, trace elements content, the weak negative Eu anomaly, as well as mineralogy and petrographic observations, indicate an intermediate/mafic rock source of the tonsteins.

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APPARENT TEMPERATURE MODIFIES THE EFFECTS OF AIR POLLUTION ON CARDIOVASCULAR DISEASE MORTALITY IN CAPE TOWN, SOUTH AFRICA

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ABSTRACT

Introduction: Cardiovascular disease (CVD) is the top cause of mortality and a main contributor to disability globally. Evidence is increasing on the short- and long-term effects of outdoor air pollution on CVD, one of the many risk factors of CVD. Government air pollution monitoring as well as exposure assessment and epidemiological studies are lacking in Africa, and the true burden of air pollution on human health in Africa is up for debate. Human activities that lead to air pollution emissions also contribute to climate change. Climate change will alter weather conditions such as temperature, humidity, wind speed, atmospheric direction and mixing height. These weather conditions in turn may modify the human health effects of air pollution by altering levels, transboundary movement and chemical transformation and composition. Globally studies are lacking on how the effects of air pollution on human health are modified by temperature.

Objectives: To investigate CVD mortality during a 10-year study period (2006–2015) in Cape Town, one of the largest cities in South Africa, in order to address the identified research gaps.

Methods: Individual level data on CVD mortality were obtained from Statistics South Africa for each day of the study period. Hourly air pollution (PM_{10}, NO_2 and SO_2), temperature (◦C) and relative humidity (%) data were obtained from the South African Weather Service. A daily average was calculated using the hourly exposure data. Air pollution data from nine air quality stations were applied in the study. Temperature and relative humidity were used to calculate apparent temperature (Tapp), which combines the joined physiological experience of temperature and humidity. A time-stratified case-crossover epidemiological design was applied. The association between the air pollutants (lag0-1) and CVD mortality was investigated using conditional logistic regression models. Lag0–1 is the average of lag 0 (same day of exposure as day of death) and lag 1 (day prior to day of death). Stratified analyses were used to investigate effect modification by Tapp (lag0-1). Susceptibility by sex and age groups was investigated.

Results: In total, 54 356 CVD deaths were included in the 10-year study. The average PM_{10}, NO_2 and SO_2 levels were 30, 16 and 9 μg/m^3, respectively. Daily Tapp varied from 5 to 30 °C. The daily PM_{10}, NO_2 and SO_2 levels exceeded the daily WHO guidelines on 463, 421 and 8 days of the 3652 days, respectively. The air pollution levels were similar to or even lower than those in Western Europe and North America, where most of the epidemiological evidence on the health effects of air pollution and human health are derived. However, the CVD mortality risks due to air pollution exposure were higher in Cape Town compared to those reported in meta-analyses that summarised the evidence. In general, the elderly and females seemed to be vulnerable to air pollutants, especially at high and moderate Tapp levels.

Conclusion: The results can be used to develop an early warning system for the city

Corresponding Author: Janine Wichmann

ASSESSİNG THE DİSTRİBUTİON OF THE CHEMİCAL FRACTİONS OF IRON İN AGRİCULTURAL ACİDİC SOİLS FROM THE ATLANTİC REGİON OF SPAİN

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ABSTRACT

One of the main problems with acidic soils is the availability of soil nutrients. Identifying the different chemical forms in which iron is found in soil is useful for understanding both the immediately (bio)available amounts and the potential reserves of this metal and, therefore, for understanding and predicting the iron fate in the environment. The distribution of the iron concentrations in the different geochemical fractions of the surface layer of agricultural acidic soils, developed over biotitic-schists, in an Atlantic climate setting was investigated, in order to obtain information about of iron mobilization capacity and potential environmental availability. Iron distribution in geochemical fractions was studied using a sequential extraction procedure. This procedure defines six operational fractions: soluble/exchangeable/specifically adsorbed, bound to manganese oxides, associated with amorphous compounds, bound to oxidizable organic matter, iron in the crystalline iron oxides, and residual fraction. Iron contents were measured by flame atomic absorption spectrophotometry. The results of the iron fractionation showed that iron was present in all the analyzed fractions. Most of total iron resides in the residual and crystalline Fe oxide fractions, i.e. iron is primarily retained within crystal lattices of layered silicates and well-crystallized iron oxide minerals, making it less available in the environmental setting. Therefore, its incorporation into the soil solution in large quantities is unlikely under current environmental conditions.

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ASSESSING THE INTERDEPENDENCE BETWEEN AIR POLLUTANT EMISSIONS AND ENERGY CONSUMPTION IN THE CONTEXT OF ENERGY INDEPENDENCE

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ABSTRACT

There is extensive agreement between energy resources and strategy analysts in Romania and the accelerating energy demand is the principal contributing factor to anthropic air pollution emissions. Energy is indispensable to entire economic sectors, despite that, the expanding consideration given to changes in the global climate and sustainable economic growth has reiterated the scientific interest in the connection between pollution and economic development, especially in the current period when energy independence is extremely important. This paper analyzes the long-term and the connection between air pollution emissions, primary energy resources, final energy consumption in industry and the economic value of the production of environmental goods and services over the period 2008–2023. The data sets used in this article are based on statistical research by the National Institute of Statistics, in compliance with the provisions imposed by Community legislation. From the total analysis of energy sources, a decrease can be observed from 48,166 thousand tons of oil equivalent in 2008 to 40,578 thousand tons of oil equivalent in 2023, which required a series of investments in alternative sources to compensate for this decrease. The production and supply of electricity and heat, gas, hot water and air conditioning generated approximately 42,772 thousand tons (Gg) CO_2 in 2008 compared to 17,865.65 thousand tons (Gg) CO_2 in 2023 and also during this period PM_{10} varied from 15,241.94 Tons (Mg) to 22,091.25 Tons (Mg). At the national level, the degree of energy independence for energy products as a whole was around 72.2%.

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ASSESSMENT OF COASTAL AND FLUVIAL MORPHODYNAMIC CHANGES USING STRUCTURE-FOR-MOTION: A CASE STUDY OF THE SF GHEORGHE DANUBE RIVER MOUTH DISCHARGE INTO THE BLACK SEA

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ABSTRACT

The ability to accurately map erosion, flooding, and habitat loss in coastal environments is crucial for formulating national strategies aimed at preventing and mitigating the impacts of natural disasters. A fundamental component of this process is the implementation of coastal morphodynamics monitoring through Structure-from-Motion (SfM) techniques, utilizing high-resolution 2D/3D data obtained from aerial photogrammetry.

To assess morphodynamic changes over a three-year period (2022–2024), several SfM-based photogrammetric studies were conducted, each year, in the Romanian sector of the Danube-Black Sea coastal zone, specifically at the mouth of the Danube River (Sf Gheorghe branch) into the Black Sea, and along the left bank, near Sf Gheorghe locality, located within the Danube Delta Biosphere Reserve (DDBR). Furthermore, for a comprehensive analysis of sediment deposition and erosion trends over a more extended timescale, LIDAR data from 2012 were also utilized for comparison, providing valuable information on shoreline dynamics and elevation values.

The essential equipment for aerial photogrammetry comprises Unmanned Aerial Vehicles (UAVs) and Global Navigation Satellite Systems (GNSS). In this study, the UAV used was a DJI Mavic 3T (Enterprise/Thermal) drone, complemented by two Trimble R12i and R4 GNSS systems, as well as approximately 10 Ground Control Points (GCPs). Data acquisition and processing were carried out using specialized photogrammetric software (Agisoft Metashape) along with various GIS tools (e.g., Blue Marble Geographics Global Mapper and ESRI ArcMap). The photogrammetric products generated for the study, as detailed in this paper, include Digital Elevation Models (DEMs), Digital Terrain Models (DTMs), orthomosaics (orthophotos), and others.

At Sfântu Gheorghe beach, a comparison between 2023 and 2024 photogrammetric surveys revealed shoreline erosion of up to 64 meters, occurring immediately adjacent to the left bank of the Sfântu Gheorghe Danube confluence with the Black Sea. Additionally, erosion-induced surface area loss of up to 16,202 square meters was documented between 2023 and 2024, relative to the total selected comparison area of 31,910 square meters. This contrasts with the period between 2022 and 2023, during which deposition predominated.

Erosion in the Danube Delta and the adjacent Black Sea coastline is driven by a complex interaction of natural and anthropogenic factors. Natural processes, including subsidence, sea-level rise, and episodic extreme storm events, contribute significantly to coastal dynamics. Meanwhile, human-induced factors, such as navigation activities, upstream infrastructure that limits sediment transport, and the exacerbating effects of climate change, further accelerate erosion. The recent Structure-from-Motion (SfM) surveys provide essential quantitative data, enabling a detailed analysis of both short-term and long-term morphodynamic changes influenced by seasonal variations and extreme hydrometeorological events in this highly dynamic coastal system.

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ASSESSMENT OF THE MORPHOLOGICAL DYNAMICS OF THE DANUBE RIVER BANKS IN THE CEATAL IZMAIL BIFURCATION AREA

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ABSTRACT

The genetic processes of a riverbed significantly influence its dynamics, shaped by various active factors, such as liquid and solid flow, and passive factors, including geological characteristics, geomorphometric features, and the granulometry of the riverbed. In a river bifurcation, the distribution of water flow and sediments downstream between the branches is uneven, leading to alterations in the riverbed and banks. Understanding the dynamics of the riverbed in confluence areas is crucial for managing water resources, assessing flood risk, predicting the long-term morphological evolution of the branches, and ensuring the success of river regulation projects. This study aims to evaluate the dynamics of the Danube banks from 2003 to 2020 in the confluence area at Ceatal Izmail, located at the entrance to the Danube Delta at Mm 43 (Km 80). A diachronic analysis of satellite images was performed to illustrate the riverbank dynamics in the Ceatal Izmail bifurcation, providing highly effective and yielding valuable results. For this study, we utilized Landsat 8 OLI/TIRS satellite images and images from Google Earth from the studied period and topographic surveys carried out in 2020 using a Trimble R4 RTK GPS. As a result of the satellite images analysis of and topographic measurements of the Danube banks, we created a map showing the changes in the banks of the Ceatal Izmail bifurcation between 2003 and 2020. Significant changes were observed during this period, attributed by erosion or sediment accumulation. Some sectors exhibited relative stability, remaining unchanged throughout the analyzed period. The area most impacted by erosion is located on the right bank of the Danube, between Mm 43.8 and Mm 43, where the erosion of the riverbank varies between 15 and 70 meters. This sector was monitored in 2021, 2022, and 2023 through topographic surveys of 20 trees arranged in two alignments at the edge of the Danube riverbank. We also calculated the erosion rate. After processing the collected data, we found significant changes in the distance between the first row of trees and the edge of the right Danube bank. Five trees marked in the first alignment fell into the water due to bank collapse. As a result of the erosion affecting the banks, the area of land lost between 2003 and 2020 totaled approximately 3.8 hectares. The most significant sectors with sediment accumulation are located on the right bank of the Chilia branch and on the left bank of the Danube between Mm 43.8 and Mm 43, where the total area of land gained through sedimentation at the bifurcation banks was 10.7 hectares. In this study, we calculated the erosion and deposition rates by considering three cross-sections on each bifurcation branch. The rates of erosion and sedimentation varied, ranging from -1.04 m to +2.01 m for sections on the Danube, from -0.47 m/year to +4.15 m/year for sections on the Chilia branch, and from -1.03 m/year to +1.07 m/year for sections on the Tulcea branch.

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ATMOSPHERIC FINE PARTICULATE MATTER (PM2.5), BLACK CARBON AND ORGANIC CARBON LEVELS IN OSHAKATI, NAMIBIA

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ABSTRACT

Introduction: Ambient air pollution, especially airborne particles with an aerodynamic diameter of equal or less than 2.5 µm ($PM_{2.5}$), poses a significant threat to human health and the environment. Epidemiology studies reported a range of non-communicable diseases that are associated with $PM_{2.5}$ exposure, such as cardiovascular, respiratory and metabolic diseases. The Global Burden of Disease (GBD) Study reported that air pollution was the reason for an estimated 1.1 million deaths across Africa in 2019. However, due to the lack of air pollution ground-based observations in Africa, researchers often rely on models to estimate pollution levels. Electronic health data are also lacking in Africa that can be used in epidemiology studies to strengthen the GBD estimate. Namibia is one of the majority of African countries that does not have an air quality act, hence the government is not obliged to monitor air quality.

Objectives: To report on $PM_{2.5}$ levels and some of its chemical components in Oshakati, Namibia.

Methods: The 24-hour $PM_{2.5}$ samples were manually collected on 37 mm PTFE membrane filters using a GilAir-5 personal air sampler. The samples were collected at a building of the University of Namibia. A study from Pretoria, South Africa indicated a good correlation between $PM_{2.5}$ sampling results obtained with the GilAir5 pump and continuous real-time sampling instruments. Samples were collected every sixth day during 30 July 2021 to 24 February 2023. The sampling flow rate was set at 4.0 L/min. The black carbon (BC) and organic carbon (OC) levels of the $PM_{2.5}$ filter samples were determined with a model OT21 optical transmitter.

Results: During the study period 72 samples were collected. The $PM_{2.5}$ levels ranged between 0.5 and 47.7 µg/m^3. The average level (10.6 µg/m^3) exceeded the updated World Health Organization (WHO) annual guideline (5 µg/m^3). The daily WHO guideline (15 µg/m^3) was exceeded on 13 days. The average BC and OC level was 0.8 µg/m^3 and 0.9 µg/m^3, respectively. On average, winter had the highest $PM_{2.5}$, BC and OC levels, followed by spring, autumn and summer.

Conclusion: This study is the first of its kind in Oshakati and provides valuable information on $PM_{2.5}$, BC and OC levels. Health effects have been observed for air pollution levels even below the WHO guidelines. Given that the $PM_{2.5}$ levels were observed at an urban background study site, it is essential to recognise that if these concentrations are representative of the broader air quality conditions in Oshakati, they could pose various health issues over the short- and long-term.

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BASIC CHARACTERIZATION OF ORE SAMPLE FROM THE BANSKÁ ŠTIAVNICA DEPOSIT (CENTRAL SLOVAKIA)

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ABSTRACT

The transformation of industry, and especially the energy sector, in the EU enhances demand for strategic metals. For this reason, geological exploration has been revived, and raw material samples from known deposit locations are also being verified.

Thus, the contribution deal with basic characterization of ore sample from the Banská Štiavnica deposit with gold-silver-polymetallic mineralization. The large andesitic volcano Banská Štiavnica as a part of The Central Slovakia Volcanic Field is well known as long time exploited deposit of precious (Au-Ag) and base (Cu-Zn-Pb) metals.

Firstly, the sample of delivered ore was crushed, ground and sieved to prepare analytical sample with grain size under 100 microns. Then the sample was assayed using XRF, AAS and ICP-MS. Mineralogical composition was determined using XRD. Study by optical method was also performed.

The ore contains 56.76 % SiO_2, 1.21 % Al_2O_3, 3.03 % CaO, 0.51 % MgO, 0.28 % Na_2O, 0.16 % K_2O, 4.67 % S, and as to valuables 27.47 % Fe_2O_3, 4.2 % Cu, 0.28 % Bi, 0.21 % Mn, 900 ppm Pb, 100 ppm Zn, 180 ppm Ti and 94 ppm Ag.

XRD study showed that quartz occurs as a dominant mineral in this ore. Hematite and chalcopyrite are presented as accompanying minerals. Accessories are represented by covellite, rhodonite, chlorite, probably chamosite and kaolinite.

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CHALLENGES AND THREATS REGARDING THE DISTRIBUTION AND TREATMENT OF WASTEWATER IN ROMANIA

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ABSTRACT

Both globally and in Romania, one of the major challenges facing decision-makers is the degradation of surface and groundwater quality. Human settlements and localities that do not have wastewater collection systems or appropriate sludge collection and disposal systems from wastewater treatment plants, as well as localities that have non-compliant household waste dumps, agro-zootechnical farms without appropriate manure storage systems, and the excessive use of pesticides can lead to significant pollutant emissions. The main purpose of this study is to present a clear and comprehensive picture regarding the management of water resources and access to drinking water and sanitation for the population in Romania. The data used in this study were collected by the National Institute of Statistics in 2008-2023, and the statistical survey for the collection, treatment and disposal of wastewater has, as main purpose, to obtain information necessary to substantiate Romania's national policy in the field of environment and water, thus ensuring the harmonization of environmental statistics in Romania with the standards and norms of the European Union. In 2008 the population served by the public water supply system was 11,336,676 compared to 14,705,481 in 2023. If we talk about the population connected to sewage and wastewater treatment systems with treatment, we can see an increase of 5,022,884people in 2023 compared to 2008, the first year analyzed in this study. The number of those connected to untreated sewage systems has decreased from 3022657 in 2008 to 274,586 in 2023, thus demonstrating that lately, the quality of discharged water is definitely superior.

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CHANGE OF QUALITY OF WATER IN A LARGE WATER RESERVOIR IMMEDIATELY AFTER A RAINSTORM – CASE STUDY AT THE TURČEK WATER RESERVOIR

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ABSTRACT

Introduction

Ongoing climate change is marked by occurrence of extreme weather events (e.g., heavy rainfalls and heat waves), to which reservoir ecosystems are sensitive. Despite the occurrence of heavy rains, the lack of water can increase, since such precipitation is characterized that it falls quickly, but also runoff quickly. Therefore, it is necessary to capture and use these precipitations as much as possible. On the other hand, in order to ensure suitable water quality for future use, it is necessary to take into account the land use around water bodies, especially in locations where heavy downpours may burden water bodies with flushed nutrients.

Therefore, in the context of warming and more extreme climatic conditions, further research should focus on the underlying ecological mechanisms of reservoirs and providing scientific support for water security and sustainable development.

Water reservoirs and water quality in them are the subject of the project APVV – 22 – 0610 "Technological procedures for the removal of endocrine disruptors and the elimination of the occurrence of cyanobacteria and their undesirable effects in water sources to ensure the quality of drinking water according to the increasing requirements of the new EU Drinking Water Directive", within which water quality indicators in selected water reservoirs in Slovakia are monitored. One of them is the Turček water reservoir located in central Slovakia above the village of Turček in the Turčianske Teplice district at the confluence of the Turiec and Ružová streams.

On 17.07.2024, during field measurements for the purposes of this project, a storm event with intense precipitation occurred in this location. Paper deals with processing and analysis of changes in the measured values of selected indicators of water quality in the reservoir - water temperature, electrical conductivity of water and dissolved oxygen concentration - before and after this storm event.

Materials and methods

Before the initial monitoring of the spatial distribution of selected water quality indicators in the Turček water reservoir, the current bathymetry of the reservoir was measured by the AUV – EcoMapper. According to these data, a network of monitoring points was designed, in which the values of the monitored water quality indicators are measured in the specified horizons. The values of the water quality indicators are measured with the 3630 IDS digital multimeter together with the MPP 930 IDS depth probe with housing. On July 17, 2024, a heavy rain combined with hail lasting 1 hour brought a precipitation total of 18 mm. After the precipitation event, water quality indicators were monitored at two monitoring points with depth of 10 m and 37.5 m.

Results and conclusion

The results show that such precipitation event did not significantly affect the values and distribution of evaluated water quality indicators in the deep horizons of the reservoir. At the same time, however, the results point to the fact that places with shallower depths located near the tributary react more sensitively to the occurrence of such a precipitation event than places in the central part of the reservoir.

Of course, for a more detailed evaluation, or confirmation of the findings, it would be necessary to have more of these or similar data available. However, due to the spatial and temporal unpredictability of extreme hydrometeorological situations, obtaining such data is very difficult.

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CHANGES IN FLOW RATES ON THE KOMÁRŇANSKÝ CHANNEL DUE TO SILTING UP FOR PERIOD 1993-2019

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ABSTRACT

The subject of this paper is to clarify the influence of bed sediments and their composition on the change in flow conditions in the Komárňanský channel, the biggest channel of Žitný Ostrov channel network. This research is based on the results from field measurements, located at Žitný Ostrov area during the period 1993 to 2019. This area is flat land and the velocities in all channels of channel network are very slow what is the main cause of sediment deposition, especially on the channel bottom. The flow profile of channels decreases as the thickness of bed sediments increases, and in consequence of continuous sedimentation processes, not only the cross-section of channel, but also its longitudinal profile changes unfavorably. The volume of sediments is also increasing. The thickness and structure of sediments have an important influence on the interaction between surface water in channels of ŽO and groundwater in its surroundings. The detailed field measurements of bed sediment thicknesses along the Komárňanský channel were performed during the period 1993 – 2019. Then there was determined the longitudinal distribution of the bed sediments in the Komárňanský channel, the percentage of the profile silting by sediments and the values of the volume of bed sediments in this channel for the monitored period (based on the calculation of the values of the average thickness of the bed sediments). The results are summed up in all tables and figures of this paper and their comparison indicates an increasing trend in the longitudinal siltation of this channel as well as in the volume of sediments during the monitored period.

The flow conditions in the channel are also influenced by the composition of the bed sediments, especially their permeability, expressed by the value of saturated hydraulic conductivity. This parameter is one of the key inputs for modeling of the interaction between surface water in channel and groundwater level in its surroundings. In order to determine the value of the saturated hydraulic conductivity, it was necessary to take samples of bed sediments. The bed silts were obtained by two ways, as disturbed samples (from 2016 to 2019) and as undisturbed samples (in 2019). For disturbed samples, the empirical formulas based on the grain size analysis were used to determine the saturated hydraulic conductivity value. We calculated these values according to 7 empirical formulas: Bayer – Schweiger; Špaček I, Špaček II, Hazen I.; Bayer; USBR and Orechova. We used the number of valid calculated results as a criterion for determining the ability of a formula to provide results that meet its validity requirements. The most suitable formula according to this criterion has been shown the Hazen I. formula, its range for Komárňanský channel in 2019 was 2.86 10^{-08} to 3.98 10^{-06} m s^{-1}. For undisturbed samples of bed sediments was used to determine the saturated hydraulic conductivity value the laboratory falling head method. The saturated hydraulic conductivity values determined by this method are presented in tabular form and its range was from 1.31 10^{-07} to 1.10 10^{-05} m s^{-1}.

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DEEP LEARNING AT TWO TIMESCALES: DUAL NEURAL NETWORKS FOR PREDICTING FAST URBAN AND SLOW KARSTIC FLOODS.

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ABSTRACT

Flash flood forecasting in Mediterranean region is an important issue to reduce societal damages of intense rainfall episodes. Low data availability and limited knowledge of hydrogeologic basins, limit the ability of physical hydrodynamic modeling. Indeed, statistical modeling such as neural networks is a promising framework to develop forecasting systems with limited costs. Neural networks can identify relationships linking input and output variables, which are not necessarily the state variables of the physical relationships, but they have difficulty representing several very different temporal dynamics within the same hydrosystem. In this case, one solution may be to constrain the architecture of the model in order to integrate expert knowledge to better represent these different dynamics.

The present study focusses on the Las River at the Lagoubran station in Toulon (180,000 inhabitants, south-east France). The Las River, an 8 km long river originates from karst springs: the Dardennes springs and the intermittent Ragas Spring, and flows through the Toulon city (Mediterranean coast of France). These springs feed a dam used to supply drinking water. The river is fed by a karst spring with a 70 km² impluvium on Siou Blanc karst limestone plateau around 600 meters above sea level. The rainfall-runoff response of the karst floods is around 12 hours. Downstream, the Las River further collects urban runoff from about a 12km² subcatchment, generating flash floods with response time around 30 minutes. From these observations, two different types of floods can be distinguished, one-third of which are urban runoff events with little karst influence, and two thirds of which are mainly karst events with high karst influence. The objective is to forecast the water level at the watershed outlet with a time horizon of 30 minutes.

To build a neural network able to represent the complexity arising from this multi-process behavior, we propose to build two multilayer perceptrons whose architectures respectively correspond to the double influence: one built and trained on the quick urban runoff events, and a second built and trained on the events with slow karst contribution. A third model is built by coupling these two specialized models, aiming to forecast the whole system behavior. At each step of the models' design, the performance of the model will be evaluated using the persistency criteria, measuring how the model outperforms the naive prevision. A comparative analysis will determine the most effective approach for predicting unseen extreme events of the Las River.

The external forcings of the model are the precipitations time series available inside and around the study area, the water level measured in the karst springs, and the previous water levels observed in the river at Lagoubran station, time step is equal to 15mn.

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DEVELOPMENT OF HIGH EFFICIENT SOLAR ENERGY PHOTO-CONVERTING ELEMENT BASED ON SILICON-GRAPHENE NANOSYSTEM

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ABSTRACT

Recent progress in nanosystems development has generated significant enthusiasm for creating high-aspect-ratio nanostructures, which are efficient devices. Nanowires, nanorings, and nanodots are some of the most extensively explored nanostructures for various technologies. Most of the research has primarily focused on two-dimensional 2D planar nanostructures where the film thickness is significantly smaller than the planar dimensions. However, with advances in nanofabrication techniques and the increasing demand in the field, it is possible to exploit the effect of film thickness on many applications such as medical, photovoltaic cells improvement, 3D spin, and quantum electronics. According to the thin-film dimension, the thin-film performance is correlated to the quality and uniformity of its lattice. Consequently, the technology that is applied is significant. On the other hand, different material structures affect the lattice quality, which leads the study to an appropriate mathematical model as Dynamic Fractal.

Hence, in this article, abstracts of various methods are reviewed, but the main technology that is investigated is Laser-Plasma. In this approach, the case study of Graphene thin film on the silicon photovoltaic solar cell through the patented CWLD technology is explained. Finally, the other applications of the Laser-Plasma methodology are introduced.

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DIFFERENT METHODS FOR DETERMINING OF THE ROUGHNESS COEFFICIENT IN LOWLAND STREAMS OVERGROWN WITH AQUATIC VEGETATION

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ABSTRACT

The flow regime in channels or in surface water at lowland territories during the growing season is often very strongly influenced by the occurrence of aquatic vegetation. As a result of global warming, temperatures are rising, and for this reason, the year-round water growth in the warmest regions of Slovakia - Záhorská lowlands. Lowland streams flow mostly in important agricultural areas of the country, where fertilizers can greatly affect water quality and promote the growth of aquatic vegetation. Another factor affecting the occurrence of aquatic vegetation is the small slope of water flows in lowland areas, and the resulting small flow velocities in the flow. There is a settling of carried particles in the stream, an increase in the thickness of the bottom sediments and thus an improvement in the conditions for the growth of aquatic vegetation. From a hydrodynamic point of view, water plants alter the size and distribution of flow velocities at a large rate; they increase the stream bed roughness and decrease the discharge capacity of a stream. This study investigates flow resistance in the Malina stream, located in the Zahorská lowland of western Slovakia, with a particular emphasis on refining the estimation of Manning's n in vegetated stream and analyses impact of aquatic vegetation density on the dynamics of flow process by evaluation of the roughness coefficient value obtained from different methods (measurements in streams/open channels; empirical equations; tables of the roughness coefficients; photographics catalogs; Cowan´s method). Measurements performed during vegetation season (from April to September) along the part of the Malina stream were used for determination of the roughness coefficient value for different extents of river bed overgrowth during the year.

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DOPING OF GAN WITH SILICON USING LAYER BY LAYER MAGNETRON SPUTTERING TECHNOLGY

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ABSTRACT

Gallium nitride remains one of the most promising wide-bandgap semiconductor, which is widely used in the production of opto-electrical devices, laser diodes and solar energy converters. Due to the large band gap (3.4 eV), its doping with other impurities becomes technologically difficult, unlike the known doping technologies of other small-bandgap semiconductors (Si, Ge). In order for the doped impurity to be activated and the material to start electrically “burning”, high-temperature annealing is required. Partial solutions to these problems are presented in this work. The research uses reactive magnetron sputtering as a technology for obtaining gallium nitride and also for its doping with silicon. The sequence of technological processes and optimal modes are shown. X-ray diffraction (XRD) analysis was performed on the obtained samples, which showed a pronounced crystal direction. X-ray photoelectron spectroscopy (XPS) was measured, which determined the Ga/N percentage ratio. The optical band gap of gallium nitride was calculated using the transmission spectra.

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ECOTOXICITY FINDINGS IN AGRICULTURAL SOILS OF THE SUBURBAN AND INDUSTRIAL AREAS OF KOŠICE

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ABSTRACT

The input of anthropogenic external pollutants is the main cause of environmental problems in agricultural soil. The main objective of the present study was to evaluate the potentially ecotoxicity of heavy metals in suburban and industrial agricultural soils from Košice, using biological tests (Phytotoxicity on *Sinapis alba*, acute and avoidance tests with the *Dendrobaena veneta*). The agricultural areas were selected, namely soils from the around Košice, is exposed to suburban and industrial contamination sources such as municipal sphere (domestic waste), road traffic, coal burning and various industrial sources (U.S.Steel, TEKO). The total Fe, Mn, Cu, Zn, As, Pb, Cr, Ni and Co concentrations and ecotoxicological tests of agricultural soils from the around Košice were determined of 8 sampling sites in 2024 year. Exceeded heavy metal concentration limits according to law No. 220/2004 coll. were in order of Cu> As> Cr in study soils of the marked as Ťahanovce village (1). The highest median concentrations were in the case Cu approximately 8.3 times; for As of 1.2 times; and for Cr of 1.1 more than limit value. Similarly, exceed median values of metals in soils of the Krásna (2), were in the order of Cu > Cr > Zn, for copper of 7.5 times more than limit ; and also high median was in the case sample Barca (3) for chromium of 3.6 time more than limit value. The obtained results of the contact arrangement phytotoxicity showed that the all sample soils from the around Košice (1 - 8) had less than 50% inhibition of the seed germination and root growth in the mustard *Sinapis alba* compared to the control soil. Low mortality effects were recorded in the acute tests with *Dendrobaena veneta*. The percentage of avoidance response of the earthworms found in the double control was within the range -40 % to 90 % for the all agricultural soils around Košice. The significant ($P<0.05$) avoidance by *Dendronaena veneta* were 90% in soils of areas Gomboš (5) and from main Plant west of the U. S. Steel (7), Košice. Results indicate that the terrestrial pollution mainly comes from the around vicinity of U.S. Steel Košice and agricultural activities have a certain impact and motor vehicle exhaust act too. Environmental monitoring and pollution assessment on the whole city scale are highly important to figure out the contamination level and spatial distribution of pollution.

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EFFECT OF BACTERIOSTATIC ADDITIVES ON POLYSACCHARIDE-BASED BIODEGRADABLE FILMS

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ABSTRACT

Biodegradable packaging materials derived from renewable resources offer an eco-friendly alternative to conventional plastics, addressing growing environmental concerns. This study aimed to develop and evaluate polysaccharide-based films using sodium alginate, enriched with bacteriostatic agents—thyme essential oil and thymol—to enhance both antimicrobial and mechanical properties. Films were prepared with the addition of glycerol as a plasticizer and varying concentrations of the active compounds (2–8%), then tested for their mechanical strength and antibacterial activity against selected bacterial strains using the disc diffusion method. The incorporation of thyme oil and thymol improved film tensile strength, with optimal results observed at 4% concentration, which provided a favorable balance between elasticity and strength. Antibacterial testing showed inhibition zones primarily against Salmonella, Bacillus cereus, Bacillus megaterium, and Enterococcus faecalis, with thymol-containing films displaying slightly stronger effects. These findings demonstrate the potential of sodium alginate-based films with essential oil additives as biodegradable, active packaging materials capable of contributing to improved food safety and extended shelf life.

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EFFECT OF SURFACE MODIFICATION ON MINERAL WASTE DISSOLUTION USING MICROORGANISMS: PHYSICOCHEMICAL ASPECTS

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ABSTRACT

The bioleaching efficiency of various solids, including mining waste, is influenced by the physicochemical changes occurring on the particle surface in the presence of microorganisms. Mineral modification is widely used in mineral processing and can also be applied in bioextraction and bioremediation. Surfactant adsorption can serve as a tool to control bacterial attachment, a critical factor in such processes. Bacterial adhesion promotes the intensification of leaching, while increased mobility reduces the metal removal. Therefore, the impact of such modification and its further effect on the release of toxic metals from mining waste was investigated, focusing on physicochemical aspects.

Bioleaching experiments were conducted in shaken flasks for four weeks, with solid to liquid ratio of 1:10. Two types of surfactants were used: cationic (cetyltrimethylammonium bromide) and anionic (sodium dodecyl sulfate). Zeta potential was measured using the classic streaming potential and streaming current method. The surface morphology of the leaching residue was analysed using scanning electron microscopy. Secondary precipitates formed were identified by X-ray diffraction, revealing jarosite formation. The presence of surfactants caused a change in the surface charge of particles, which could affect the behaviour of bacteria during leaching and, thus, its efficiency. Arsenic was identified as the primary toxic element. When no modifications were applied, its recovery from the solid reached 61.8% after three weeks of leaching. Conditioning of the mineral waste with surfactants before the process resulted in lower leaching efficiencies: 43.5% for a cationic surfactant and 34.2% for an anionic surfactant. Moreover, a correlation was observed between the efficiency and the measured surface area—higher recovery rates were associated with larger specific surface area values. The adsorption of surface-active agents altered the surface properties of the waste material. Treatment with the anionic surfactant increased the negative zeta potential, whereas exposure to the cationic surfactant resulted in a positive surface charge. At the end of the bioleaching, all leaching residues exhibited a positive zeta potential. This effect was primarily caused by the formation of positively charged iron(III) precipitates under acidic conditions.

It has been demonstrated that in the presence of microorganisms, arsenic can be released from mining waste and that surface modification with surfactants inhibits this process, which may have potential applications in preventing unwanted effects of bioweathering.

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EFFECT OF URBAN GREEN INFRASTRUCTURE ON COMBINED SEWER OVERFLOW VOLUMES

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ABSTRACT

Urban stormwater management is crucial for mitigating the hydrological risks of cities during intense rainfall events, especially as urban drainage systems are increasingly exposed to climate change, urban sprawl and aging infrastructure. The paper evaluates the potential of green infrastructure and other runoff reduction strategies in a case study of a city in eastern Slovakia – the Trebišov city. The study focuses on combined sewer systems and employs hydraulic modeling using the MIKE+ software to simulate runoff from short-term rainfall events of varying intensity. This study focused mainly on the application of green roofs, permeable surfaces and disconnection of roofs from the stormwater network. Key indicators of the effectiveness of green infrastructure are the volume of surface exceeding water, the volume discharged through combined sewer overflows; or the volume delivered to the wastewater treatment plant. Based on the simulation results, green infrastructure development scenarios were assessed and ranked both according to hydrological performance and cost-effectiveness.

The results of the study confirm that green infrastructure has the potential to reduce the runoff volume, especially during rainfall events with low to moderate intensity. At the same time, it was shown that the effectiveness of green infrastructure decreases with increasing rainfall intensity. The identified relationships are not linear, which underlines the need for further research. The findings support the importance of integrating multiple green infrastructure measures depending on site-specific conditions. In terms of cost-effectiveness, roof disconnection was found to be the most advantageous, achieving good results with the cheapest implementation. Permeable surfaces ranked as the second position and combined solutions as the third one.

The study also highlighted the ability of green infrastructure to reduce the volume of water discharged from the combined sewer overflows, which represents a significant contribution to the protection of receiving water bodies and the overall sustainability of urban water management.

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EVALUATION OF THE EFFECT OF COMBINED COLLECTOR APPLICATION IN THE PROCESS OF FLOTATION OF POOR ORES CONTAINING PRECIOUS METALS

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ABSTRACT

Precious metal processing includes both mechanical and hydrometallurgical enrichment methods. The risk of environmental contamination is high in hydrometallurgical processing, as it mainly uses toxic chemicals. The environmentally friendly gravity concentration method is mainly used in the initial stage of combined technology. For example, the combined enrichment technology scheme can be visualized as follows: gravity-flotation-metallurgy, gravity-flotation-magnetic separation, gravity-flotation. In precious metals processing, flotation enrichment is often used, where traditional approaches (use of a single reagent as a collector, sample grinding without classification) do not always ensure the maximum recovery of gold and silver in the concentrate, which is replaced in production by the environmentally harmful hydrometallurgical method.

The paper presents the results of obtaining high quality concentrate from poor ores of precious metals by flotation enrichment method. In order to obtain a high-quality flotation concentrate (to avoid sample crushing), the initial sample was crushed into separate size classes, as it is well known that the correct calculation of crushing and grinding has a double effect in the mineral enrichment process:

1. more than 50% of the economic costs in the enrichment process are crushing/grinding costs;

2. when crushing the sample, silt is formed, which complicates the enrichment process. A large amount of silt enters the concentrate, which adversely affects the performance of the enrichment process.

Close sizing grinding has reduced the number of multiple operations for concentrate clearing.

The effect of simultaneous use of two collector reagents (reagents with short and long hydrocarbon numbers) in the flotation process to obtain high-quality concentrate was evaluated. The attachment of the collector mineral to the surface is determined by its hydrocarbon number. The longer the hydrocarbon radical in the reagent, the greater the stability of attachment to the mineral. The disadvantage of such reagents is that it takes a relatively longer time to make the mineral hydrophobic than reagents with a weaker effect. The effectiveness of using two collectors simultaneously is explained as follows: the reagent with a short hydrocarbon number instantly imparted hydrophobicity to the target minerals, while the reagent with a long hydrocarbon number prolonged this ability. As a result, the target minerals were incorporated into the concentrate and the loss of useful components in the tailings was reduced. A single clearing of the concentrate resulted in a high-quality concentrate of precious metals with a yield of 1.7%, a gold content of 39.33 g/t, and a silver content of 52.88 g/t.

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EXPLORING MUGWORT BIOMASS AS A NOVEL CATALYST SUPPORT FOR GREEN CHEMISTRY

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ABSTRACT

Mugwort (Artemisia vulgaris) is a widely available yet underutilised biomass that holds great promise as a sustainable precursor for catalyst support materials. This study investigates the feasibility of converting mugwort biomass for novel catalyst support in green chemistry applications. The research is motivated by the need to develop renewable, cost-effective, and environmentally benign alternatives to conventional catalyst supports, typically derived from non-renewable, fossil-based sources.

This work's primary objective is to optimise mugwort's conversion into a high-performance activated carbon through controlled carbonisation and activation processes. In this study, mugwort biomass is subjected to pyrolysis under an inert atmosphere at moderate temperatures to initiate carbonisation. Subsequent chemical activation uses appropriate activating agents to enhance the material's surface area, porosity, and surface functionality. These structural characteristics are critical to ensuring effective dispersion and stabilisation of active catalytic species.

A comprehensive physicochemical characterisation of the prepared material is performed using several analytical techniques. The Brunauer-Emmett-Teller (BET) method is employed to determine the surface area and pore size distribution, while X-ray diffraction (XRD) provides insights into the crystalline structure of the carbon matrix. Scanning electron microscopy coupled with energy-dispersive spectroscopy (SEM-EDS) examines the morphology and elemental composition, and thermogravimetric analysis (TGA) assesses the thermal stability.

The catalytic performance of the mugwort-derived activated carbon is evaluated in model reactions, specifically oxidation and hydrogenation, which serve as benchmarks for green chemistry applications. The study further explores modifications of the catalyst support to enhance the interaction between the active phase and the support, thus improving catalytic efficiency and longevity.

This scientific novelty lies in the first systematic exploration of mugwort biomass as catalyst support. The study addresses both environmental and economic challenges associated with conventional catalyst production by repurposing an abundant and renewable resource. This innovative approach promotes waste valorisation and sustainable resource management and aligns with the principles of a circular economy and green chemistry by reducing reliance on synthetic materials.

Preliminary results indicate that mugwort-derived activated materials have a high surface area, well-developed porosity, and favourable chemical properties comparable to traditional catalyst supports. The findings suggest that this material can be tailored for specific catalytic applications with further optimisation, ultimately contributing to cleaner and more sustainable industrial processes.

This research demonstrates that mugwort biomass has significant potential as a novel catalyst support for green chemistry, paving the way for developing eco-friendly catalysts and advancing the sustainable utilisation of biomass resources.

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FABRICATION OF FIBER REINFORCED AL-POLYMERIC COMPOSITES AND TESTING UNDER LOW INTENSITY SHOCK

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ABSTRACT

This study explores the mechanical behavior of fabric-metal laminates (FMLs) composed of aluminum alloy, aramid fiber, and an epoxy binder matrix when subjected to localized shock energy suppression. The research specifically investigates the impact of varying surface densities of aramid fiber in the laminate, as well as the amount, distribution, and configuration of aluminum layers.

The laminates examined in this study are disc-shaped (ø-70 mm, h - 4 mm) and consist of 16 layers of glass fabrics with two different surface densities (350 g/m³ and 200 g/m³). These fabric layers are interleaved with three aluminum sheets, ensuring that each of the four fabric sections is separated by a single aluminum layer. The double-sided, warp-tight glass fabric used in these laminates undergoes low-speed impact testing (<10 m/s) following the Falling Dart Impact Tester methodology.

Experimental findings indicate that the orientation of fabric layers within the laminate significantly influences impact resistance. Specifically, a One-Direction fabric positioning within the laminate enhances resistance to low-speed collisions, effectively mitigating damage development. Notably, tissue damage in these laminates remains confined to a limited area, ensuring improved structural integrity.

Furthermore, test results highlight that the laminate's strength under dynamic loading conditions surpasses its performance under static loads. This increased strength is attributed to the laminate's lower sensitivity to increasing thread speed, which enhances its capacity to absorb and dissipate impact energy efficiently. These findings underscore the potential of FMLs as robust materials for applications requiring enhanced impact resistance, particularly in aerospace and defense industries.

prolonged this ability. As a result, the target minerals were incorporated into the concentrate and the loss of useful components in the tailings was reduced. A single clearing of the concentrate resulted in a high-quality concentrate of precious metals with a yield of 1.7%, a gold content of 39.33 g/t, and a silver content of 52.88 g/t.

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HIGH-DEFINITION 3-D SHORELINE MAPPING WITH INTEGRATED UAV–SBES/MBES BATHYMETRY AND IMMERSIVE XR VISUALIZATION

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ABSTRACT

Accurate and comprehensive characterization of the land-water interface is essential for effective monitoring and decision-making regarding inland waters. This study presents a complete workflow that integrates centimetre-resolution UAV (drone) photogrammetry with single- and multibeam echo-sounding to create a seamless three-dimensional model of shoreline and bed morphology.

The procedure includes RTK/PPK georeferencing, and point-cloud co-registration within a 3D GIS environment. This is followed by topology-preserving meshing and physically-based texturing, which are suitable for real-time rendering.

Preliminary results from a pilot survey demonstrate the geometric coherence of the fused data and confirm that the system maintains an interactive frame rate after mesh optimization. The discussion includes aspects of computational efficiency, interoperability with open geospatial standards, and limitations related to water turbidity and seasonal vegetation dynamics.

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IMPACT OF AGRICULTURAL CROP PRODUCTIVITY ON PM2.5 AND PM10 POLLUTION LEVELS IN ROMANIA

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ABSTRACT

Atmospheric particulate matter (PM), classified into PM2.5 (particles ≤ 2.5 micrometers) and PM10 (particles ≤ 10 micrometers), represents a major environmental and health issue. These particles, originating from sources such as smog, soot, industrial dust, and agricultural residues, remain suspended in the atmosphere for extended periods, contributing to air pollution, ecosystem degradation, and respiratory and cardiovascular problems. Vegetation plays a key role in reducing PM concentrations by capturing and retaining particles on leaf surfaces, but the burning of agricultural residues and intensive farming practices remain significant sources of emissions. In the European Union, agriculture contributes approximately 15% of PM2.5 and 22% of PM10 emissions, particularly through plowing, harvesting, and open biomass burning. In Romania, PM levels vary regionally, being higher in areas with intensive agricultural activity. Strategies to reduce PM include promoting precision agriculture, optimizing fertilizer use, and adopting clean technologies. However, implementing these measures is challenging due to economic and administrative barriers.

In this paper, we analyzed suspended particulate emissions (PM2.5 and PM10) reported in Romania during the period 2010–2022. The study aimed to correlate emission levels with the agricultural area cultivated with various crops, including grain cereals, grain legumes, oil plants, soybeans, sugar beets, potatoes, vegetables, perennial fodder, and forage roots. Through this analysis, we aimed to identify how agricultural activities contribute to atmospheric particulate matter levels and assess their impact on agricultural productivity.

Data on PM2.5 and PM10 emissions were collected from official air quality reports and correlated with statistical data on the cultivated area and agricultural production for each type of crop analyzed. The study results highlighted a significant relationship between particulate matter emission levels and the intensity of agricultural activities, especially in areas with large surfaces cultivated with grain cereals, soybeans, and oil plants. Additionally, it was found that variations in agricultural productivity can be influenced by crop exposure to air pollution, particularly in regions with high PM emissions.

The relationship between air quality and agricultural productivity highlights the need for sustainable policies and better management of agricultural waste. In Romania, support from the Common Agricultural Policy (CAP) facilitates the adoption of eco-friendly practices, but the agricultural sector faces challenges related to competitiveness in the European and global markets. Effective measures to reduce PM emissions are crucial for protecting human health and the environment while ensuring food security.

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IMPACT OF THE DATUM POINT LOCATION ON THE BENCHMARK STANDARD DEVIATIONS

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ABSTRACT

Despite the long-term usage of the precise leveling, there are some issues about the accuracy of leveling networks. It is supposed that the propagation of leveling errors is proportional to the square root of the leveled distance. However, there is a lack of correspondence between the leveling accuracy given by the least squares mean error per 1 km leveling distance and the final standard deviations of the adjusted benchmark heights as regards their remoteness from the datum point. To investigate the sources of this accuracy disagreement we adjusted the precise leveling network of Bulgaria – III leveling cycle 33 times. A different nodal benchmark was chosen as a datum point in each adjustment. All adjustments produced the same adjusted benchmark elevations and the same mean adjustment error per 1 km leveling distance, equal to 1.21 mm/√km. However, the sums of the standard errors of the adjusted heights of the nodal benchmarks, and as a result, the average of these standard errors varied between adjustments. The minimum sum of the benchmark standard errors was obtained when the datum point was set in the Knezha benchmark, located almost in the center of the network. The average standard error of the benchmark in this adjustment was estimated to be 10.55 mm. The official datum point in the Third Leveling of Bulgaria is the fundamental benchmark in Varna, located in the network periphery. The average standard error of the benchmark in an adjustment with a datum point in Varna was estimated to be 13.27 mm. Comparison between the means of the benchmark standard error samples based on the datum point in Knezha and Varna, performed by different types of t-tests shows that the mean of the standard error sample based on the datum point in Knezha is significantly less than in Varna. The conclusion is valid at a 99% confidence level. In addition, a better correspondence between the leveling accuracy given by the least squares mean error per 1 km leveling distance and the final standard deviations of benchmarks was found in the case of the Knezha datum point adjustment.

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INTEGRATED HYDROGEOPHYSICAL MODEL FOR IDENTIFYING AND PREVENTING HYDROCARBON POLLUTION IN THE OIL TERMINAL CONSTANȚA AREA IN THE CONTEXT OF NEPTUN DEEP DEVELOPMENT

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ABSTRACT

OIL Terminal Constanța is one of the largest petroleum terminals in Eastern Europe, playing a strategic role in the transportation and storage of petroleum products for the European market. Its economic and operational importance is increasing, particularly in the context of the upcoming exploitation of the Neptun Deep gas field in the Black Sea, which will transform the terminal into a key logistics hub for exports and the distribution of natural gas and its derivatives. This development underscores the need for enhanced pollution prevention measures to protect the region's soil and water resources.

This study develops an integrated hydrogeophysical model for characterizing the subsurface extent of pollution by correlating advanced geophysical methods with pre-existing hydrogeological and geological data. Based on the geomorphological analysis of the area, magnetometry, electrometry, ground-penetrating radar (GPR), and photogrammetry are applied, alongside seismic refraction, which is used for the first time in this region.

The studied area features a coastal landscape dominated by recent sedimentary deposits and complex aquifer structures that influence the dynamics of subsurface pollution. Natural coastal erosion and fluctuations in the water table contribute to increased vulnerability to contamination, necessitating close monitoring of interactions between industrial activities and the geological environment.

Magnetometry is employed to detect buried metallic structures, such as historical pipelines that may be fractured and serve as potential pollution sources. Electrometry assesses variations in soil resistivity, enabling the identification of the water table level and sedimentary succession, both critical factors in evaluating pollutant migration potential. Ground-penetrating radar (GPR) provides high-resolution imaging of contaminated areas, while seismic refraction helps identify geological discontinuities that may influence contaminant spread. Aerial photogrammetry supports detailed terrain mapping and long-term pollution monitoring.

The correlation of geophysical data with historical borehole records in the area allows for the reconstruction of geological structures and stratigraphic sequences. These data are integrated into the hydrogeophysical model, which estimates the migration pathways of the pollution plume and identifies essential measures for protecting soil and groundwater resources.

The study results offer a comprehensive understanding of hydrocarbon dispersion mechanisms in the subsurface and support authorities and industrial operators in making informed decisions regarding pollution risk management. This research demonstrates the applicability of modern geophysical methods in environmental protection and proposes a replicable methodological framework for other industrial areas exposed to contamination risks.

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INVESTIGATING A TEMPERATURE INCREASE BEFORE AND DURING A MAGNITUDE 8 EARTHQUAKE AFFECTING THE PORTUGUESE TERRITORY

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ABSTRACT

Historical and registered earthquakes of great magnitude have caused destruction with injuries and deaths in mainland Portugal. This work uses data not yet used to investigate a possible increase of the temperature of the water in the region and possible consequences when materials with different thermal properties are in physical contact.

A temporal link between geomagnetic anomalies recorded by Permanent Geomagnetic Observatories and earthquakes detected in the Iberian Peninsula and adjacent regions during the month of February in 1969 was found using data from 3 Observatories located in the Iberian Peninsula. The anomaly recorded on February 27,1969 is due to large alterations in the direction (inclination) of the geomagnetic field and associated variations in the electric field of the atmosphere recorded in Lisbon. The source of the first earthquake filled and registered in the early morning of February 28 was in the Atlantic Ocean. The variations in the geomagnetic inclination, detected in the records, may have led to rotations of the water molecules to align their electric dipoles with the electric field in the region, originating heat release. As consequence, an increase of temperature occurred.

The analysis of the arrival times of the first seismic waves at the seismic stations located in Lisbon, Coimbra and Porto (cities located near the Atlantic Ocean at different latitude values) combined with the distances of the cities to the earthquake source, shows different values of the average speed of propagation of the seismic waves. The values found decrease from Porto to Lisbon. Seismic velocity values change with temperature and pressure. As we are talking about the same earthquake, different temperature values found in the last part of the wave paths seems to be responsible for this fact. This means that temperature values at lower latitude values (Lisbon city and earthquake source) are higher.

The increase of the temperature values of water contributes to the opening of cracks and faults in the region with the entry of hot water that can reach great depths, increasing the temperature, the volume, and the pressure of the materials. When materials with different values of thermodynamic properties like specific heat, thermal conductivity and thermal expansion coefficient are in physical contact, the heat received from the water can originate perturbations like pressure gradients of thermal origin whose value can increase causing rupture of the materials. The presence of water with elevated temperatures in deep regions can also change the velocity of chemical reactions with heat release, increasing the described effect.

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ISSUES WITH TAP WATER QUALITY AND STABILITY IN DISTRIBUTION NETWORK

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ABSTRACT

The main objective of any water supply company is to provide consumers with water of adequate quality that meets all physico-chemical and microbiological requirements. The legal requirements concerning the quality of water in water supply systems and networks and the operation and use of the water supply system are contained in the following legislation (EU Official Journal L 435 of 23.12.2000). Despite complying with the Directives, water supply companies face difficulties due to the inadequate quality of the water supplied to consumers. Sludge and biofilm formation in water pipes can be the cause of poor quality.

This paper presents an assessment of tap water quality in terms of its stability. Tests were carried out on tap water collected at the treatment station and at selected problematic points in the distribution network.

Determinations of physicochemical and microbiological parameters were performed on the basis of the Regulation of the Minister of Health of 7 December 2017 on the quality of water intended for human consumption, Journal of Laws 2017, item 2294 - total bacterial count at 37°C and 20°C, coliforms, *Escherichia coli*, *Pseudomonas aeruginosa* and faecal streptococci. The direct measure of microbiological status was the ATP concentration. In addition, the basic physico-chemical parameters - colour, turbidity, oxidisability, conductivity, pH and biogen concentration - were determined. The free chlorine concentration was also measured. On the basis of the parameters determined, the physical, chemical and microbiological stability of the tap water was determined.

The study confirmed the proliferation of bacterial microflora in the treated water during transport through the water supply system, particularly in the sections furthest from the treatment plant and in sections with low water consumption. coliforms, *Escherichia coli* and *Pseudomonas aeruginosa* were detected in the water tested. Free chlorine concentrations were also found to be too low, indicating that the disinfection effect is not effectively maintained during the transport of the treated water. Biological instability was observed due to the presence of nitrogen and phosphorus compounds, resulting in a secondary deterioration of the microbiological quality of the water in the distribution system. The authors also point out the possibility of using direct methods to determine microbiological parameters, such as the determination of ATP concentration. The rapid availability of a result allows the detection of a sanitary risk and an efficient response.

Ongoing research indicates the need for non-standard measures to maintain the stability of treated water. It also seems important to monitor not only the water supplied for distribution, but also at selected points in the distribution network. Particular monitoring should be carried out in public and healthcare buildings, as well as in childcare facilities, schools and kindergartens.

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MICROWAVE VALORIZATION OF WHEAT STRAW: SYNTHESIS AND RAPID REGENERATION OF MAGNETIC BIOCHAR ADSORBENTS

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ABSTRACT

This study focused on the synthesis, characterization, and application of a magnetic carbon adsorbents. The magnetic biochar was evaluated for its efficacy in adsorbing arsenic and methylene blue, both significant environmental pollutants. A key objective was to investigate the potential of microwave energy for both the synthesis and regeneration of this adsorbent, aiming to develop an efficient approach to water treatment.

Magnetic biochar adsorbent (MWchar-Maghemite) was synthesized via a two-step process. First, wheat straw was subjected to microwave pyrolysis (900 W, 2450 MHz, 6 minutes) in a nitrogen-flushed quartz flask. This was then modified by adding iron ions (Fe^{3+}/Fe^{2+} = 2:1 molar ratio) and precipitating maghemite nanoparticles using 24% ammonium hydroxide (1-hour precipitation time). The resulting magnetic biochar was characterized using ^{57}Fe Mössbauer spectroscopy, X-ray diffraction, nitrogen adsorption, and electron microscopy. The material's adsorption efficacy for arsenic (As^{5+}) and methylene blue was evaluated under batch-type conditions, and its regeneration via microwave irradiation was investigated.

Microwave pyrolysis of wheat straw produced biochar with a 58.9% carbon content, comparable to that obtained through conventional pyrolysis (58.1% at 550°C for 90 minutes), demonstrating the efficiency of microwave heating. The modification of biochar with nano-maghemite particles significantly improved its surface texture, increasing the surface area from 21.1 m²/g for the precursor biochar to 139.1 m²/g for the magnetic biochar, thereby enhancing its adsorption properties. The magnetic biochar exhibited excellent arsenic adsorption capabilities, with a maximum adsorption capacity (Q_m) of 24.9 mg/g at pH 3.8. The Freundlich isotherm and pseudo-second-order kinetics suggest heterogeneous adsorption and inner-sphere complex formation, as well as electrostatic interactions between arsenic oxyanions and the iron-based adsorbent. Microwave irradiation (900 W, 10 s) significantly accelerated arsenic desorption in 0.1 M NaOH, increasing desorption rate constants eightfold compared to non-irradiated samples.

For methylene blue, optimal adsorption occurred at alkaline pH (maximum adsorption capacity of 55.0 mg/g at pH 10.2). Microwave-assisted pyrolysis (30-180 s) effectively regenerated the adsorbent, with complete methylene blue degradation achieved after 60 s, as confirmed by UV-VIS and HPLC/ESI-MS analysis. However, repeated regeneration cycles (30 s) led to a decrease in adsorption capacity (from 27.6 to 19.1 mg/g) and a significant reduction in magnetic susceptibility (81% decrease) and surface area (S_{BET} = 54.9 m²/g).

These results underscore the potential of microwave technology in biomass valorization, offering rapid biochar production and efficient adsorbent regeneration. The study highlights the necessity for careful consideration of regeneration cycles to maintain adsorbent properties and emphasizes the importance of toxicity monitoring for treated solutions.

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MINERAL FERTILIZERS PRODUCED FORM MINERAL POWDERS BASED ON MINING WASTE

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ABSTRACT

The aim of the study was to develop an optimal soil improver based on granite meal, microsilica, and limestone meal, in a ratio of 2/2/1. In the experiment, the substrate consisted of a mixture of light soil (pH 6.5, medium phosphorus, potassium, and magnesium content) and sand in a weight ratio of 5/2. Maize was used as the test plant.

The research was carried out using a pot experiment. Pots with a volume of 5 dm^3 were filled with soil up to 75% of their capacity, then amended with 50, 100, or 150 g of the improver and thoroughly mixed. As control treatments, one pot without fertilization and another with mineral NPK fertilization were used. In each pot, 10 seeds were placed and left to germinate. During the leaf development phase, the number of plants was thinned to 5 per pot.

The applied improver had a positive effect on maize growth. In the treatment with 100 g of the improver, a higher biomass yield was obtained compared to the mineral fertilization treatment. Increasing the improver dose to 150 g/pot resulted in 20% greater plant growth compared to the 100 g/pot treatment. The highest biomass yield was recorded in the treatment with 150 g of the improver. The use of the improver improved the nitrogen and phosphorus nutritional status of the plants. Higher nutrient concentrations and greater plant biomass led to increased nutrient uptake in the treatments with the improver compared to the control plants. After harvesting, a significant increase in phosphorus content in the substrate was observed, along with an increase in organic carbon content.

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MODULAR UAV-BASED SYSTEM FOR LOW-COST AIR POLLUTION MONITORING USING OPEN-SOURCE MICROCONTROLLERS AND MULTI-GAS SENSORS

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ABSTRACT

The article presents the design and initial implementation of a low-cost air quality monitoring system integrated with an unmanned mobile platform (UAV). The system is based on an open-source microcomputer (Raspberry Pi) to which a set of environmental sensors (PM, CO, CO_2, NO_2, CH_4, VOC, NH_3 and others) is connected. Each of the sensors can be dynamically mounted and configured thanks to a flexible software system. Data is saved locally on an SD card and sent in real time to a remote server using a GSM/LTE module. Thanks to the integration with the GPS module, it is possible to create spatial maps of air pollution, which opens up new possibilities of applications in urban and agricultural environments. The system can simultaneously support from several to a dozen or so sensors of different types, which makes it a universal tool for field studies of atmosphere quality.

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NEURAL NETWORKS FOR SEASONAL GROUNDWATER LEVEL FORECASTING

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ABSTRACT

Reliable and sustainable water resource management largely depends on the accurate prediction of groundwater levels, a challenge that has become increasingly critical due to climate change, and the growing exploitation of aquifers due to human activities. Reliable forecasts are essential for effective decision-making in water resource management, particularly in regions facing seasonal fluctuations or long-term declines in groundwater availability. The hidden nature of underground reservoirs makes it impossible to gain detailed knowledge of structural variability and water paths. Apart from large homogeneous basins, the physical properties of aquifers are thus poorly understood, making them difficult to model using physical or physically based models. Also, difficulties encountered in delimiting their feeding basin make it a challenge to fully understand them and accurately simulate and forecast their evolution. Thus, the lack of physical knowledge of underground hydrosystems encourages the use of systemic modeling methods, based on statistical approaches that do not require such knowledge. These include models based on artificial neural networks, particularly multilayer perceptrons (MLPs), that have proven to be a promising approach for improving the accuracy of hydrogeological forecasts. These models offer the advantage of capturing complex, nonlinear relationships between meteorological variables and groundwater level fluctuations, often outperforming traditional statistical methods. Although IA methods need a sufficient volume of data, they do not require extensive information about the hydrodynamics of the aquifer, making them easier to implement in poorly known contexts.

In this study, we develop a seasonal groundwater level forecasting model for 30, 60, and 90 days ahead, for a piezometer located in the basement of the Sélune River watershed, in the Manche region of France. To achieve this, we use a multilayer perceptron (MLP) neural network while integrating regularization techniques to prevent overfitting and enhance generalization capabilities. The model is trained on a historical dataset covering a 15-year period with a decadal time step, incorporating several input variables, including temperature, actual evapotranspiration, precipitation, and the discharge of the nearby river. Cross validation and a separated test set are used to ensure the robustness of the model. Furthermore, the impact of future meteorological data on forecast quality is analyzed to assess its contribution to improving model performance.

The results show a variation in forecasting accuracy depending on the lead time, with a general tendency toward reduced accuracy over longer periods. However, the integration of available future meteorological data significantly enhances model performance, highlighting its importance in hydrological forecasting and resource planning, opening new paths of inquiry for future developments.

Estimating future trends in meteorological variables, even if uncertain, therefore appears to be a significant way of improving seasonal water level forecasts.

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NUMBER SIZE DISTRIBUTION AND CONCENTRATION OF DROPLETS GENERATED BY SAILING SHIPS

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ABSTRACT

Ship diesel engines are a significant source of aerosol nanoparticles on water bodies. The nanoparticles, significantly enriched with various environmental pollutants, are transported ashore by air currents or deposited on the water surface. The predominance of transport over deposition depends on the sedimentation rate of the nanoparticles. In general, the sedimentation rate of nanoparticles is very low, but can be significantly accelerated by scavenging nanoparticles on microdroplets. The mist of microdroplets is generated by sailing ships through hull motion and/or propeller rotation. Therefore, the number and size of microdroplets are critical parameters for the environmental fate of nanoparticles.

The number size distribution and number concentration of microdroplets generated by sailing ships were measured using commercially available disdrometer mounted on the prow of an inflatable boat, which chased the ship. A Meteorological Particle Spectrometer (MPS) was deployed in the Baltic Sea, where a ship with a length of 140 m and a maximum diesel engine power of 7.9 MW was measured. The distance between the ship and the MPS ranged from 40 to 800 m. The microdroplet number concentration was in the range of $8.2 \cdot 10^{-4}$ - 3.1 cm^{-3} and microdroplet size distribution exhibited mode at 50 - 100 µm. A Laser Precipitation Monitor (LPM) was used on the Vltava River in Prague, where four ships ranging in length from 30 to 50 m with maximum diesel engine power from 125 to 229 kW and a ferry 8.5 m long with engine power of 22 kW were measured. The distance from the ships to the LPM varied between 18 and 120 meters. Out of a total of 54 measurements made, 28 were evaluated. The average speed of the ships was found to be approximately 4.5 $m \cdot s^{-1}$. The microdroplet number concentration ranged between 4.6 10^{-5} - $2.6 \cdot 10^{-2} cm^{-3}$, microdroplets number size distributions always showed mode at 160 - 250 µm. Besides the difference of detection capabilities of the LPM and MPS, the differences between the sea and river experiments for droplet number concentrations and size distribution can be attributed to the difference in size and power of the ships being tracked.

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OPTIMIZATION OF THE REGISTER OF ENVIRONMENTAL ASPECTS WITH REGARD TO THE AGING OF MACHINES IN THE MACHINING PROCESS

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ABSTRACT

In recent decades, the state of the environment has deteriorated significantly, leading to increasing pressure for its protection and sustainability. Air, water and soil pollution have a negative impact on biodiversity and the health of ecosystems. Industrial companies are forced to comply with strict environmental regulations and voluntarily implement environmental management systems to minimize their impact on the environment. This trend has a significant impact on social and economic development, as well as on the quality of life and health of the population. The aim of this article is to expand the basic register of environmental aspects identified in machining according to ISO 14001, with regard to the aging of machines in the machining process. Expanding the basic register of environmental aspects according to ISO 14001 is important for improving environmental performance and compliance with legislation, leading to cost savings and strengthening the reputation of the company. Identifying and managing aspects associated with the aging of machines helps prevent environmental accidents and supports long-term sustainability. The research focused on analyzing the impact of aging machine tools on emissions and energy consumption. The research was carried out in the following steps: defining parameters, collecting and analyzing data, interpreting results, conclusions and recommendations. Furthermore, the possibilities of recycling older machines and implementing new technologies were examined. The result of the research work was a register of environmental aspects for the machining hall, where it can be observed that older machine tools have higher emissions and energy consumption, require more frequent maintenance, but can be recycled. On the contrary, new technologies, such as energy-efficient machines, advanced cutting tools, energy recovery, low-impact cooling systems, automation and digitalization, and adhesive machining, can significantly reduce environmental impacts. The implementation of these new technologies and processes not only contributes to environmental protection, but also increases the efficiency and competitiveness of industrial enterprises, which is key to their long-term sustainability, growth and continuous improvement. Sustainable development makes it possible to meet the current needs of the human population without compromising the living standards of future generations and the preservation of the planet's ecosystem.

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ORIGIN AND EVOLUTION OF FURNAS VOLCANIC LANDSCAPE (AZORES): A REVIEW

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ABSTRACT

The Autonomous Region of the Azores is a Portuguese archipelago located in the Atlantic Ocean, with 236,413 inhabitants (2021 census) and a total area of 2,322 km. The islands are characterized by volcanic landscapes, green pastures, hedgerows of blue hydrangeas and fishing villages. In 2023, the Azores archipelago embodies the list of 'European Best Destinations ®', this distinction is reflected in the 1.496,503 passengers disembarked at the archipelago's airports in the first eight months of 2023. In the last years, the increasing numbers of visitors reflected in the modernization of infrastructures, changes in the management of visits to iconic places and the production of quality information about the history and interpretation of those places. The village of Furnas and several 19th century gardens were built inside the volcano high caldera walls between fumaroles, thermal and mineral waters, and near a big lake, forming an idyllic place that offers one of the most diverse and complete visiting experience in the Azores. This review aims to provide accurate and updated information on the origin and evolution of Furnas Volcano Landscape from ancient Portuguese documents to the most recent scientific published research.

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POSSIBILITIES OF OBTAINING ZINC FROM STEEL MAKING WASTES AND GALVANIZING USING MICROWAVE ENERGY

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ABSTRACT

The application of microwave energy in waste processing after iron and steel production represents an innovative method of their recycling. The paper describes the possibilities of using electromagnetic radiation in the microwave band at treatment of waste from electric arc furnace. As global steel production increases, a significant amount of waste is produced, which causes significant environmental problems. The generated waste with content of iron and zinc is suitable after conventional or microwave treatment use in the sense of a circular economy. Also, in the subsequent processes of galvanizing steel parts, several types of waste containing zinc are produced. Flue gas particles in the form of ash and fly ash, produced in the galvanizing process over a zinc bath are a dangerous by-product with a content of 25.5% Zn and 0.64% Fe. The microwave treatment of zinc fly ashes is dependent on knowledge of their dielectric properties and parameters of used microwave equipment. The attention was paid to the thermal analysis of the studied fly ash. The majority mass loss of 60.99%, accompanied by an exothermic effect (666°C), occurred in the temperature interval 490-790°C. Scanning electron microscopy confirmed the presence of strategic metals, the need is currently increasing with the rapid increase in modern technologies.

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POTENTIAL USE OF BRICK WASTE FOR THE PRODUCTION OF GEOPOLYMER ROOF TILES

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ABSTRACT

The construction and demolition waste sector produces significant quantities of waste brick (WB), which can be repurposed for creating new eco-friendly materials. This study assesses the feasibility of utilizing waste brick in metakaolin-based geopolymers and measures their key physical and mechanical properties. Sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3) served as the activating alkaline solution. Various formulations were developed, incorporating increasing amounts of waste bricks. The molded samples were cured at room temperature for 24 hours, with their upper surfaces covered by a thin plastic film to minimize moisture loss. Following this initial curing, the specimens were demolded and further cured at room temperature for 28 days. Comprehensive analyses were conducted, including particle size distribution, chemical characterization, X-ray diffraction, specific gravity, and pozzolanic activity of the solid precursors. Additionally, physical and mechanical tests were performed on the geopolymer specimens, assessing flexural and compressive strength, ultrasonic pulse velocity, Leeb rebound hardness, apparent density, water absorption, and porosity. The chemical and mineralogical analysis of the brick waste revealed a high concentration of reactive silica and alumina, essential components for geopolymer synthesis. The optimal compressive strength achieved for geopolymers containing waste brick powder was approximately 30 MPa, with a metakaolin to waste brick ratio of 90/10, utilizing 10M NaOH and a hydroxide to silicate ratio of 1:2; the corresponding ultrasonic pulse velocity and Leeb hardness values were around 2000 m/s and 700 HLD, respectively. Geopolymeric mortars produced with a binder to aggregate of waste brick ratio of 1:3 exhibited promising mechanical properties comparable to geopolymers with powder waste brick. The findings suggest that incorporating brick waste into geopolymer binders and mortars can yield both environmental and economic advantages by providing an alternative to fired brick in construction.

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PRECISE BATHYMETRIC MEASUREMENTS OF INLAND WATER BODIES USING SBES/MBES HYDROACOUSTIC AND GNSS SATELLITE TECHNIQUES

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ABSTRACT

Bathymetric surveying is the process of collecting data on the shape of the bottom of water bodies, nowadays usually using GNSS positioning and hydroacoustic depth measurement techniques. Information on the shape and structure of the bottom of rivers and lakes is an essential element for their monitoring, management, reclamation planning or flood prevention. Precise bathymetric surveys of the bottom shape must be carried out regularly on some water bodies. A good solution is modern geodetic/bathymetric mobile mapping of the reservoir bottom using integrated GNSS (Global Navigation Satellite System) and SBES (Single Beam Echo Sounder). Each of these systems has its own group of measurement errors. The continuous movement of the survey boat through the water, its own movements around the axis (roll, pitch, yaw, heave), changes in water levels generate a number of inaccuracies and require the surveyor/hydrographer's knowledge and determination to eliminate them. The RTK/OTF GNSS (Global Navigation Satellite System) satellite positioning system using phase observations and the support of the local GBAS (Ground Based Augmentation System) allows determining the position of the bathymetric boat with an accuracy of 1 cm. A properly configured and calibrated depth measurement system SBES (Single Beam EchoSounder) also allows to measure the distance from the transducer to the bottom with an accuracy of 1-2 cm. Both measurement systems operate on a moving boat and in changing water level. It is crucial to continuously monitor the vertical position of the survey platform. A robotic total station, GNSS RTK and readings from local water gauges can be used to estimate sub-centimeter level changes and reduce final depth readings during hydroacoustic surveys. The final measurement data obtained must be corrected for the offsets of the measurement system and brought to the reference water level. The result of these precise measurements is the monitoring of the bottom shape with an accuracy of 5 cm. The presentation pointed out how to properly configure and calibrate measurement equipment and how to eliminate systematic and random errors during bathymetric measurements.

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REASESSMENT OF THE HYDROCARBON RESERVES OF EXHAUSTED AND PERSPECTIVE AREAS IN BULGARIA BY APPLYING CONTEMPORARY METHODS FOR FUTURE SUSTAINABLE EXPLORATION

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ABSTRACT

Petroleum and natural gas are among the most critical energy sources in contemporary societies, still impossible to replace with recoverable resources. They are projected to play a pivotal role in addressing the global energy demands in the near future. Achieving energy security for the present turbulent times is of utmost importance. The discovery and development of new hydrocarbon deposits, along with increasing productivity from existing fields. The majority of onshore oil and gas fields in Bulgaria are in a mature to final stage of exploitation, thus emphasizing the need for innovative approaches and modern methods for outlining perspective exploration territories. Some of the economic oil fields are still in production (Tyulenovo, Dolni and Gorni Dabnik, Dolni Lukovit-Staroseltsi and Burdarski Geran) and their recoverable potential remains to be fully tapped. Conversely, a number of other fields have been classified as depleted or with minimal remaining reserves, which seriously raises the question of their future (e.g., Devetaki, Pisarovo, Aglen and Deventsi). These "depleted" deposits are of significant interest due to the possibilities to reassess and apply modern technologies for optimization and increasing the yield from already exhausted fields. Therefore, the primary goals are enhancing the recovery factor to prolong the operational lifespan of existing brownfields and reassessing the hydrocarbon perspective areas in Northern Bulgaria. Moreover, a significant set of geological, geophysical and technical data concerning hydrocarbon accumulations is available for reassessment. This extensive data base provides a robust foundation for contemporary characterization and evaluation of natural reservoirs in the case of Devetaki gas condensate field and overall evaluation of several perspective adjacent areas (Bohot, Gradina, Kriva Bara, Bazovets, Tarnak and etc.). It also facilitates quantitative estimations of resource and reserve volumes within these reservoirs as well as delineation of future exploration territories. The integration of software platforms with modern geoscience concepts offers a cost-effective tool for economic growth. This study highlights the need for realistic geological models and production plans to enhance recovery from mature oil and gas fields in Bulgaria. Reassessment of the promising areas where hydrocarbons are present will also provide a new in-depth view on the future oil and gas sustainable exploration.

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RESOURCE CYCLİNG-BASED TECHNOLOGİES FOR WATERSHED POLLUTİON CONTROL

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ABSTRACT

Preserving the ecological health of water networks is essential for sustainable water resource management, particularly in regions facing escalating pollution challenges. Conventional approaches often depend on end-of-pipe treatments, which are costly and insufficient for addressing diffuse pollution sources. To overcome these limitations, this study presents an innovative Efficient Pollution Control Technology for Clear Water Networks, integrating material cycling principles, hydrodynamic regulation, and ecological restoration to enhance pollutant degradation and reinforce the self-purification capacity of aquatic ecosystems.

This technology is founded on three key components: high-efficiency sediment remediation, ecological interception barriers, and intelligent water quality monitoring. High-efficiency sediment remediation reduces internal nutrient release, mitigating secondary pollution and improving substrate conditions. Ecological interception barriers, strategically designed with native aquatic vegetation and bioengineering techniques, serve as natural filters that capture, break down, and prevent pollutants from dispersing downstream. Complementing these measures, an intelligent water quality monitoring system utilizes real-time data collection and adaptive management to enable dynamic pollution control, early warning capabilities, and precise environmental regulation.

Field applications in pilot river networks have demonstrated a 30–50% reduction in total nitrogen and total phosphorus concentrations, significant improvements in dissolved oxygen levels, and enhanced biodiversity indices, underscoring the resilience of restored ecosystems. Moreover, the integration of hydrodynamic regulation facilitates pollutant dilution and dispersion while supporting habitat recovery. These findings highlight the potential for large-scale deployment of this technology in degraded water bodies, providing a cost-effective, scientifically sound, and ecologically sustainable solution for holistic watershed management.

By addressing both point-source and non-point-source pollution through a comprehensive, ecosystem-based strategy, this technology offers a robust scientific and engineering framework for sustainable water network restoration, contributing to global efforts in water quality improvement, ecological rehabilitation, and long-term environmental resilience.

Keywords: Water network restoration, pollution control, hydrodynamic regulation, sediment remediation, ecological engineering, real-time monitoring, adaptive management, ecosystem resilience.

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REZISTIVITY SURVEY AND SOIL FLUX MEASUREMENTS IN AN AREA WITH NATURAL CO_2 EMISSIONS

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ABSTRACT

In monitoring CO_2 storage sites, it is assumed that detectable variations in electrical resistivity exist in the monitoring area, as supercritical CO_2 has a significantly higher resistivity compared to the fluids in the reservoir's pores. Geophysical methods, particularly geoelectric ones, have been successfully applied to obtain detailed images of a wide range of geological structures, including the heterogeneity of aquifer lithology, aquifer layer thickness, the presence of shale lenses, the position of the hydrostatic level, the identification of fractures and cracks, as well as the characteristics of contamination plumes with inorganic and organic compounds. In this context, vertical electrical sounding (VES) is a near-surface geophysical method, aiming to determine the resistivity distribution with depth and at the surface. Complementary to the monitoring methods for the Băile Lăzărești site (Romania), electrical resistivity measurements – electrometry – were carried out to highlight water bodies near the surface, their regional extent, local geological characteristics, and potential gas migration pathways to the surface, by outlining resistivity anomalies. The method implemented was vertical electrical sounding (VES) – Schlumberger device (MiniSting R1) on 12 profiles (6 profiles from the 12 in the high CO_2 emission area in the northern part of the Lăzărești site, and 6 profiles in the low CO_2 emission area in the southern part of the site). For each of the 6 profiles measured in the high CO_2 emission area, 6 VES measurements were made, with 9 measurements each (a total of 54 resistivity values acquired for each profile). The distance between the current electrodes (AB) was 4, 6, 8, 10, 12, 14, 16, 18, and 20 meters, while the MN distance remained constant at 2 meters. Due to the physical-chemical properties of the soil (alternating shale, marl, and sandstone from the Cretaceous flysch), the maximum penetration depth was calculated at 4.20 meters. The length of the 6 profiles is 30 meters. The geoelectrical investigation revealed that the presence of shale content tends to reduce the increase in resistivity caused by the replacement of water with less conductive CO_2. The obtained results represent one important step to demonstrate the feasibility of using resistivity surveys for monitoring CO2 geological storage sites.

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RISK-BASED FRAMEWORK FOR COMPLIANCE ASSESSMENT AND CO_2 GEOLOGICAL STORAGE MONITORING: APPLICATION IN THE GETICA CCS STUDY

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ABSTRACT

Geological CO_2 storage is one of the key solutions for reducing greenhouse gas emissions, but its successful implementation depends on developing effective monitoring strategies and compliance assessment frameworks. This paper presents a risk-based monitoring methodology for CO_2 storage, based on the experience gained from the feasibility study of the Getica CCS project, which aims to store CO_2 in saline aquifers.

The monitoring plan developed within Getica CCS ensures compliance with European and international regulations while demonstrating the safety and efficiency of the storage process. It integrates a comprehensive set of monitoring technologies, including geophysical, geochemical, and reservoir engineering methods.

Geophysical monitoring is a core component of the plan, utilizing advanced technologies such as 4D seismic based on distributed acoustic sensing (DAS) and seismic nodes. These methods allow for detecting any changes in the geological structure of the saline aquifer and identifying potential risks associated with CO_2 migration. Additionally, gravimetric and ground deformation measurements are employed to assess the behavior of the geological formation and detect any variations in pressure and mechanical stresses.

Geochemical monitoring plays a crucial role in verifying CO_2 storage safety and identifying possible chemical interactions between CO_2 and the host formation. The monitoring plan includes isotopic analyses and CO_2 concentration sensors in groundwater to detect potential leaks and assess the system's chemical stability. These methods are complemented by analyses of dissolved gas composition and measurements of pH and alkalinity, providing essential data on the geochemical balance of the site.

Furthermore, the monitoring plan incorporates an advanced pressure and temperature monitoring system within the reservoirs, using dedicated probes and numerical modeling to predict the long-term evolution of the CO_2 storage site. This approach enables the adjustment of operational strategies to ensure long-term storage security.

Another important aspect analyzed in this study is the integration of risk perspectives and monitoring strategies from different European countries. The Getica CCS project serves as a concrete example of how these methods can be applied in the specific context of saline aquifers, contributing to the development of best practices for future CO_2 storage projects.

This paper highlights the importance of integrated and risk-based monitoring for ensuring compliance and operational safety in CO_2 storage projects. The lessons learned from Getica CCS demonstrate the necessity of using advanced technologies and a multidisciplinary approach to guarantee efficient and sustainable CO_2 storage, offering a replicable model for future carbon capture and storage initiatives.

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SEDIMENT TRANSPORT IN AN ATLANTIC RURAL CATCHMENT: A MULTI-EVENT ASSESSMENT

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ABSTRACT

Soil loss and sediment pollution in surface waters are two major environmental problems worldwide, with the agricultural activities identified as the main diffuse source of sediment in inland waters. A comprehensive assessment of sediment dynamics is therefore essential to determine where and when sediment supply is taking place and to what magnitude. This can provide valuable information about geomorphological and ecological status of the fluvial systems and assists managers and other stakeholders to implement water protection measures. In this study, sediment flux and transport dynamics during runoff events in a small (65 km^2) Atlantic rural catchment in NW Iberian Peninsula is analyzed. For this purpose, continuous discharge monitoring was conducted at the catchment outlet, and high-frequency water samples were collected during runoff events using an automatic sampler. The findings indicated substantial variations in sediment flux and concentration, strongly associated with hydro-climatic conditions and agricultural practices conducted in the watershed area. An evident interaction was observed between soil cover in agricultural fields and hydro-sedimentological processes. In this context, it was observed that certain high-magnitude rainfall-runoff events did not produce major impacts on sediment load, whereas other events with comparable features had substantial effects on sediment concentrations and contributed markedly to annual sediment load. For example, a single rainfall-runoff event (<0.1% of annual period) accounted for about 25% of the yearly sediment load, highlighting the significance of event-scale monitoring for accurate evaluation of sediment fluxes. At the event scale, diverse patterns were identified for sediment concentrations, which could be related to the spatial variability of sediment source areas during different rainfall-runoff events.

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SELECTED PROPERTIES AND COMPOSITION OF SAHARAN DUST IN RELATION TO ATMOSPHERIC DEPOSITION IN THE KOŠICE AREA (SLOVAKIA)

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ABSTRACT

This paper analyses Saharan dust (SD) from settled precipitation from the episode of its record occurrence in eastern Slovakia at the end of March and early April 2024.The aim is to assess the impact of SD on atmospheric deposition (AD) and particulate matter immissions in the Košice area with the metallurgical industry present. The particles' size and distribution, chemical, and phase composition were analyzed. The methods of laser granulometry, electron microscopy (SEM and EDX), ICP MS, CHNS, and X-ray powder diffraction analysis were used. Saharan dust is polydisperse, with a mean geometric grain diameter of 15.1 μm; the proportion of particles with sizes below 10 and 2.5 μm is 37 and 10.9 %, respectively. The proportion of particles larger than 20 μm is 45 %. The sample SD is polymineralic, with quartz dominantly represented, accompanied by calcite, and less by dolomite. The SD sample is polymineralic, with quartz as the dominant component, accompanied by calcite and dolomite to a lesser extent. Additionally, feldspars, micas, kaolinite, and other common phyllosilicates and rock-forming minerals were confirmed. The main components of the analyzed EDX spectra, apart from oxygen and silicon, also included elements such as Al, Ca, K, Fe, Mg, and Na. The SD sample contained a relatively high carbon content (9.6%). Based on their occurrence in the spectra, the elements were present in the following order: O, Si, Al, Fe, Ca, Mg, K, C, Ti, Na, Cu, P, Mn, Nb, Ba, Br, Cr, and Pt. The chemical composition of SD is very similar to the average composition of the Earth's crust. Compared to the concentrations of the monitored elements in AD, the SD sample exhibited higher levels of aluminum and, to some extent, calcium and magnesium. In the case of other elements, their concentrations in AD from an area in the metallurgical industry were significantly higher than in Saharan dust.

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SPATIAL DISTRIBUTION OF PM_X AND NUMBER CONCENTRATION OF SUBMICRON AEROSOL PARTICLES BEHIND SAILING SHIPS ON THE VLTAVA RIVER

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ABSTRACT

Ship diesel engines have been suggested as significant sources of particulate matter PM_x, defined as a mass of aerosol particles with aerodynamic diameter smaller than x microns, and submicron aerosol particles on water bodies. Ship diesel-originating aerosol particles form a plume that trails ships while sailing. The plume dispersal, temporal and spatial distribution aerosol particles, determines its environmental impact. Therefore, the objective of the study was to measure the spatial distribution of aerosol submicron particle number concentrations and PM_x behind sailing ships.

The number concentration of submicron aerosol particles (PNC) and PM_1, $PM_{2.5}$, PM_{10} were measured by a condensational particle counter and optical particle sizer respectively at a height of approximately 1 m above water level, on board of a boat powered by an electromotor behind the sailing ships. The measurement was conducted on the Vltava River in Prague in Spring 2025. A total of seven ships with diesel engines ranging in power from 125 to 229 kW were chased. The distance between the boat and the ship's stern ranged from 20 to 50 meters, and the inclination angle of the boat relative to the ship's axis was $\pm$15°.

For instance, $PM_{2.5}$ concentration ranged from 17 to 213 μg m^{-3}, while the PNC concentration ranged from 2.4 × 10^3 to 1.51 × 10^5 cm^{-3} behind the ship with diesel power of 138 kW, sailing at a speed of approximately 3.5 ms^{-1}. A tight regression (R^2 = 0.82) was observed between PNC and $PM_{2.5}$ at the distance of 25 meters, irrespective of the inclining angle. Since PNC indicates diesel emission, we may conclude that ship diesel was the predominant source of $PM_{2.5}$ on inland water at this locality during our investigation. The extension of our measurements to other ship types is currently under investigation.

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SUBSTRATE IMPROVEMENT TECHNIQUES FOR CONTROLLING SPARTINA ALTERNIFLORA INVASION AND RESTORING NATIVE VEGETATION IN COASTAL WETLANDS

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ABSTRACT

Coastal wetlands are critical ecosystems that provide essential services, such as biodiversity support, water purification, and carbon sequestration. However, the invasion of non-native species like Spartina alterniflora poses significant threats to the structure and function of these ecosystems. This research aims to develop innovative substrate improvement techniques to control the spread of Spartina alterniflora and restore native plant species in coastal wetlands, focusing on the Tiaozini World Natural Heritage Site in Dongtai, China.

Spartina alterniflora, a highly invasive grass, has significantly altered the ecological balance of tidal flat ecosystems. Its rapid spread leads to the replacement of native species, degradation of habitat quality, and loss of biodiversity. One effective approach to controlling its invasion is through improving the substrate characteristics of the tidal flats, which directly influence the growth and spread of Spartina alterniflora. This study explores several methods of substrate modification, including the use of organic soil amendments, microbial agents, and native plant extracts, to enhance soil conditions and inhibit the growth of the invasive species.

The research involves a comprehensive analysis of the impact of these substrate improvement techniques on the growth of Spartina alterniflora, as well as on the recovery of native plant species. Microbial agents, in particular, show promising results in altering soil structure and reducing the competitive advantage of Spartina alterniflora. The study also investigates the regulatory role of micro-topographical features in controlling the invasion by providing a physical barrier or altering hydrological conditions that favor native plant growth.

Through a combination of field experiments, laboratory studies, and ecological modeling, this research provides valuable insights into the interaction between substrate characteristics and plant invasion dynamics. The outcomes of this study have the potential to inform global wetland management strategies, offering sustainable and environmentally friendly solutions for invasive species control.

This presentation will share the key findings of the project, discuss the ecological implications of substrate improvement on Spartina alterniflora control, and propose recommendations for future research and practical applications in wetland restoration efforts worldwide.

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SURFACE WATER QUALITY OF THE DANUBE LOWLAND AND ITS SPATIAL AND TEMPORAL ASSESMENT

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ABSTRACT

Climate change in recent years has also greatly affected extreme dhrought, floods and surface water quality too.

Non-anthropogenic and anthropogenic activity have an impact on the parameters of the hydrological regime of rivers, potentially leading to negative effects on the surface water. Therefore, monitoring changes in the quantity and quality of water in streams is necessary. The partial aim was to evaluate eutrophic state of water in Danube River basin following the assessment physical-chemical and microbiological indicators in monitored period. The major influencing factors on water eutrophic include nutrient enrichment, hydrodynamics, environmental factors such as temperature, salinity, carbon dioxide, element balance, microbial and biodiversity.

During the years 2010 – 2025 the values of pH were evaluated in the Žitný ostrov channel network Danube Lowland (Slovakia). From obtained results it follows that the mean pH value varied from 6 to 8,5 and EC from 250 $mg.l^{-1}$ to 450 $mg.l^{-1}$ over the whole monitored period. In clean natural waters (both surface and underground), the pH value is determined by physical-chemical parameters and the balance between free CO_2 and bound CO_2.

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THE EVALUATION OF THE WEAR OF SURFACE-SET DIAMOND DRILL BITS BY ANALYSIS THE ROCK DEBRIS AND PROCESS PARAMETERS

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ABSTRACT

In this article, experimental research on rotary drilling into limestone and granodiorite samples, conducted on a horizontal drill stand constructed at the Institute of Geotechnics of the Slovak Academy of Sciences, is described. Drilling into limestone and granodiorite was conducted using two surface set core diamond drill bits with diamonds of different sizes but identical drill bit contact areas. The purpose of the experiments was to obtain data on the wear of drilling tools, in particular by changing the type of the rock used in the drilling experiments. Initial drilling was conducted into limestone, and after drilling the length of 6.75 meters, the drilling was conducted into granodiorite, the rock with higher abrasivity. The findings observed with the use of granodiorite included more significant changes in the shape and abrasion degree of the diamonds embedded in the drilling tools. For the purpose of the assessment of the condition of the surface set diamond drill bits, the penetration depth and torque parameters were measured during experimental drilling, and subsequently used to calculate the values of specific energy. Rock debris generated by drilling was collected and subjected to a sieve analysis in a laboratory. Results of the sieve analysis were used to calculate the coarseness index (CI) in order to compare the changes in the rock debris particle size. It was examined whether the changes in the shapes and condition of the diamonds embedded in drill bits affected the process parameters and the rock debris particle size. The objective was to identify the effects of deterioration of the drilling elements of the surface set diamond drill bits on the values of the yield of rock debris of all fractions, as well as its effects on the penetration depth and specific energy values. It was observed that the tested drill bits exhibited comparable values of the yield of rock debris of all fractions after drilling into limestone to identical penetration depths. The difference in the calculated CI values observed for the drill bit with larger diamonds during the first conducted drilling into granodiorite was more significant that that observed with the use of the bit with smaller diamonds. The resulting comparison of the drilling tools, in particular the respective values of the penetration depth and the CI calculated based on the analysed rock debris, revealed that the surface set drill bit with smaller embedded diamonds was more suitable for drilling into limestone as well as granodiorite.

Corresponding Author: Mária Bali Hudáková

THE HISTORICAL GARDEN TERRA NOSTRA (SÃO MIGUEL ISLAND, AZORES): THE CONTRIBUTION OF GEOGRAPHIC INFORMATION SYSTEM TOOL TO CONTENT DEVELOPMENT

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ABSTRACT

Placed in a landscape of great beauty, Terra Nostra Garden has more than two centuries of history, a unique landscape architecture, a dense canopy, several botanical collections, and thermal waters. The garden is located at Furnas village, an active volcanic area of the Azorean Island of São Miguel. The increased number of visitors associated with the Terra Nostra Garden Hotel and the garden natural SPA, triggered the need of a Geographic Information System (GIS) to improve both park management and contents communication. This work aimed to add scientific and economical value to the historical Terra Nostra Garden through the implementation of a GIS. With this purpose we established the following specific objectives: describe the origin and evolution of Terra Nostra Garden, supported on published work, unpublished notes, and age determination in georeferenced tree specimens; implement a GIS linked to walking trails covering the maximum points of interest regarding: special specimens, botanical collections, historical constructions, and points of view; and select 121 plant specimens of interest to obtain the following information: height, diameter at breast heigh, canopy area, and phenology. The heart of Terra Nostra Garden has its origins in the 1786 summer house of Thomas Hickling. Trees' age estimation enabled to link the sampled trees to different garden historical periods supporting an apparent pattern of plantation from West to East and from North to South probably explained by the land acquisitions made sequentially by the Viscount and his son the Marquis. The oral tradition referring the Quercus robur as the oldest tree, already present in Thomas Hickling Garden was confirmed (255 years) as well the plantation of at least one Araucaria near the tank (Araucaria bidwillii) by the Viscount Duarte Borges da Câmara Medeiros. Besides Quercus robur, we linked 2 more specimens to the Thomas Hickling period. Araucaria heterophylla, a species introduced to Kew Gardens in 1793 by Joseph Banks, was planted in the early 1800s at Terra Nostra Garden by Thomas Hickling. Although the Ginkgo Lane has been designed between 1936/37 by Vasco Bensaude; an older specimen planted by the Marquises' heirs already existed. This study allowed also to identify the tallest Araucaria heterophylla in Europe (world 4th place).

Corresponding Author: Maria Pereira

THE PRESENCE OF A SELECTED GROUP OF MICROPOLLUTANTS IN WATER RECLAIMED FROM WASTEWATER

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ABSTRACT

Reclaimed water from wastewater is a practical alternative to conventional water resources. However, its use, especially for municipal and environmental purposes, is of concern due to its content of micropollutants, including microplastics (MPs). The legal requirements for the quality of water reclaimed from wastewater do not include any limits for such contaminants, which unfortunately can be returned to the environment.

The aim of the study was to assess microplastics contamination of water reclaimed from wastewater, along with an assessment of ecotoxicological risks, in relation to the various technological solutions used.

The study used MBR-treated wastewater (membrane pore size: 0.04 μm), which was subjected to post-treatment processes on granular activated carbon (GAC) and quartz sand (PK). Physico-chemical (BOD_5, TSS, turbidity) and microbiological (bacteria *E. coli*) parameters were determined for raw, treated and post-treated wastewater (reclaimed water). Studies were also conducted to detect the presence of MPs using the Agilent LDIR 8700 Chemical Imaging System, providing results such as the types of MPs present and the number of particles. In addition, an assessment of potential ecotoxicological risk was made based on the polymer hazard index (PHI) value.

The use of MBR technology allowed the complete removal of TSS from the treated wastewater, and thus from the post-treated wastewater (Class A reclaimed water: TSS ≤ 10 mg/dm^3). The turbidity and BOD_5 values in samples after GAC and PK were below the threshold values specified for Class A reclaimed water. Wastewater treated with MBR meets the standards for Class B reclaimed water. The MBR technology ensured the complete elimination of *E. coli bacteria*, while the application of GAC and PK contributed to an increase in the biostability of the reclaimed water. The studies revealed the presence of MPs particles in all samples. The highest concentration of MPs was recorded in raw wastewater (61 800 MPs/dm³) and polypropylene (PP) was dominant component (96.3%). The use of membranes reduced the presence of MPs in wastewater (12 900 MPs/dm³, 45.0% PP), but a significant share of polyethylene (PE) (55.0%) was observed. The presence of MPs in the reclaimed water was 14 500 (GAC) and 3800 MPs/dm^3 (PK). The dominant MP was PE, 64.3% and 96.7%, respectively. The risk level for raw wastewater, due to MPs contamination is at level IV – danger. For the sample after MBR and GAC, it is at level II – medium.

The use of post-treatment processes for treated wastewater allows to obtain Class A reclaimed water. The physical and chemical parameters are in accordance with legal regulations. However, MPs particles are present in the reclaimed water. Of course, the use of GAC and PK allows further elimination of this group of micropollutants. The results obtained indicate leaching of MPs in the technological systems, which should be eliminated in further studies. In addition, the results suggest that the issues of the presence of MPs in water reclaimed from wastewater should be discussed in the scientific community.

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TOWARD GREENER MORTARS WITH WASTEWATER SLUDGE AS CEMENT REPLACEMENT

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ABSTRACT

The cement industry has a significant impact on environmental issues, leading to growing demand and research into developing alternatives that result in more environmentally friendly building materials. This study explores whether sludge from the Bragança Wastewater Treatment Plant (WWTP) can partially replace cement in mortar production, offering a more eco-friendly solution while promoting waste reutilization.

The sludge was prepared using five different methods to evaluate this possibility. M1 was oven-dried, M2 and M3 were sun-dried, M4 was incinerated in a muffle furnace, and M5 was pyrolyzed. The mechanical strength of the mortar was tested using a compression analysis.

Different mixtures were formulated and analyzed, and the M3 specimen containing 7% sludge, showed the highest strength, outperforming the control mortar and those with M1, M2, and M4 sludge preparations, which displayed similar results. On the other hand, the mixture subjected to the pyrolysis treatment (M5) showed the least satisfactory results in terms of strength, even lower than those obtained for the control mortar.

Considering the environmental perspective and the pressing need to move towards a circular economy, evaluating the associated energy consumption and mechanical performance is essential.

The results showed that partially replacing cement with treated sludge effectively reduced energy consumption when subjected to low-consumption processes, such as drying by solar exposure. It should be noted that all the modified mortars, following different methods, were shown to comply with the EN 998-1:2018 standard for compressive strength, which attests to their viability for practical applications.

The incorporation of WWTP sludge in mortar production not only reduces cement consumption but also minimises the environmental impacts associated with this industry. At the same time, it contributes to sustainable waste management and economic valorization. This study demonstrates the potential of sludge-based mortars as an economically viable alternative that also plays a role in mitigating environmental issues.

Further studies should assess long-term durability and potential environmental trade-offs to better understand this approach's practical implications in real-world construction.

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TOWARDS SUB-CENTIMETER MSST DETECTION: A GNSS-ON-BOAT AND ACCELEROMETRIC SENSOR APPROACH

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ABSTRACT

In recent years, the GNSS-on-boat method has undergone substantial development, significantly enhancing the accuracy of Mean Sea Surface Topography (MSST) measurements—reaching precision levels close to 1 cm. MSST serves as a fundamental oceanographic and geophysical quantity, reflecting both dynamic ocean processes and the underlying structure of Earth's gravity field. Precise mapping of MSST not only improves our understanding of ocean circulation and sea level variations, but also offers a valuable proxy for detecting gravitational anomalies, a long-standing challenge in theoretical physics and geodesy. This study introduces a novel prototype platform specifically designed to push the limits of current GNSS-based MSST measurement techniques. The system consists of a floating array equipped with four GNSS receivers strategically arranged to form a geometric baseline network, and a set of high-sensitivity accelerometers. This configuration allows the device to capture both translational and rotational motion, enabling robust correction of wave-induced noise and vessel dynamics. A mathematical formulation of the positioning problem led to the development of a custom algorithm that fuses GNSS signals with accelerometric data using a filtering approach. This algorithm accounts for wave motion, platform tilt, and sensor latency, delivering a corrected and dynamically stable vertical position. Simulated sea trials across a range of wave conditions showed that the system can achieve MSST measurement accuracies between 0.87 and 0.29 cm—surpassing the 1 cm benchmark and entering a regime of resolution previously inaccessible through in situ GNSS methods. The potential of this approach is far-reaching. Beyond its implications for geophysical theory, the enhanced sensitivity of the system could support fine-scale marine geodesy, hydrographic surveying, offshore engineering, and localized gravity anomaly detection. Field deployment of the prototype in real marine environments is expected to validate these preliminary results and pave the way for a new class of ultra-precise ocean surface monitoring platforms.

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TRACKING URBAN IMPACT ON THE FERVENÇA RIVER VIA WATER QUALITY INDEX

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ABSTRACT

Water quality is essential for the survival of living organisms and the preservation of aquatic ecosystems. Monitoring water resources is crucial for identifying pollution sources and for implementing mitigation strategies. This study aimed to evaluate the water quality of the Fervença River, located in Bragança, Portugal, using a Water Quality Index (WQI). Water samples were collected monthly from January to June 2022 at five distinct locations along the river, including rural and urban areas.

The parameters analyzed included physical, chemical, and microbiological variables such as pH, temperature, dissolved oxygen (DO), biochemical oxygen demand (BOD_5), turbidity, nitrates, total phosphorus, total solids (TS), and fecal coliforms (FC). The analysis followed the methods outlined in the Standard Methods for the Examination of Water and Wastewater. The results were used to calculate the WQI, which ranges from 0 to 100, with classifications such as "Excellent," "Good," "Regular," "Bad," and "Very Bad."

Points 1–4 exhibited consistently good WQI values throughout the study period, reflecting minimal spatial and temporal variations. However, Point 5, located downstream near the wastewater treatment plant (WWTP), consistently showed reduced WQI values, ranging from "Regular" to "Bad." This pattern suggests a significant negative impact of urban activities and WWTP effluents on the river water quality. Elevated levels of BOD_5 and FC at Point 5 indicate increased organic load and microbial contamination, rendering the water unsuitable for human consumption even after conventional treatment.

During the study period, the region experienced unprecedented drought, with significantly lower rainfall than historical averages. These climatic conditions likely hindered the expected improvement in water quality over time, particularly during the winter months (January to March). Additionally, riparian vegetation, which typically acts as a barrier against sediment runoff, did not appear to influence the WQI results because of the lack of rainfall during spring.

The results were also compared with the limits established by Decree-Law No. 236/98, which classifies surface water quality for drinking water production. Based on this analysis, water from Points 2, 3, and 4 can be used for this purpose after undergoing physical, chemical, and disinfection treatments (Classes A2 and A3). However, the water from Point 5 exceeded the acceptable limits for several parameters, rendering it unsuitable for any use related to human consumption.

The June sampling campaign had the lowest overall water quality. This decline was attributed to higher temperatures, which negatively affected DO levels, a parameter with the highest weighting factor in the WQI calculation. Additionally, increased bacterial activity likely contributed to elevated BOD_5 values. Severe drought during the study period limited the influence of rainfall on the WQI results because the precipitation volumes were significantly below average.

This study highlights the importance of continuous water quality monitoring and underscores the negative impacts of urbanization on aquatic ecosystems. The findings demonstrate that while Points 1 to 4 maintained good water quality, Point 5 exhibited consistent deterioration linked to anthropogenic activities and WWTP discharge. Effective measures, such as stricter control of effluent discharge and conservation of riparian areas, are recommended to mitigate these impacts.

In conclusion, the application of the WQI proved to be effective for assessing the water quality of the Fervença River. The results revealed that the city of Bragança exerts a direct negative influence on river water quality, particularly downstream of the WWTP. Although the river maintains relatively good water quality in the upstream areas, significant deterioration occurs in the urbanized zone. This study emphasizes the need for sustainable water management practices to safeguard this vital resource for the future generations.

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UNRAVELING THE FIELD-RELEVANT EFFECTS OF MICROPLASTICS AND HEAVY METALS ON VALLISNERIA NATANS PHYSIOLOGY AND SEDIMENT BIOGEOCHEMISTRY

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ABSTRACT

The ubiquitous presence of microplastics in freshwater ecosystems has raised significant concerns regarding their compounded ecological risks, particularly through synergistic interactions with persistent contaminants such as heavy metals. This investigation systematically examines the ecotoxicological effects of co-exposure to 200 nm polystyrene microplastics (MPs-PS) and heavy metals at environmentally relevant concentrations on Vallisneria natans and benthic sediments. Our multiparametric analysis encompassed plant physiological and biochemical responses, particularly the antioxidant defense system activation, along with comprehensive assessments of heavy metal speciation dynamics, sediment bioavailability variations, and microbial community structural modifications. Notably, the co-exposure regime demonstrated enhanced plant growth compared to heavy metal exposure alone. Fluorescence tracing revealed efficient root absorption of 200 nm MPs-PS with preferential accumulation in cortical parenchyma. Subsequent cellular internalization triggered a cascade of defense mechanisms, including significant upregulation of antioxidant enzymes and enhanced callose synthesis in root tissues . While MPs-PS exposure effectively mitigated sediment acidification, no statistically significant alterations were observed in heavy metal speciation patterns or bioavailable fractions through sequential extraction analysis. This study provides mechanistic insights into the complex interplay between emerging microplastic contaminants and legacy heavy metal pollutants in freshwater systems. Our findings establish a critical framework for environmental risk assessment and inform evidence-based strategies for aquatic ecosystem management under multi-pollutant stress scenarios.

Corresponding Author: Zheng Zheng

UAV-BASED INFRARED IMAGİNG SYSTEM FOR GREENHOUSE GAS EMİSSİON DETECTİON USİNG FLIR TECHNOLOGY

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ABSTRACT

Monitoring greenhouse gas emissions, such as methane (CH_4), carbon dioxide (CO_2) or nitrous oxide (N_2O), is an important element of climate policy and environmental engineering. This paper presents the concept and initial validation of a mobile measurement system based on an unmanned aerial vehicle (UAV) equipped with a FLIR GF77 or Gx620 thermal imaging camera. The system enables remote, non-contact detection and quantitative analysis of gas emissions in agricultural and urbanized environments.

The aim of the study was to assess the possibility of using infrared imaging methods to visualize and analyze greenhouse gas emissions in real time. The methodology includes recording video recordings in the thermal range from the UAV, and then analyzing the recorded data in the MATLAB environment. Techniques such as thermal image segmentation, optical flow analysis to determine the direction and speed of gas cloud movement, and data conversion into volumetric units were used. The UAV system additionally integrates GPS modules and laser rangefinders, which allows for precise spatial mapping of emissions. Thermal imaging data is saved locally on SD cards. The obtained results confirm the possibility of effective detection of gas emissions with high spatial resolution. The recorded data enables integration with geographic information systems (GIS), which allows for the creation of dynamic emission maps.

Corresponding Author: *Bartosz Nycz*

URBAN ENVIRONMENTAL ASSESSMENT: THE ROLE OF SOIL MAGNETIC SUSCEPTIBILITY IN GEOCHEMICAL INVESTIGATIONS - A CASE STUDY FROM MAKSIMIR PARK, ZAGREB, CROATIA

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ABSTRACT

The aim of the current research was to determine the spatial variability of soil geochemical and geophysical properties in the Maksimir Park. The park, encompassing 316 hectares, is situated in Zagreb and attracts over two million visitors annually. Soil sampling was carried out in summer 2022 at 12 locations at a depth of 0-30 cm. Prior to the detection and quantification of selected parameters, the soil samples were air-dried, ground, sieved, and homogenized. The pH and organic matter content were determined by standard laboratory methods, while total Pb, Zn, Cu, Cr, Mn, Fe, Ni, As, Sr and Y content by portable X-ray fluorescence analyzer. Magnetic susceptibility (MS) was measured using a SM30 susceptibility meter. The deterministic spatial interpolation technique Inverse Distance Weighting (IDW) was used to display the spatial variability of the soil properties.

The results indicate that the soil of Maksimir Park is highly acidic to alkaline. Acidic soil predominates in the northern forested section of the park, whereas alkaline soil is predominantly found in the southern areas, particularly near roads. The organic matter content indicates that the soil in the Park is quite (3.9%) to very highly supplied (13.7%) by organic matter. The average concentrations of accumulated elements were as follows: 48.3 mg Pb/kg, 97.8 mg Zn/kg, 32.1 mg Cu/kg, 97.9 mg Cr/kg, 713.5 mg Mn/kg, 33.9 g Fe/kg, 33.1 mg Ni/kg, 15.2 mg As/kg, 115.1 mg Sr/kg and 33.9 mg Y/kg. Across all examined sites within the park, the levels of lead, copper, arsenic, and nickel were below the statutory threshold limits (OG 71/19). However, in the northern park areas with acidic soil conditions, zinc and chromium levels exceeded the prescribed thresholds (60 mg Zn/kg and 40 mg Cr/kg), with recorded values ranging between 63.0–114.0 mg Zn/kg and 88.0–99.5 mg Cr/kg.

MS values were in the range from 0.057 to 0.325 x 10^{-3} SI units, with the mean value of 0,175 x 10^{-3} SI units. A statistical correlation analysis was conducted to examine the relationships between MS and soil geochemical properties. The highest correlation of MS was observed with Fe (0.91), accompanied by other very strong relationships with pH (0.77), Zn (0.75), Cu (0.86), Ni (0.83), and Sr (0.89). Consequently, it can be inferred that elevated MS values correspond to increased concentrations of these elements. Although the positive correlations with Pb, Mn, As, and Y do not meet the threshold for statistical significance, they still indicate a slight association with MS. In locations with higher MS values, at least marginally elevated levels of these elements can be anticipated. When comparing the correlations of MS with heavy metals in the broader Zagreb area, the results are largely consistent. However, in the Maksimir Park, the correlation with Fe is notably stronger than that observed across the entire city. Using the example of Maksimir Park in Zagreb, the magnetic susceptibility method has demonstrated its effectiveness as a rapid screening tool for iron and a range of heavy metal concentrations in the soils of urban parks.

Corresponding Author: Stanislav Frančišković-Bilinski

VARIATIONS OF ALLOCHTHONOUS AND AUTOCHTHONOUS INPUTS INVESTIGATED IN CORE SEDIMENTS COLLECTED FROM SEVERAL LAKES OF THE GORGOVA-UZLINA HYDROGRAPHIC UNIT, DANUBE DELTA, ROMANIA

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ABSTRACT

Purpose: This study focuses on the physical-chemical characteristics of sediments in shallow delta lake settings and evaluates the role of allochthonous and autochthonous inputs in the distribution of the main lithological components of sediments (i.e., total organic matter-TOM%, carbonates-CAR%, and the siliciclastic fraction-SIL%). We compare the vertical distribution of the TOM%, CAR% and SIL% in core sediment samples extracted from selected lakes within an inter-distributary depression, i.e., the Gorgova-Uzlina Hydrographic Unit of the Danube Delta, Romania. Coring in transitional environments, such as wetlands, lagoons, and lakes, is a common practice to investigate the physical-chemical character of sediment deposits.

Materials and methods: Sampling was conducted during two distinct hydrological periods of the Danube River's flow: low-water level (September 2024) and high-water level (October 2024). Short sediment cores were collected using the gravitational Hydro-Bios sampler from lacustrine regions, including Uzlina L. (3 cores), Isacova L. (3 cores), Bleziuc-Pojarnia L. (1 core), Pojarnia L. (2 cores), Rotund L. (1 core), Rădăcinos L. (1 core), Gorgova L. (3 cores), and Potcoava de Sud L. (1 core). Lithological analysis of the core sediment samples was carried out using the Loss on Ignition Method, and the vertical distribution of the main lithological components was investigated.

Results and discussions: In general, the physical-chemical sediment characteristics (i.e., TOM%, CAR% and SIL%) in sediment cores collected from the inner parts of the lakes do not reveal significant variations in the main lithological components. Most of the investigated sediment samples are characterized as organic-rich sediments (≥15-30% organic matter). Shallow lakes, characterized by low flow velocity and relatively low inflows and outflows, can accumulate large amounts of organic matter. Infrequently, some differences were observed among the cores at different depth intervals. In contrast, sediment cores collected from areas with active hydrodynamic conditions (i.e., near channels or streams) exhibited variations in the main lithological components, indicating that these samples are mineral-rich (≤15-30% organic matter).

Conclusions: The distribution of the main lithological components in the investigated sediment cores can be attributed to various anthropogenic and natural factors and their interactions. The physical-chemical characteristics of the sediments may also suggest different origins. The results of this study may contribute to the development of programs aimed at predicting future environmental trends and managing natural resources more effectively.

Corresponding Author: Irina Catianis

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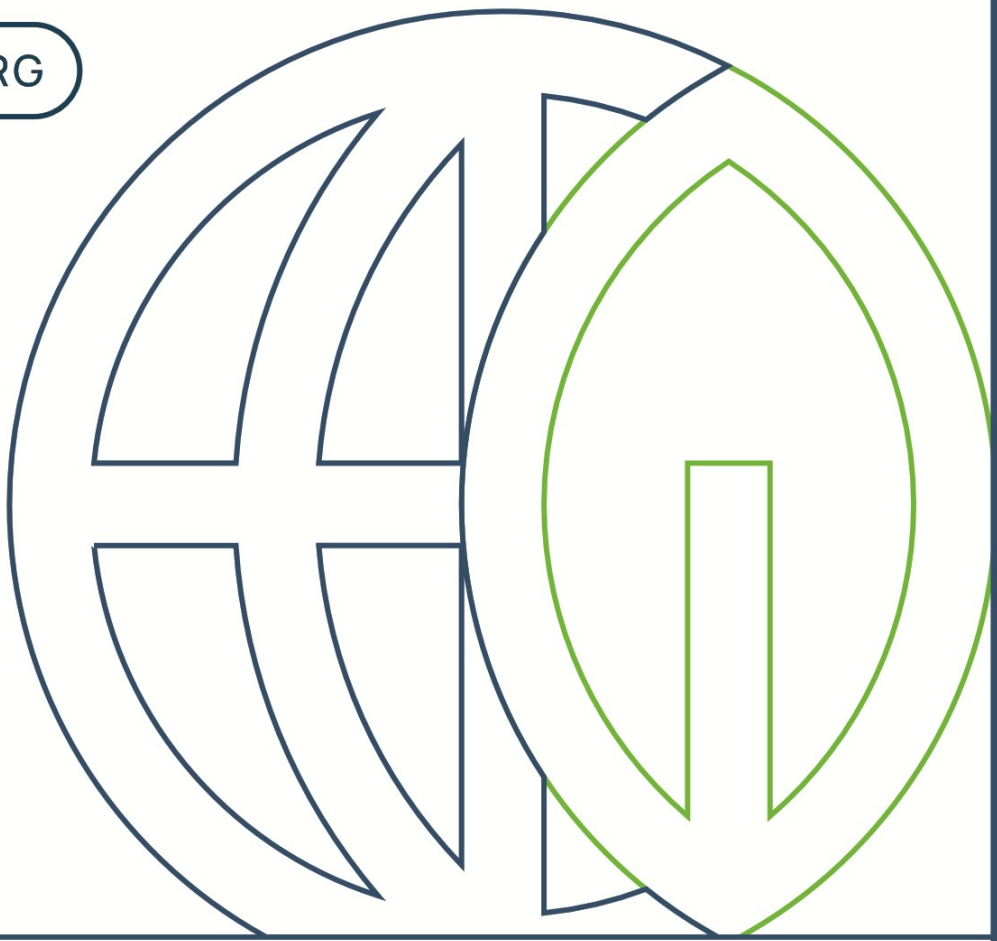

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