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Regionalna Inicjatywa Doskonałości

The Excellent Sub-Carpathian region – a comprehensive environmental study at the University of Rzeszów for the benefit of the region

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PRESENTATIONS

PERSONALIZED POLLEN ALLERGY SYMPTOM FORECASTING SYSTEM FOR EUROPE

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Pollen allergies impact millions of people throughout Europe, leading to significant health issues and financial costs. The intensity of allergic reactions depends on environmental conditions, pollen levels, and individual sensitivity. A personalized method for predicting pollen allergy symptoms is essential because allergic responses differ widely due to variations in immune system reactivity, genetic factors, environmental influences, and lifestyle choices. Traditional pollen forecasts offer general pollen concentration levels, which may not accurately represent the severity of symptoms for each person. By customizing predictions according to an individual's specific allergy profile, a personalized system increases accuracy, enhances symptom control, and enables individuals to take preventive actions.

The personalized pollen allergy symptom forecasting system developed instrumentation for collecting the symptom data of allergy sufferers, handling the CAMS pollen and Air Quality model predictions downscaled using regional computations of SILAM model, first, for Lithuania and Latvia back in 2018, and covering most of European countries in 2024. All key variables included in the operational CAMS and SILAM forecasts were considered: birch, grass, alder, mugwort, olive, ragweed, as well as air pollutants such as SO_2, NO_2, O_3, and PM2.5, recorded as both daily average and maximum values. The spatial resolution was 0.1° longitude-latitude for pollen and 0.5° longitude-latitude for air quality parameters. Personalized symptom predictions are generated using statistical and persistence models. The forecasting system of PASYFO has been enhanced with advanced statistical tools in the MASK-Air App, as an independent system in the PASYFO mobile App, and as a component in the Pollen+ mobile application.

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LIFE IP HUNGAIRY: ADVANCING AIR QUALITY MANAGEMENT AND PUBLIC HEALTH PROTECTION

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The LIFE IP HungAIRy project aims to enhance air quality in 10 Hungarian municipalities (Békéscsaba, Budapest, Debrecen, Eger, Kaposvár, Karcag, Miskolc, Pécs, Szolnok, and Tatabánya) across 8 regions of the country. Launched on 1 January 2019, the project is set to run until the end of 2026.

To strengthen local capacities, an eco-manager network was established in 2020, providing expert support to participating municipalities. The network's responsibilities include, among others, biannual revisions of air quality plans and awareness-raising campaigns. A decision-support tool, ATMO-Plan was developed to help predict the impact of various measures on air quality, assisting in the revision of air quality plans.

As part of the initiative, two new air quality monitoring stations were installed in cities that previously lacked such infrastructure. Furthermore, a PM monitoring network using low-cost sensors was deployed in two partner cities to identify hotspot areas and support awareness-raising activities, among other objectives. Several pilot activities have been implemented to address emissions from key sectors. Measures for reducing residential emissions include garden waste burning regulations, support for local composting, promotion of district heating and optimising indoor air quality in public settings for children. Initiatives on the traffic sector involve a smart parking system and mini public bicycle networks. Training programs have been introduced to promote best practices on low PM emission techniques for farmers. The biomass supply chain has been assessed, and a national strategy for its improvement is in development.

To raise public awareness, educational materials have been created for both adults and children, alongside nationwide awareness campaigns. Numerous networking events have also facilitated knowledge exchange at national and international levels.

The project's environmental, social, and economic impacts are monitored biannually. At present, LIFE IP HungAIRy partners are primarily focused on collecting and sharing best practices from their pilot actions to benefit interested stakeholders. The actions and tools developed by the project may help address certain challenges associated with the implementation of the new EU air quality directive.

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APPROACHES TO EVALUATING POLLEN LOAD IN URBAN GREEN SPACES: A CASE STUDY OF ŠIAULIAI CITY

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Urban green spaces serve as essential recreational areas for urban populations, however, pollen emitted by urban flora contributes to airborne allergen concentrations, posing significant health risks. This study aimed to compare two sampling methods for assessing the distribution and concentration of airborne pollen in an urban environment.

Pollen sampling was conducted in Šiauliai, Lithuania, from 2017 to 2018 using a Coriolis μ instrument. Pollen analysis followed the methodologies of Carvalho et al. (2008) and Gomez-Domenech et al. (2010). Concurrently, aerobiological monitoring data from samples collected with a Hirst-type sampler were analysed. Pollen concentrations were calculated as the number of pollen grains per cubic metre (m^3) of air for both methods.

The Coriolis sampler identified seven pollen taxa: *Artemisia*, *Betula*, *Poaceae*, *Pinaceae*, *Chenopodium*, *Tilia*, and *Urtica*. Analyzing the data from the Hirst-type sampler, the same pollen species were selected as those recorded by the cyclonic air sampler during the study period. The results indicated that *Poaceae* pollen exhibited the longest atmospheric persistence in 2018. Among woody plants, *Pinaceae* (776 pollen/m^3) and *Urtica* (758 pollen/m^3) were the most abundant, followed by *Poaceae* (657 pollen/m^3). *Poaceae* pollen dominated the recorded pollen spectrum, comprising 46% (708 pollen/m^3) of the total pollen load. Spatial pollen distribution maps were generated to visualise potential trends in pollen abundance across the city.

Statistical analysis revealed no significant difference ($p > 0.05$) between pollen concentrations detected by the Hirst and Coriolis samplers, confirming their comparable effectiveness. These findings enhance understanding of urban pollen dynamics and underscore the necessity for targeted measures to mitigate allergenic risks in urban green spaces.

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URBAN GREEN SPACES AND HUMAN HEALTH: EVALUATING ALLERGENIC RISKS

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Urban green spaces play a vital role in enhancing ecological balance, providing recreational opportunities, and supporting public health in cities. However, their allergenic potential presents significant challenges, especially in areas where urban vegetation planning does not account for the impact of allergenic plant species. This study focuses on evaluating the allergenic risks associated with the Moulay Rachid Garden, a key public park in Tetouan, northern Morocco, characterised by a Mediterranean climate. By analysing the park's vegetation composition and calculating IUGZA values, the research explores the relationship between urban green space design and allergenic risks. The findings highlight how both native and introduced plant species influence pollen concentrations, with direct implications for public health. The study emphasises the importance of strategic vegetation management to reduce allergenic risks. It advocates for hypoallergenic green space planning as a critical approach to promoting climate resilience, improving public health, and creating more sustainable urban environments. In addition, the results underline the significance of considering allergenic potential in urban planning, particularly in Mediterranean and African contexts, where plant diversity and climate conditions create unique challenges. This research contributes to the growing body of knowledge on urban green spaces and their role in fostering healthier, allergy-aware cities.

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AIRBORNE POLLEN CALENDAR OF İNEBOLU, TÜRKİYE (2023-2024)

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The number of people suffering from allergies in the world is increasing day by day. Allergic pollens present in the atmosphere are one of the main triggering factors in the emergence and exacerbation of these diseases. Determining the periods in which pollen concentrations increase in the atmosphere and creating pollen calendars can provide more effective protection against these allergens for allergy-sensitive individuals [1]. This study aimed to create a pollen calendar specific to the İnebolu district of Kastamonu. İnebolu is a district located on the Black Sea coast in the north of Kastamonu province. In the study, atmospheric pollen samples were collected using the Burkard pollen and spore trap over a two-year period from January 2023 to December 2024. The 4-row counting technique was applied in the sampling process [2]. Pollen from 38 plant taxa was detected in the atmosphere in 2023. In this period, the dominant pollens were; Pinaceae (20.7%), *Betula* sp. (19.1%), *Ambrosia* sp. (13.0%), *Castanea* sp. (8.0%), *Alnus* sp. (7.4%), *Corylus* sp. (5.1%), *Carpinus* sp. (4.5%), Urticaceae (3.9%), *Quercus* sp. (2.9%), Cupressaceae (2.6%), Poaceae (2.5%), *Juglans* sp. (2.2%), *Humulus* sp. (1.4%). In 2024, pollen from 40 plant taxa was detected in the atmosphere. The dominant pollens detected in the atmosphere in this period were; *Betula* sp. (20.0%), Pinaceae (17.1%), *Castanea* sp. (10.3%), *Alnus* sp. (9.3%), *Ambrosia* sp. (6.9%), *Corylus* sp. (5.8%), *Quercus* sp. (5.5%), Cupressaceae (5.4%), Urticaceae (5.2%), Poaceae (2.4%), *Fagus* sp. (1.9%), *Carpinus* sp. (1.8%), *Salix* sp. (1.3%), Amaranthaceae (1.3%), *Fraxinus* sp. (1.0%). The highest pollen release was seen in spring in 2023 and in summer in 2024. The pollen calendar created as a result of these findings aims to provide valuable and functional data for experts operating in the fields of allergy and public health.

[1] Calderón-Ezquerro, M. C. et al. 2016, vol(32): 225-244, doi: 10.1007/s10453-015-9392-4.
[2] Galán S. C., González, P.C., Teno, P.A., Vilches, E.D. Spanish Aerobiology Network (REA): Management and Quality Manual. Córdoba, Servicio De Publicaciones De La Universidad De Córdoba, 2007.

Acknowledgment: This study was supported by the TUBITAK 1001 project with the code 123Z779 "Investigation of atmospheric pollen and spores of Merkez, İnebolu and Tosya districts located in different climatic regions of Kastamonu province".

INVESTIGATION OF DAILY CHANGES IN POLLEN DETECTED IN KASTAMONU ATMOSPHERE (2023-2024)

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Pollen, an important part of the reproductive strategies of plants, contributes to increased cases of allergies by spreading into the atmosphere. The allergenic properties of pollen can vary depending on the plant species, the structural properties of the pollen, and its concentration. Pollen allergies cause symptoms such as allergic rhinitis, asthma, and conjunctivitis as a response of the immune system. This situation arises from a combination of genetic predisposition and environmental factors. In this study, daily counts of pollen detected in the atmosphere of Kastamonu were recorded. Atmospheric pollen samples were collected using the Burkard pollen trap over a two-year period, from January 2023 to December 2024. The pollen preparations were examined using the 4-row counting technique [1]. In 2023, pollen from 41 plant taxa was detected in the atmosphere, and the annual pollen integral (APIn) was calculated to be 8263 pollen/m^3. During this period, the most commonly detected pollen types in the atmosphere were from Pinaceae (55%), Cupressaceae (12.2%), Poaceae (8.1%), *Corylus* (4%), *Quercus* (3.9%), *Ambrosia* (3.5%), *Betula* (2.4%), Amaranthaceae (1.9%), and *Alnus* (1.6%). In 2024, pollen from 37 plant taxa was detected, and the annual pollen integral (APIn) was calculated to be 4233 pollen/m^3. During this period, the most commonly detected pollen types were from Pinaceae (23%), Cupressaceae (20.09%), *Quercus* (11.3%), *Betula* (6.31%), Poaceae (6.07%), *Corylus* (5.34%), *Ambrosia* (4.58%), *Carpinus* (3.94%), *Alnus* (3.8%), Amaranthaceae (2.15%), Urticaceae (2.06%), *Salix* (1.98%), *Populus* (1.42%), *Fraxinus* (1.23%), and *Juglans* (1.18%). When the data from the last two years are analyzed, Pinaceae pollen is the most frequently encountered in the atmosphere. It is believed that the data presented in this study will contribute to improving the quality of life for sensitive individuals. Daily detection of pollen in this way is crucial for allergy sufferers, as it allows them to take appropriate precautions. By knowing when specific plant taxa are abundant in the atmosphere, people can plan to avoid outdoor exposure on high-pollen days. This approach aims to enhance the quality of life for allergy sufferers.

[1] Galán S. C., González, P.C., Teno, P.A., Vilches, E.D. Spanish Aerobiology Network (REA): Management and Quality Manual. Córdoba, Servicio De Publicaciones De La Universidad De Córdoba, 2007.

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AIRBORNE MICROPLASTICS AS PARTICULATE MATTER

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Microplastics, plastics particles ≤5 mm, integrate particulate matter and contaminate our surroundings. Most suspended microplastics consist of small fragments, released from plastic objects, or fibers, released from synthetic textiles in clothing and furniture. While suspended, microplastics may be carried by winds, reaching remote locations, and sediment, transferring the contamination to other matrices (such as the soil or water). Higher concentrations are found indoors, where sources are abundant and dilution is lower, leading to human exposure. While most inhaled particles will be cleared out in the airways, small particles may reach the alveoli and be internalized. Previous studies on occupational exposure show that the accumulation of synthetic particles in the alveoli can lead to a persistent inflammatory state that results in breathing difficulties. The effects of lower exposure concentrations are not fully understood. Research on airborne microplastics remains limited due to methodological constraints. Yet, airborne microplastics should be considered as a fraction of particulate matter which should be considered in air quality standards. This session will address methodologies, concentrations and human health impacts of airborne microplastics.

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DNA DAMAGE MARKERS IN WORKERS EXPOSED TO CHEMICAL HAZARDS: IMPLICATIONS FOR WORKPLACE AIR QUALITY AND HEALTH

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Data from the Central Statistical Office indicates a growing percentage of individuals employed under exposure to chemical substances: from 4.2% in 2019, to 6.1% in 2023. Although these statistics encompass various hazards, previous analyses confirm that exposure to chemical substances remains a key issue. Historical data from the Central Statistical Office shows that as early as 1998, as many as 54,632 people worked under conditions of exposure to chemical hazards, suggesting a potential underestimation of the scale of this phenomenon, particularly in the context of the dynamic growth of industrial sectors.

Volatile organic compounds (VOCs) represent a significant workplace air pollutant, contributing to various adverse health effects, including carcinogenicity. The lack of appropriate regulations and effective exposure reduction strategies may lead to severe health consequences for workers. Monitoring chemical exposure is an increasing challenge, partly due to the rapid rise in the number of new substances introduced to the market—an estimated 2000 new chemical compounds emerge each year.

Special attention should be given to the polyurethane industry, where toluene diisocyanate (TDI), a mixture of 2,4- and 2,6-isomers [CAS: 26471-62-5], is used. Although the continuous production process of polyurethane foam helps reduce the emission of this substance into the environment and occupational exposure, TDI remains hazardous to health.

Toxicological data indicate that TDI can cause respiratory tract irritation and allergic skin reactions. Prolonged exposure is associated with an increased risk of developing chronic lung diseases, including occupational asthma. TDI is classified with the hazard statement H351 – "Suspected of causing cancer," which may suggest a potential effect on DNA damage. Biomarkers of DNA damage, such as 8-hydroxy-2'-deoxyguanosine (8-OHdG) and micronuclei peripheral blood, may serve as valuable tools for assessing long-term health risks.

The presentation will cover the latest data on VOCs exposure, results of TDI self-monitoring, and the potential of DNA damage biomarkers as risk indicators, as well as the implications for workplace air quality assessment.

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CHARACTERISTICS OF FRACTIONS OF AIR POLLUTION PARTICLES OF DIFFERENT SIZES IN THE RANGE OF 6 NM – 10 MM IN THE AUTUMN SEASON IN RZESZÓW

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Studies on particulate air pollution indicate that a new type of pollutant, so-called environmentally persistent free radicals (EPFRs). These radicals, ubiquitous in the environment, have a long life span and are capable of producing harmful reactive oxygen species. Samples of air pollution were collected using Electrical Low Pressure Impactor [1-3] (Dekati, Finland) in 2024 autumn season. Wide range size of particles (6 nm – 10 μm) were considered. ELPI provides real-time particle size distribution and concentration measurements, with size of particles range 6 nm - 10 um and up to 10 Hz time resolution. Wide operational concentration range allows ambient air measurements in remote areas as well as measurements directly from local particle source.

A detailed analysis of air pollution depending on the time of day (night & day) is planned, and the correlation with weather parameters will be studied. A global characterization of the volume and amount of air pollutants during the study period will be carried out.

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THE IMPACT OF EARTHQUAKE-RELATED DEMOLITION ACTIVITIES ON MICROPLASTICS IN AMBIENT AIR

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On February 6, a devastating earthquake with a magnitude of 7.8 struck southern and central Turkey, as well as northern and western Syria, followed by a second major tremor of magnitude 7.5 [1]. These earthquakes resulted in the loss of thousands of lives, and an assessment conducted on March 11 indicated that 821,302 independent units and 279,000 buildings had either collapsed or sustained severe damage, necessitating urgent demolition [2]. To evaluate the environmental impact of these demolition activities, this study collected air samples from severely affected cities, including Şanlıurfa, Adıyaman, Hatay, Gaziantep, and Kahramanmaraş. The collected samples were analyzed using both microscopic and spectroscopic techniques to assess airborne particulate composition. The analysis of air samples collected from four cities—Adıyaman, Urfa, Gaziantep, and Maraş—revealed varying concentrations of airborne microplastic particles. The concentrations were calculated based on the air sampling rate of 4 L/min over a 20-minute period, equating to a total sampled air volume of 0.08 m^3 per measurement. Among the sampled locations, Gaziantep exhibited the highest concentration of airborne microplastics, with a total concentration of 275 particles/m^3. This was followed by Adıyaman and Urfa, each with a concentration of 250 particles/m^3, while Maraş recorded the lowest concentration at 225 particles/m^3.Descriptive statistics of microplastic characteristics showed that fibers and fragments were the most common types of microplastics detected, with a diverse range of colors observed across all sampling sites. Raman spectroscopy identified multiple polymer types, with polyethylene (PE) and polystyrene (PS) being predominant.

This study was supported by **The Scientific and Technological Research Council of Türkiye (TUBITAK)** under project number **123Y223**.

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[2] Ministry of Environment, Urbanization, and Climate Change of Turkey, "Evaluate the cost of damage" (2023); https://csb.gov.tr/bakan-kurum-11-ilimizde-279-bin-binanin-acil-yikilacak-agir-hasarli-yikik-veya-orta-hasarli-oldugunun-tespitini-yaptik-bakanlik-faaliyetleri-38479 [in Turkish].

IMPACT OF INTENSIVE POULTRY FARMING ON THE SURROUNDING AIR QUALITY

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Intensive rearing aims to maximize profit or efficiency while minimizing time and costs. However, such methods can likewise be a source of environmental pollution as well affect human health. Poultry farming is usually associated with massive exposure to organic dust, which is largely composed of microbiological origin particulates. The aim of the study was to assess the impact of intensive poultry farming on the surrounding air quality. Emissions of air pollutants, including particulate matter (PM) and bioaerosols, were studied over a multi-seasonal time period. PM concentrations were measured using optical-scattering aerosol particle spectrometry, within a range of 500 m from the farm in order to map its emissions profile and ascertain the impact on farm employees and nearby population. Airborne microorganism concentrations in the vicinity of the poultry house (250-500 m) were measured stationarity using Andersen and MAS impactors, as well as Coriolis and BioSampler impingers.

The highest concentrations of airborne bacterial and fungal were observed at the level of 1.26×10^8 CFU/m^3 and 3.77×10^4 CFU/m^3, respectively. These pollutants spread around through the ventilation system, but their concentrations decreased significantly at a distance of 500 m from the chicken coop. The results have shown seasonality in PM10, PM2.5 and PM1 measured values, the influence of meteorological conditions as well as a strong impact of the use of forced ventilation in the poultry houses due to hot weather on overall emissions. This may result in emission values above current air quality standards on the area of the farm and the immediate surroundings. Therefore, appropriate mitigation strategies should be implemented to limit negative environmental and human health effects in such situations.

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THE IMPACTS OF GLOBAL MEGATRENDS ON AIRBORNE FUNGI IN THE PANNONIAN BIOGEOGRAPHICAL REGION

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Megatrends are slow processes that are hardly noticeable initially, but later cause long-term global effects. The European Environmental Agency (EEA) has set 11 global megatrends. Some of them - globalization, risk of pandemic, technical development and climate change - have major impacts on microfungi in a vulnerable region of Europe, the Pannonian Biogeographical Region [1]. Due to the globalization, high amount of inocula is imported with tropical fruits, soil and packaging materials. Due to technological development, these fungi gain new habitats in the immediate surroundings of humans. In most of the cases these are considered to be extreme environments for which fungi can increasingly adapt. As a result of climate change, non-native species are more likely to colonize the natural habitats in the region. Some of these fungal species have great effect on human health and agriculture. The effects of global megatrends on fungi raise new issues not only from the point of view of economy and health, but also from plant protection and environmental perspectives. Warming and heat waves are predicted by different climate models. Their effects were tested on fungi being endemic or unintentionally introduced by global trade from regions of warmer [2]. Common fungal species were selected for the study and exposed to heat waves during 7 days according to two climate scenarios: one moderately (RCP 4.5) and one strongly pessimistic (RCP 8.5) for July 2050. According to our results, *Aspergillus flavus, A. niger, A. tubingensis* and *Fusarium* strains introduced from tropical regions tolerated heat waves, unlike *Penicillium* and *Talaromyces* spp. and endemic *Cladosporium* spp. which were unable to grow under the RCP 8.5 treatment. Our results suggested that heat waves driven by climate change promote the colonization and growth of the tested strains of nonnative fungi more likely than that of the native ones. Two years after this experiment, extreme concentrations of airborne *A. flavus* and *A. niger* (>3000 and >5000 CFU/m^3, respectively) were measured in urban outdoor samples in 2024 [3]. High percentage of *A. flavus* and its mycotoxins were reported from cereal crops [4,5]. Apparently, the predicted advance of the molds has occurred, but prematurely. Because of the increasing presence of these fungal species, it is important to take them into account during the development of adaptation strategies.

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ECONOMICAL ASPECTS OF THE AEROBIOLOGY BASED SYSTEM FOR FORECASTING OF FUSARIUM HEAD BLIGHT IN WHEAT

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Fusarium Head Blight (FHB) caused by fungi of the Fusarium genus contribute to yield losses in all cereal crops, particularly wheat and triticale. Moreover, these fungi produce toxic metabolites in cereal grains. Severely infected grains cannot be used for food or feed purposes, as the toxins produced do not degrade under thermal processing and can cause severe diseases in humans and livestock. Therefore, any technologies aimed at reducing the occurrence of Fusarium infection in cultivated plants are of utmost importance from both a health and economic perspective. This is why for three consecutive years an aerobiological study was conducted at four experimental sites located in different regions of Poland, which involved capturing and identifying Fusarium spores and determining their concentration. Based on the results obtained in this study an economic analysis was performed, taking into account the cultivation area at country scale, the yield increase after applying fungicides (minimizing the impact of FHB), and global wheat prices. The analysis demonstrated the high profitability of implementing a monitoring system for wheat protection and highlighted the environmental benefits by the reduction of pesticide applications. This approach aligns with the European Commission Directive 2009/128/EC, which was adopted by Poland in 2014. In accordance with its principles, decision-making should be implemented with the use of forecasting systems for plant diseases. Furthermore, chemical plant protection should be limited to necessary treatments performed at optimal time intervals determined by the monitoring of plant pathogens and based on knowledge on their biology.

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AN AUSTRALIAN PERSPECTIVE ON AUTOMATED SURVEILLANCE SYSTEMS FOR THE DETECTION OF AIRBORNE PATHOGENS FOR THE AGRICULTURE SECTORS

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New systems for the surveillance of airborne plant pathogens were developed in collaboration between the South Australian Research and Development Institute (SARDI) and Data Effects, with an evolution of prototypes in partnership with Agri Samplers Ltd and Rothamsted Research (UK). First realised through a national project 'iMapPESTS: Sentinel Surveillance Systems for Agriculture' these systems provide a major technology step toward surveillance networks to monitor and report the presence of airborne pests that threaten major agricultural sectors. This was funded via the Australian government and six major agricultural industry research organisations [1].

Our collaboration produced specialised 'sentinel' units designed for optimal sampling of airborne fungal spores. The sentinels are equipped with advanced automation to control accurate and traceable collection of air samples linked with weather, time, location and operational data. They are linked via telemetry to outputs from qPCR analyses of samples by the high throughput diagnostics laboratory at SARDI. Data from the field-deployed sentinels are visualised in a portal linked to our current project website [2]. These insights are freely available to end-users to engage farmers and demonstrate the benefits of accurate airborne pathogen data to inform disease management decisions in their crops.

The added benefits of using DNA-based detection are being further explored to monitor pathogen abundance, enable identification at the strain level, and to detect fungicide resistant alleles in pathogen populations [3]. These innovative approaches to monitoring airborne biota has brought together industry-applied agricultural research groups, data and mechatronic technology providers, air sampling engineers and molecular diagnostic teams to take an exciting step in advancing airborne pathogen surveillance for agriculture in Australia.

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REAL TIME PATHOGEN INOCULUM MONITORING: A HIGH POTENTIAL OF AEROBIOLOGY IN PLANT PROTECTION

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Crops of all types are under constant threat from various plant pathogens. To achieve adequate control with minimal pesticide use real time pathogen inoculum monitoring is in demand. Many of them spread through the air so the aerobiological methods combined with molecular technologies can greatly contribute to plant protection. The presentation will show application of spore sampling system in Polish agriculture – the System for Forecasting of Disease Epidemics (SPEC). This System focuses on *Plenodomus lingam* (formely: *Leptosphaeria maculans*) and *P. biglobosus* (*L. biglobosa*), two pathogens of oilseed rape responsible for the stem canker disease, which causes big economic losses for farmers. The ascospores of both species are mostly discharged in the autumn and partially also in early spring. In SPEC system tapes from volumetric traps are used for spore counts followed by DNA extraction which enables the determination of pathogen species by quantitative Real-Time PCR. Tapes from volumetric traps are also used for studies of the other pathogens including *Cercospora beticola*, *Fusarium* and *Alternaria* spp. SPEC is the largest system based on aerobiological monitoring of pathogen inoculum in Europe. The presentation includes the organization of monitoring, results obtained over the last 20 years and the examples of their use in agricultural practice.

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INNOVATIONS FOR DETECTING AND MONITORING AIRBORNE PLANT PATHOGENS

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Surveillance and monitoring of fungal plant pathogens is needed to enhance the timing and efficacy of crop protection products, particularly due to climate change causing diseases to be more sporadic. Various approaches for monitoring airborne spores are possible and many DNA-based methods are also providing information about biodiversity, airborne allergens and animal and human pathogens. This can include the occurrence of genetic traits causing fungicide resistance. Rapid diagnostic assays are increasingly available (mainly as LAMP assay kits or LFDs) and can be used manually with samples from spore traps.

Automation of spore traps is under development to detect airborne spores before exposure or infection occurs. Detection can be based on optical properties of the spores themselves or application of a diagnostic test such as an LFD or LAMP assay. Integration of wireless reporting with the assay allows results to be received by the user in a timely way compared to samples being sent to a lab and this is essential for rapidly developing plant diseases such as potato blight. Combining automated spore traps with metagenomic sequence-based technologies, such as DNA metabarcoding utilising the MinION platform (Oxford Nanopore) [1] will in future enable rapid real-time monitoring of the entire aerobiome to profile abundance and genetic traits (e.g. fungicide resistance [2]) of many pathogens simultaneously. Further research is needed to optimise sampling to understand the area represented by a single spore trap, which depends on the wind speed and turbulence each day, and the spore trap's height above ground.

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HOW TO EXPLAIN SUDDEN INCREASES IN POLLEN GRAINS CONCENTRATIONS?

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By analysing multi-year aerobiological data, the occurrence of sudden short-term increases (STI) in concentrations at different times of the day was noted. It was presumed that these could be related to a specific weather pattern and/or diurnal rhythm of concentrations of individual taxa. The aim of the analyses was to determine the likely causes of STIs phenomenon.

Average pollen grains concentrations at hourly resolution were obtained from 2016-2023 from an aerobiological monitoring station located in Rzeszów at an altitude of 12 m a.g.l. Meteorological data at hourly resolution were obtained from 2 stations located at distances of 4 and 10 km from the aerobiological monitoring point and from the ERA 5 database. A situation was defined as an STI when, in the first hour of the episode, the concentration of pollen grains was 3 times higher than in the previous hour. Such episodes lasted from 1 to 4 hours with a similarly rapid drop in concentration. Days with STI episodes were divided into 3 groups according to season and into several subgroups according to the occurrence of precipitation. After this division, relationships of STIs with meteorological parameters were analysed using cluster analysis and Spearman's rank correlation. An analysis of the mean daily rhythm of concentrations of individual pollen grain types was also performed.

There were 99 days with STI episodes for 13 types of pollen grains-the most common were: Poaceae, *Taxus/Cupessaceae*, *Alnus*, *Pinus*. STI occurred at different times of the day (also at night), the most frequent phenomenon lasting 2 hours. Among the meteorological parameters, the highest correlation was found with relative air humidity - a significant relationship was most frequent in all subgroups. A weaker relationship was shown with temperature (the strongest in summer). The occurrence of STIs was also favoured by weather conditions associated with strong convection and thunderstorms, although these were not always associated with the occurrence of precipitation.

In summary, STI episodes may be associated with diurnal rhythms of pollen grains release and transport, but only in some cases (particularly Poaceae). On the other hand, meteorological conditions favourable for the occurrence of STI episodes are: a decrease in humidity - also shortly after the onset of precipitation, an increase in temperature and sunshine, and strong convection favouring the occurrence of thunderstorms.

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CURRENT METHODS OF COMMON RAGWEED (*AMBROSIA ARTEMISIIFOLIA*) OCCURRENCE, CONTROL AND POLLEN MONITORING

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Ambrosia artemisiifolia, more often known as common ragweed, is North American native plant belonging to the Asteraceae family, which was moved to Europe and has been spreading as invasive plant. A. *artemissifolia* produces large amounts of allergenic, anemophilous pollen, that may cause serious inhalant and skin allergy symptoms and become a crops weed. It is estimated, that only in Europe annual costs of battling allergies caused by ragweed reach 7.4 billion of Euro [1]. With the global climate changes, it is predicted, that the common ragweed ecological niche will be growing and moving towards the Northern parts of Europe, exposing more and more people to possible sensitization and expanding the very noticeable strain it exerts on the economy [2]. It is clear, that fighting only its effects is not enough, and efficient methods of its limitation and removal are needed. The aim of the presentation, was to compile all the methods of controlling *A. artemisiifolia*, such as biological control, mowing regimes, or anti-ragweed programs, as well as show their results, with a special account to COST Action FA-123 initiated as a long-term management options to reduce ragweed in Europe [3].

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THE COMPOSITION AND IMMUNOGENIC PROPERTIES OF BIRCH POLLEN SAMPLES COLLECTED IN DIFFERENT ENVIRONMENTAL CONDITIONS

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The content of the main birch pollen allergens depends on the level of air pollution as most of them belong to the plant defense system. The aim of the study was to compare the composition and immunoreactive properties of protein components of birch pollen growing in Iceland, with a slight exposure of anthropogenic pollution with birches from Kraków and Małopolska with a higher level of pollution.

The following analyzes were performed in birch pollen samples, collected in Iceland (*Betula pubescens*) and Małopolska (*B. pendula*): assessment of the samples morphology and chemical composition using scanning electron microscopy with an X-ray energy dispersive spectrometer (SEM-EDS); FT-Raman with pollen samples; protein total (colorimetric method; BioRad) and Bet v1 antigen concentration in samples (ELISA, Inbio); SDS-PAGE with pollen samples and Western Blot with serum from people sensitive to birch (BioRad).

The chemical composition of pollen samples from Iceland was dominated by carbon, but other elements are also present (e.g., P, K, Ca and Mg). Particles of 50 mm to <1 mm in diameter, which chemical composition corresponded to minerals found in basalt-type volcanic rocks were present among pollen. The mineral particles (quartz, aluminosilicates, calcite and others) found in the samples from Małopolska were significantly smaller, and rich in metals, e.g. iron or iron occurring together with other metals. Differences in the amide I region obtained for selected pollen samples collected in Iceland are observed however. The estimated maximum intensity of the band is located at 1590cm-1. Viability of pollen grains measured by Alexander method was comparable for both environments, slightly higher in case of samples from Małopolska (99.6% vs 80.8%). Protein total concentration did not differ significantly between samples from Iceland and Małopolska, while in the case of Bet v1 concentration significant differences were found ($p=0.045$). The profile of immunoreactive proteins differed slightly between samples from Iceland and Małopolska, but the frequency of protein fractions with a stronger immunodetection signal was lower in samples from Iceland, especially in the case of samples collected in Hauganes. In the BAT test with downy birch extracts, 20-95% activation of CD63+ receptors was obtained, both

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in the test and control groups, while ex vivo challenge with silver birch extracts showed activation only in allergic people.

The chemical composition of mineral particles in birch pollen samples varies depending on the place of collection. The assessment of immunoreactivity of pollen proteins allows us to expect a lower allergenic potential of birches from Iceland compared to the Małopolska region.

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THE IMPACT OF ENVIRONMENTAL STRESSORS ON BIRCH POLLEN ALLERGENICITY

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Birch pollen grains are a major trigger of inhalant allergies in the Northern Hemisphere. It is hypothesized that the major allergen of birch pollen, Bet v 1, is overexpressed when plants are subjected to stressful environmental conditions. To test this hypothesis, a field experiment was conducted along an urban-rural gradient in Poznań, a medium-sized city in Central Europe.

Birch pollen grains were collected from 47 locations within 30 km from Poznań. The Bet v 1 level per pollen grain was quantified using an enzyme-linked immunosorbent assay (ELISA).Remote sensing data (thermal and vegetation) and land use data (CORINE, within 1 km of the birch population) were used for a detailed analysis of the collection sites, including land surface temperature (LST) and air pollutants, specifically NO_2 and O_3 concentrations.

A significantly higher level of Bet v 1 ($W = 424.5$, $p = 0.02$) was detected in pollen collected from trees growing in urban environments (urban index >0.5) compared to those in rural locations. On average, pollen allergenicity in urban areas was 240% higher than in rural areas (2.41 pg vs. 1.06 pg Bet v 1 per pollen grain, respectively). The level of Bet v 1 showed a significant correlation ($p < 0.05$) with two analyzed environmental factors, LST and NO_2 levels. Specifically, the strongest positive relationships were observed between birch pollen allergenicity and environmental factors recorded between July and September (one year before pollination), which corresponds to the period of birch pollen production and male catkin development. Regarding the day-to-day variation in birch pollen allergenicity, the Bet v 1 level was lowest during the first days of pollination and gradually increased until the peak pollination phase (on average, within 5-6 days). During this period, the Bet v 1 level increased by approximately 300-400% and remained stable for another 3-4 days.

Our study demonstrates that birch pollen grains released from urban populations pose a significantly higher risk for individuals suffering from pollen allergies. These findings

suggest that adequate planning in urban design and careful selection of plant species may help mitigate the adverse impact of pollen on human health.

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ALLERGENICITY OF CUPRESSALES POLLEN GRAINS

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Pollen grains released by species from the order Cupressales are a significant cause of seasonal allergies worldwide [1]. It is estimated that their pollen accounts for up to 30% of allergy cases among sensitized individuals [2]. Over the past 25 years, a dramatic increase in Cupressales pollen concentration has been observed in Poznań. This phenomenon is hypothesized to be associated with the widespread planting of various representatives of this group in private gardens as well as in urban parks, squares, and along transportation routes. Species belonging to this order produce pollen grains that are morphologically indistinguishable, making it unclear how different species contribute to the overall airborne Cupressales pollen load. Furthermore, data on the allergenicity of pollen from individual species within this group remain limited.

The aim of the study was to determine the variation in the occurrence of Cup a 1 homologues, the major allergen of cypress pollen grain and to investigate differences in the expression levels of genes encoding these proteins, in pollen grains of selected Cupressales species. Additionally, the phonological pattern of flowering for the studied species was analyzed.

For this purpose, pollen grains were collected during the pollen season (between February and May), and Cup a 1 homologue was quantified by enzyme-linked immunosorbent assay (ELISA). The differences in the expression profile of genes encoding the major pollen grain allergen were measured using the real-time PCR method. The content of Cup a 1 homologue exhibited substantial variation. Similarly, the expression levels of genes encoding the allergenic proteins differed significantly among the studied species. These findings indicate a high degree of variability in the allergenicity of the analyzed taxa. The phenological data showed that the species contributed the most to total pollen level *are Taxus baccata, Thuja plicata* and *Thuja occidentalis*.

Since Cupressales order pose a significant allergic problem in many countries, as well as their widespread use as ornamental plants, it is assumed that the obtained results will have substantial cognitive and applicative value (e.g., in allergy prevention).

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TREE POLLEN RECORDED AT THE GROUND LEVEL: ATTEMPTS TO DISTINGUISH BETWEEN LOCAL AND DISTANT SOURCES

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Typical aerobiological monitoring is conducted at the roof level with 7-day volumetric trap of the Hirst design. The placement of the trap on the roof ensures that it collects pollen from the relatively large area. It is assumed frequently that 30 km is the source area, but there are also evidences that pollen traps may collect pollen produced and emitted much further, sometimes reaching more than 1000 km. The foreign pollen may be detected by specific bi-hourly patterns (e.g. nocturnal increase in pollen count) or simply when the local source plants have not started the flowering yet or have just finished this period. However, the largest pollen pool typically originates from local source plants, primarily due to the close proximity of the sources. Here, our purpose was to separate the tree pollen from local and remote sources using the network of ground pollen measurements.

Ground pollen monitoring was performed at 5 sites in April-May period in years 2023-2024 using Burkard Portable Volumetric Traps placed on tripods. One of these traps was placed at the roof of Faculty of Biology AMU (16 m a.g.l.), the others in different places surrounding the building (approximately 1.3 m a.g.l). We changed microscopic slide every hour, then fixed with fuchsin-stained glycerin gelatin and counted pollen under the optical microscope. We focused on the following tree pollen types: *Betula* sp., *Populus* sp., *Salix* sp., *Carpinus* sp. and *Fraxinus* sp. During the second year of the study, we measured also wind speed and direction at each site using Kestrel 5500 weather meter also placed on tripods.

The highest hourly pollen concentration was recorded at the ground level for Betula sp. (2239 pollen m^{-3} in 2023 and 4129 pollen m^{-3} in 2024) whereas other pollen types were not so abundant in the study period. Interestingly, the highest pollen concentrations were usually recorded at the same ground site for different pollen types. However, on some days, the highest concentrations were recorded at other ground sites, for specific pollen types (mainly Salix sp., but also Populus sp. and Quercus sp.). All these pollen types have the well-defined source plants in the vicinity. We conclude that any discrepancy from the typical spatial pattern of pollen concentrations indicates that the recorded pollen originates from the nearest surrounding.

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CELEBRATING 40 YEARS OF AEROBIOLOGIA: TRACING THE EVOLUTION AND IMPACT OF AEROBIOLOGY

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The term 'aerobiology' was first coined by Fred C. Meier of the United States Department of Agriculture to describe a research project on microbial life in the upper atmosphere. Unfortunately, Meier was lost in a flight over the Pacific Ocean in 1938 when only preliminary abstracts of his work had been published, and so the new discipline was not launched until the American Association for the Advancement of Science eventually published a symposium on Aerobiology in 1942 [1]. The discipline was still relatively young when the journal *Aerobiologia* was first established in 1985 by the Italian Association for Aerobiology, with Dr Paolo Mandrioli as the inaugural Editor-in-Chief. From humble beginnings *Aerobiologia* has grown to become a leading international journal in the field of aerobiology, publishing articles related to topics such as airborne pollen, fungal spores, bacteria, and viruses, and their impacts on plant and human health. The discipline of aerobiology can now be considered mature, and *Aerobiologia* has grown along with it as evidenced by two recent Special Issues in the journal [2, 3]. Technological advancements have meant that we are now moving towards automatic aerobiological monitoring as shown in the Special Issue on the EUMETNET AutoPollen Programme [2]. Another Special Issue focused on the 'effects of pollution on pollen' shows how aerobiology is, by nature, related to the One Health concept by examining how anthropogenic actions are altering atmospheric chemistry with subsequent impacts on plants and the health and wellbeing of people [3]. Twenty-first century challenges brought about by increasing global interconnectedness, a growing urban population, emerging contaminants, changes in land use, invasive species and global warming, which alter exposures to hazardous bioaerosols and chemicals, are certain to see aerobiology develop further as a scientific discipline in the future.

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ENVIRONMENTAL DNA (EDNA) ANALYSIS REVEALS DIVERSITY OF BIOAEROSOLS

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Bioaerosols are solid airborne particles, including microorganisms such as bacteria and viruses, fungal spores, pollen, plant debris and animal parts. Understanding the diversity and dynamics (e.g. emission, dispersion, temporal/spatial variability) of bioaerosols in ambient air is crucial for assessing their impact on atmospheric processes, human, animals and plant health. To be able to address full spectrum of impacts, air quality monitoring is required to go beyond size based particulate matter (PM) quantification and deliver concentrations of specific components. Although, aerobiology provides deeper insight into diversity of bioaerosols (e.g. pollen and fungal spores), morphology-based identification used in the EN16868 standard [1] is still limited to only a fraction of the total airborne biodiversity. High-throughput sequencing of airborne eDNA could be considered as a method of choice when aiming to reveal full spectrum of bioaerosol diversity (both taxonomic and functional). Long-read sequencing using PacBio technology and a targeted amplicon (16S rRNA and ITS) approach revealed as much as 741 bacterial and 1210 fungal OTUs (including plant and human pathogens) during only 12 days of continuous high-volume sampling. Despite faced challenges, i.e. low DNA quality and yield and notable uncertainty of taxonomic identification of OTUs influenced by the completeness of available databases, the constant advancement of technology and decrease of analysis costs will facilitate use of eDNA analysis in continuous AQ monitoring.

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CAN TECHNICAL SNOWMAKING AFFECT AIR QUALITY AND HUMAN HEALTH? AN INVESTIGATION OF BACTERIAL BIOAEROSOL AT SKI STATIONS

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The climate warming observed in recent years resulted in severe snow scarcity in winter, which made the technical snow production inevitable for maintaining ski station operations. Most ski stations are located in highly tourism-burdened areas, where anthropogenic pressure put on water resources results in their contamination due to uncontrolled discharge of treated and/or untreated wastewater. The technical snow production involves aerosolization of water by snow cannons, thus contributing to bioaerosol formation if the snow is produced from microbiologically contaminated water [1] With no studies so far concerning the detection and microbial composition of bioaerosols formed during the technical snowmaking processes, this study was undertaken to fill this gap.

The study was conducted in three sites, including two ski stations that use surface water of different contamination level to produce technical snow and a non-impacted forested slope as a control. Air sampling was done using a six-stage Andersen impactor and selective microbiological media for isolation and preliminary identification of: *Escherichia coli*, *Enterococcus faecalis*, coagulase-positive staphylococci, potential human pathogens (UTI agar), haemolytic bacteria and mold fungi. In the ski stations air samples were collected nearby the operating snow cannons.

The presence of aerosolized bacteria was observed in both ski stations, several times higher than in the control site, but the bacterial aerosol composition differed between the two ski centers. In one ski station, bioaerosol composition was dominated by staphylococci as well as non-haemolytic and beta-haemolytic bacteria. In the second ski station, where technical snow is produced from highly contaminated water, bioaerosol composition was dominated by *E. coli* and fecal enterococci, followed by *Klebsiella* spp. The results suggest the need to further investigate these yet unexplored aspects of the technical snow production.

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EVALUATION OF THE PRE-LOAD ALGORITHM MODELS FOR TRAINING AND VALIDATING AUTOMATED IMAGING AND HOLOGRAPHY-BASED AEROBIOLOGICAL MONITORING IN A MEDITERRANEAN REGION

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Córdoba, located in southern Spain, exemplifies a Mediterranean semi-arid climate where high temperatures and dust events are common. The site presents conditions that test the resilience of bioaerosol monitoring equipment against heat and very high concentrations of particulate matter. The Hirst-type trap has been used as a baseline for current pollen measurement networks due to its simplicity and reliability in data collecting. Furthermore, this method has a delay of up to 9 days in the data reported, troubled by large uncertainties due to sampling-related issues. To address these issues, a transition from manual to real-time automatic bioaerosol monitoring has begun.

After a 1-year campaign performed in Córdoba (Spain), daily and three-hourly concentrations of selected pollen types measured by the POMO BAA-500, Swisens Poleno Jupiter, and PollenSense APS-330 were compared to the measurements of the Hirst method. These results indicate that the systems had the highest number of correlation coefficients (r) of daily data with $r > 0.89$ (APS-330) for *Cupressus*, $r > 0.85$ (Swisens Poleno Jupiter) for *Platanus*, and $r > 0.84$ (BAA-500) for *Cupressus*. The average daily ratio for APS-300 was 2.31, and for BAA-502 was 2.77, indicating that both devices provided comparable concentrations. In the case of Swisens Poleno, it was 3.18 on average. While specific pollen species showed comparable seasonal kinetics but with differences in scaling factor, other pollen taxa led to a high number of false positives and lower performance than expected at the moment. We developed 44 reference datasets generated from pollen collected in the local environment for all devices, including significant Mediterranean pollen species such as *Olea* and *Morus*.

The presence of dust intrusions in Southern Europe constitutes another challenge. Misclassified dust particles can result in a significant overestimation of the amount of pollen particles, despite their morphological differences from pollen particles. The dust from the Sahara Desert is one of the most active hotspots of particulate matter in southern Europe. Córdoba is subjected to these phenomena on an annual basis, with dust capable of traveling considerable distances. Thus, solving the dust issue requires improvements.

We concluded that the performance of automated pollen counting systems requires an adjustment period (validation of more than one pollen season) to adapt the system

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to local environmental conditions. Each pollen taxon must be fine-tuned individually. Digital Reference Datasets for Swisens Poleno, BAA-500, and Pollen Sense will allow the improvement of commercial recognition algorithms. Further studies are required to investigate the performance in more detail after local classification algorithms are developed.

THUNDERSTORM ASTHMA IN POLAND

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Monitoring airborne allergenic pollen concentrations is a key task in aerobiology, as it enables timely warnings for allergy sufferers. However, recent studies increasingly highlight events that can rapidly elevate allergic risk. One such phenomenon is **thunderstorm asthma**, which is particularly associated with grass pollen. During a thunderstorm, pollen concentrations can rise sharply. Storm conditions may induce osmotic shock in pollen grains, leading to their rupture and the formation of **sub-pollen particles**-smaller fragments that remain airborne longer and penetrate deeper into the human respiratory system, including the lungs [1].

The aim of this study is to analyze daily medical data on the number of patients admitted with allergic symptoms between 2014 and 2024 to assess the overall impact of airborne allergies in Wrocław. Allergic episodes were identified following the methodology outlined in [2]. Identifying days with increased patient numbers enabled correlation with pollen concentrations and thunderstorm occurrences, assessing the potential occurrence of thunderstorm asthma events in Poland. Based on this, a single case was selected to evaluate the potential health risks associated with thunderstorms. For this purpose, pollen data from the **Swisens Poleno Jupiter** automatic detector and thunderstorm data from 2024 were used. Applying the methodology proposed by [3], the presence of sub-pollen particles during thunderstorms was verified.

The analysis indicates a rise in allergic cases after 2020. Several allergic episodes were identified, some coinciding with thunderstorm occurrences. A detailed investigation of a 2024 episode confirms that grass pollen concentrations can surge sharply during thunderstorms. Moreover, the study validates that the automated detector is capable of identifying sub-pollen particles, which are particularly prevalent during storm events.

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ESTIMATION OF LUNG TISSUE DEPOSITION DOSE FROM DIFFERENT POLLUTION SOURCES IN DELHI

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It is imperative to comprehend the process of airborne particle mass deposition in the lungs to accurately assess its health implications, particularly in regions experiencing elevated levels of air pollution. Previous studies have modelled lung deposition; however, they have overlooked critical factors such as hygroscopicity and density in polluted environments [1], and source-specific exposures [2]. This study aims to address these limitations by investigating the role of aerosol properties, including particle size distribution, effective density, and hygroscopic growth, in lung tissue deposition. The study utilizes data collected during a measurement campaign conducted in Delhi, India. The Hygroscopic Particle Lung Deposition (HPLD) model was employed to estimate tissue-deposited particle numbers (TD_n) and mass (TD_m) across diverse pollution episodes, including biomass burning, chloride emissions, hydrocarbon-like organic aerosols, and relatively clean periods. The chloride emissions exhibited the highest deposition rates, followed by biomass burning and traffic-related particles. This research underscores the necessity for precise deposition estimates in exposure assessments, particularly in regions with elevated particulate pollution levels, where such levels contribute to respiratory issues and long-term health risks.

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INVESTIGATION OF THE DAILY VARIATION IN FUNGAL SPORES DETECTED IN THE ATMOSPHERE OF İNEBOLU, KASTAMONU, TÜRKİYE (2023–2024)

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In industrialized countries, more than a quarter of the population is affected by various allergens. This rate is expected to reach 50% by 2050 [1,2]. Aeroallergens, a significant portion of these allergens, cause many diseases, such as allergic rhinitis, allergic asthma, and allergic conjunctivitis. A large portion of bioaerosols consists of fungal spores. It is reported that approximately 30% of allergy patients are infected with fungal spores [3]. The symptoms caused by these allergens significantly reduce the quality of life, leading to loss of labor and an increase in the number of patients applying to health institutions. This study aimed to determine the daily changes in fungal spores detected in the atmosphere of the İnebolu district, located in Kastamonu province, Türkiye. Fungal spores captured by the Burkard spore trap in the atmosphere of İnebolu in the years 2023-2024 were identified by the microscopic method according to the Spanish Aerobiology Network (REA) recommendations, and their concentrations were calculated. While 48 different fungal taxa were detected in 2023, 47 taxa were detected in 2024. Cladosporium, the most common taxa in both years, constituted 56.8% and 46.5% of all detected taxa, respectively. In addition, according to the counts made during the monitoring period, Alternaria, Basidiospore, Leptosphaeria, Diatrypaceae, Coprinus, and Exosporium taxa were detected in the air at levels higher than 2%. The periods when the total spore concentration was most intense occurred between June and September in both years. The findings obtained will contribute to improving the quality of life of sensitive people by revealing the composition and concentrations of fungal spores in the atmosphere of İnebolu.

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INVESTIGATION OF DAILY CHANGES IN SPORES DETECTED IN TOSYA ATMOSPHERE, KASTAMONU-TURKEY (2024)

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Fungal spores are the most abundant bio-particles in the atmosphere. Investigation of fungal spore concentrations in the atmosphere has become one of the topics that attract attention in the scientific community due to their effects on human health. Increased concentrations of allergic fungal spores in the atmosphere cause severe allergic reactions such as migraines, allergic rhinitis, and asthma in susceptible individuals [1]. This study, covering the year 2024, was carried out with the Burkard 7-day volumetric spore trap installed in the Tosya Vocational School building of Kastamonu University in Tosya district of Kastamonu province. Fungal spore concentrations were determined daily and as the number of fungal spore grains per cubic meter (spores/m3). In this context, 40 different spore taxa were detected and the annual spore integral (ASln) was determined as 75480 spores/m3. According to the data obtained, spore types commonly found in the atmosphere were identified as *Cladosporium* (68%), *Boletus* (6%), *Alternaria* (4%), *Leptosphaeria* (4%), *Coprinus* (3%), *Pleospora* (2%), *Diatrypaceae* (1%), and *Fusarium* (1%). The highest spore concentration of the year (1871 spores/m^3) was recorded on 01.08.2024. When examined seasonally, it is seen that the total spore density is at the highest level between June and October and at the lowest level in the winter months. It is thought that the data obtained in this context will contribute to the diagnosis and treatment of allergic diseases related to fungal spores.

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INVESTIGATION OF DAILY VARIATIONS OF FUNGAL SPORTS DETERMINED IN KASTAMONU (TÜRKİYE) ATMOSPHERE (2024)

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Fungi have a very wide range of habitats thanks to their parasitic, commensal, and saprophytic life forms on all living groups and inanimate organic materials. In this way, they spread very widely. Fungal spores and hyphae belonging to fungi constitute the most important group of biological particles seen in the atmosphere. Fungal spores are encountered in the atmosphere almost all year round [1]. Studies have shown that sensitivity to fungal spores is increasing [2]. In this study, fungal spores found in the atmosphere of Kastamonu city center were studied for one year in 2024. Burkard spore trap was used in the study, and the spore trap was installed on the Science Faculty building at a height of 15 m from the ground. The protocol recommended by the Spanish Aerobiology Network (REA) was followed in the preparation, counting, and calculation of the samples [3]. In the study, 33778 spores belonging to 45 taxa were detected in a one-year period throughout 2024. Of the spores detected in the atmosphere, Cladosporium constituted 46.37%, Basidiospores 11.07%, Fungal hyphae 4.9%, Coprinus 4.41%, Pleospora 3.88%, Alternaria 3.65%, Leptosphaeria 3.06%, Boletus 2.22%, Non-septate basidiospores 2.22%, Fusarium 2% and the remaining 35 taxa constituted 16.25%. Fungal spores were encountered in the Kastamonu atmosphere almost throughout the year, and fungal spores were detected intensively in the May-October period. The highest spore concentration was seen in October.

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INVESTIGATION OF ATMOSPHERIC POLLEN CONCENTRATION IN TOSYA DISTRICT, TÜRKİYE

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Airborne pollen is one of the most important allergens, and determining its concentration in the atmosphere is important in terms of early diagnosis and treatment plans for allergy patients, and increasing their quality of life. To this end, in this research, pollen was collected from the atmosphere of Tosya region in Kastamonu city, where Tosya region is 77 km away from Kastamonu city center [1,2].This study was conducted using Burkard volumetric traps [3], from 01/03/2023 to 28/02/2024, Pollen classifications during the year, their quantities and period of distribution in the atmosphere of the Tosya region were determined. A total of 31, 092 pollen grains/m3 were observed, and 35 pollen classifications were identified, 25 of them at the genus level and 16 at the family level. Based on this, a calendar and aerial pollen charts were created. As a result of the study, this classification is one of the most important classifications; Pinaceae(%63,83), Cupressaceae(%16.98), Poaceae(%3,02), *Ambrosia*(%2,53), *Quercus*(%1,62), *Populus*(%1,32), *Juglans*(%1,14), Amaranthaceae (%0,99), *Fraxinus*(%0,82), *Betula*(%0,79), *Artemesia*(%0,76), *Corylus*(%0,70), *Ulmus*(%0,59), *Rumex*(%0,58), Urticacea(%0,56), and Since pollen in the atmosphere causes allergic symptoms and respiratory diseases in humans, this pollen calendar is useful in identifying sources of allergies resulting from specific types of airborne pollen during seasons, and thus avoiding or reducing exposure to the air during periods when pollen levels are highest may help protect individuals or reduce allergy symptoms and complications.

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ARE PLANE TREES IN RZESZÓW BECOMING AN INCREASING RISK TO ALLERGY SUFFERERS?

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Pollen grains of the London plane tree are a common and strong allergen in Western and Southern European countries. In Poland, exposure to *Platanus* pollen allergens varies by region. In Poznań, where the London plane tree has long been a common avenue and park species, Seasonal Pollen Integral (SPIn) ranged from 153 to 547 pollen/m^3 in 2005-2009 [1]. In contrast, in Rzeszów, the risk was negligible for many years, with Annual Pollen Integral (APIn) between 0 and 8 pollen/m^3 from 1997 to 2006. However, continuous aerobiological monitoring has revealed an increasing trend in APIn of *Platanus* pollen in recent years. The city is also experiencing a growing popularity of planting London plane trees in residential green areas and parks.

Knowing that plane tree pollen grains have a low potential for long-distance dispersal [1], we hypothesized that in close proximity to these trees, the risk for risks for allergy sufferers during the pollination season might be significant. Therefore, we conducted a pilot study to assess the level of pollen exposure for people spending time near flowering trees. The preliminary study was carried out in Rzeszów in early April 2024 on days without precipitation. Two residential areas were selected, differing in the number, size and age of the trees. Air sampling was conducted once a day between 14:00 and 16:00 for 30 minutes using a portable Burkard sampler. *Platanus* pollen grains were counted under a microscope and converted into average concentrations per cubic meter of air (pollen/m^3). Background data were obtained from continuous monitoring using a Hirst-type sampler at a height of 12 meters. Data from this station from the years 1997–2006, 2015–2020, and 2022–2024 were also used to establish a trend line.

The results indicate that during the hours when plane tree pollen concentrations peak daily (14:00–16:00) [1], individuals near the trees are exposed to several hundred pollen grains per cubic meter of air—on average, 264 pollen/m^3. Meanwhile, the aerobiological monitoring station at 12 meters recorded average daily concentrations ranging from 0.5 to 5 pollen/m^3 during the same days.

The results do not yet show differences between the selected residential areas, but further research will continue in the coming years. Additionally, a map of plane trees in Rzeszów is planned. However, it can already be concluded that in locations with flowering plane trees, the risk for allergy sufferers significantly exceeds the threshold for triggering allergy symptoms—that was not reflect in the data from continuous monitoring station.

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TEMPORAL AND SPATIAL ANALYSIS OF *PLATANUS* L. POLLEN IN THE ATMOSPHERE OF BURSA (NORTH-WESTERN TURKEY) OVER 25 YEARS

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Selecting the right plants is of great importance in green planning and reforestation activities [1]. In addition to their natural distribution, the use of plants that produce high amounts of allergenic pollen in the landscape may increase allergy-related health problems [2]. *Platanus* sp. L. species are widely distributed in urban areas in Turkey and around the world, causing significant allergic reactions due to the pollen released into the air in spring [3].

In this study, the *Platanus* (plane tree) pollen concentration in the atmosphere of the city of Bursa, located in north-western Turkey, was analyzed using data recorded over 25 years. Pollen data were collected daily between 2000 and 2024 using volumetric air sampling devices. Samples were collected with a Hirst-type volumetric pollen trap. Pollen grains were counted and analyzed under a light microscope at ×40 magnification. Based on these data, weekly, monthly, and annual averages of pollen concentrations were calculated. The start and end dates of the main pollen season (MPS) were determined based on the days when 2.5% of the total annual pollen integral (APIn) was reached, and the length of the MPS was calculated. Meteorological data were provided by the Bursa Meteorological Station. Spearman correlation and linear regression analysis were applied for statistical analysis.

The results show a slight annual increasing trend in the total pollen concentration, but this increase was not statistically significant ($p > 0.05$). In contrast, the mean pollen concentration showed a statistically significant increase over the years ($p = 0.023$). The highest pollen concentration was mostly observed in May. Considering the potential for increased allergic reactions, long-term monitoring of *Platanus* pollen and a more comprehensive investigation of its public health impacts are warranted.

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RELATIONSHIPS BETWEEN SEASONAL VARIABILITY OF BIRCH POLLEN ALLERGENS CONTENT AND IMMUNOLOGICAL RESPONSE IN SENSITIVE INDIVIDUALS

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Birch (*Betula pendula*) pollen cause inhalant allergy in about 20% of human population in Europe, being one of the main sources of tree pollen in March and April. The aim of the study was to find out whether there are seasonal differences in the content of allergenic proteins in pollen samples collected in Małopolska and in the immune response in patients with inhalant allergy taking into account the pollution level.

Pollen samples were collected at 9 sites of highly or less polluted areas localized in Małopolska (Southern Poland), in 2022-2024. Total protein content (Bradford method, BioRad), Bet v1 concentration (ELISA Assay, Inbio) and protein composition (SDS-PAGE electrophoresis, BioRad) were analyzed in all collected samples. Immunoblotting with patients sera of individual protein subunits separated by SDS-PAGE was performed using 11 selected pollen samples in each year of the studies. A group of 30 persons with confirmed allergy to birch pollen and manifesting clinical symptoms during the pollen season, and 30 persons without birch allergy (control group) participated in these studies.

Birch pollen season in Kraków in 2024 started at the latest, lasted the longest and was the most intensive (SPIn=598 Pollen m^{-3}), then in the previous years (2022-2023). The highest PM10 concentrations occurred from Nov to April in most of the sites. Total protein content differed significantly among the seasons. The highest values were found in the samples collected in 2023, while Bet v1 concentration was the highest in 2022.

General similarities of the obtained protein spectra were found. Only few differences in staining intensity of some individual bands within and among the sites and the seasons were observed. Strong differentiation of immunobloting spectra between patients in both, allergic persons and control group, was observed. However, the patterns of immunoreactive proteins were almost identical while compared for each of individual persons in following years of investigations. This indicate a characteristic, individual immune response to the birch protein complex.

Seasonal variability in the term and intensity of pollen seasons and the allergen content in the air do not affect the patients immune response to birch allergens, however it may influence the strength of proteins binding.

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ESCAPING FUNGI FROM CRYPTS

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Opening old burial places and crypts can pose unforeseen health risks. In our presentation, we report on our experience in the exploration of 8 crypts in Hungary. The presented crypts were excavated in the sub-church of the Tihany Abbey (Tihany, XI. century), as well as in the St. Jakab and St. Imre churches in Kőszeg. Two buried crypts were detected by Ground-Penetrating Radar; these are from the XVI-XVII. century, since then representing a closed environment; 4 crypts (1 in Tihany and 3 in Kőszeg: Jurisics, Széchy, Szegedi) were closed with stone slabs (two children who died of the plague were buried in one of them in 1538); and 2 crypts were connected directly (i.e., without doors) to the outside in the downtown area. A foil tent was built around the buried crypts before they were opened; surface disinfection was performed on the protective clothing/equipment before/after sampling. The air samples were collected from the crypts and from outdoors, and from the church with an Andersen-type (SAS) sampler (100 l/min), onto blood agar (for bacteria, incubation at 37 °C, 3 days); and malt extract agar (for fungi, with 2% chloramphenicol; 25 °C, 5 days). The concentration of airborne bacteria in the crypts was ~2× the indoor reference value (260 CFU/m^3). The causative agent of plague could not be detected. We identified 57 fungal taxa from the air samples. Actinobacteria (*Streptomyces*) and fungi (*Penicillium*, *Engyodontium* spp.) colonizing mainly coffins, burial soil and textiles were found in the crypts, and remnants of fungi (mainly Onygenales) were found in large quantities on the bones. The fungal composition of the air in the crypts covered with stone slabs was similar. In 5 crypts, the fungal concentration was very high (>10,000 CFU/m^3), the outdoor and the indoor value is ~30 or 20× of the outdoor and indoor reference values, respectively. Our results confirm that it is important to use appropriate protective equipment during the archaeological excavation of crypts.

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FLUCTUATIONS OF *PLENODOMUS LINGAM* AND *P. BIGLOBOSUS* SPORE CONCENTRATIONS IN GREAT POLAND REGION IN 2004-2024

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Poland is an economically important producer of oilseed rape (*Brassica napus*). The crop is often damaged by Phoma stem canker caused by the closely related *Plenodomus lingam and P. biglobosus*. Ascospores are the primary inoculum responsible for the first leaf spot symptoms on plants. These spores originate from pseudothecia – sexual fruiting bodies formed on oilseed rape stubble from the previous season's crop. The aim of this work was to assess the risk of infection of oilseed rape in relation to ascospore concentration in the air. Experiments were performed in autumn 2004–2024 in Great Poland region. In studied years the maximum concentration of ascospores per cubic meter of the air varied from 4 (2005) to 106. The peak concentrations of spores were observed in September (20-30 September) and in October (1-27 October). The earliest detection of the first ascospores was in September (6-22 September) In the period from the beginning of September to the end of November, ascospores were present in the air for c.a. 65% of days. The results indicate that oilseed rape fields in Great Poland during 2004-2024 are at great risk of stem canker.

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A MACHINE LEARNING ENSEMBLE APPROACH TO FORECAST ALLERGENIC POLLEN CONCENTRATIONS IN AREAS WITH SPARSE POLLEN MONITORING

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Accurate forecasting of allergenic pollen concentrations is essential for minimizing health risks associated with pollen allergies and supporting more targeted healthcare resource planning. However, existing prediction systems often face challenges due to uncertainties in meteorological conditions, species distribution, and the limited coverage of monitoring networks. This study introduces a machine learning (ML) ensemble approach to predict daily allergenic pollen concentrations up to five days in advance under varying local pollen data availability conditions. The proposed method combines four decision tree-based ML algorithms—Random Forest, Extreme Gradient Boosting, Light Gradient Boosting Machine, and Extremely Randomized Trees—into weighted ensemble models. These models focus on forecasting pollen seasons for *Betula* (birch) and *Poaceae* (grass), Poland's two most allergenic taxa. The models were trained on historical pollen data from Wrocław, Poland (2006–2022) and meteorological parameters derived from the Weather Research & Forecasting (WRF) model. Key predictive features included weather variables (e.g., temperature, solar flux, precipitation), phenological indicators (e.g., growing degree days), and time-lagged pollen concentrations. The models were rigorously evaluated through nested cross-validation and tested on independent data from 2023–2024, including locations beyond the training set (Łódź, Kraków, and Szczecin). The ensemble models demonstrated strong predictive performance for short-term (+1 day) forecasts while maintaining moderate accuracy for extended predictions (+5 days). Validation on independent datasets confirmed the ability of ensembles to generalize across new locations. Notably, the models maintained reasonable accuracy when site-specific lagged pollen predictors were replaced with relevant variables from the distant sampling site located in Wrocław, highlighting the potential of using the replacement approach in areas without continuous pollen monitoring. This study underscores the feasibility of transferring ML-based pollen forecasting models beyond their original training locations, offering a scalable solution for regions with sparse monitoring infrastructure.

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KEY CONTRIBUTIONS OF AEROBIOLOGY AND PALYNOLOGY TO SUSTAINABLE DEVELOPMENT GOALS (SDGS)

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Sustainable development is a concept according to which economic development should take into account the balance of three aspects: social, economic and environmental. This means that it cannot lead to irreversible degradation of the biosphere and should be in accordance with the laws of nature, economy and culture. In 2015, the United Nations member states adopted 17 Sustainable Development Goals (SDGs) as a practical manifestation of this concept.

Scientific research underpins the effective implementation of these goals by identifying challenges, developing solutions, and assessing their efficacy. Literature indicates that advancements in aerobiology and palynology are instrumental in achieving many SDGs. Aerobiology, the study of airborne biological particles such as pollen grains, spores, and microorganisms, is crucial for assessing air quality and its impacts on human health and ecosystems. This field is particularly relevant to SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 15 (Life on Land). Palynology, which examines the biology and morphology of pollen grains and spores, is often utilized to reconstruct past climates and analyze current ecological processes. This discipline supports goals like SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), SDG 9 (Industry, Innovation, and Infrastructure), SDG 13 (Climate Action), and SDG 16 (Peace, Justice, and Strong Institutions).

Both fields, through their interdisciplinary approaches, provide essential insights into biodiversity, climate change, air quality, sustainable agriculture, and the functioning of urban ecosystems. They aid in developing effective environmental protection strategies and development policies, contributing to a more sustainable and resilient future.

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LEAD CONTENT IN PM2.5 DUST IN RZESZÓW

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Airborne particulate matter (PM2.5) poses a significant environmental and health concern due to its ability to carry toxic heavy metals, including lead (Pb). The sources of Pb in the air can be divided into anthropogenic sources, including vehicle emissions, industrial processes (factories, smelters), waste Incineration (batteries, electronics) and natural sources like volcanic eruptions, rock and soil erosion, and forest fires [1].

Lead particles are extremely small and can be inhaled directly into the lungs. From there, they enter the bloodstream, causing severe health effects even at low concentrations. Pb is not neutral to the environment either. Lead causes soil contamination, water pollution, harm to wildlife, and ecosystem disruption [2].

This study investigates the concentration of lead in PM2.5 dust collected in Rzeszów, Poland, in the heating season months - March, April, October, November and December in 2024, aiming to assess pollution levels. Airborne samples were acquired from Chief Inspectorate for Environmental Protection in Rzeszów. The content of Pb was determined using the Atomic Absorption Spectrometry (AAS) technique. The Pb was detected in analysed samples but concentration in the studied months did not exceed 0.005 ug/m^3. In the European Union, Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe applies. The average limit value for lead is 0.5 µg/m^3 per calendar year [3].

The findings underscore the need for continuous air quality monitoring and the implementation of effective pollution control measures to mitigate the impact of lead on human health and environment.

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ANALYSIS OF FREE RADICALS IN AIR POLLUTION OF SIZE IN THE RANGE OF 6 NM – 10 MM USING THE EPR METHOD

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Studies on particulate air pollution indicate that a new type of pollutant should be considered from mainly fossil fuel combustion and automobile exhaust emissions, i.e., environmentally persistent free radicals (EPFRs). These radicals, ubiquitous in the environment, have a long life span and are capable of producing harmful reactive oxygen species. Samples of air pollution were collected using Electrical Low Pressure Impactor [1,2] (Dekati, Finland) in 2024 autumn season. Wide range size of particles (6 nm – 10 μm) were considered.

EPFRs content in samples was measured by electron paramagnetic resonance (EPR). EPR measurements were performed at room temperature in the X-band on a BRUKER EPR spectrometer, ELEXYS 580 series, with the spin count module enabled. EPR spectrum consists of at least two components, which can be attributed to C-type radicals and mixed C + O radicals. EPFRs studies using EPR spectroscopy were reported in article Tracking Long-Lived Free Radicals in Dandelion Caused by Air Pollution [3]. A detailed analysis of air pollution depending on the time of day (night and day) and an examination of the correlation with weather parameters is planned.

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SPATIAL AND TEMPORAL VARIABILITY OF PM 10 AIR POLLUTION IN CHOSEN ANDALUSIAN CITIES.

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Particulate matter (PM) is a mixture of fine solid particles and liquid droplets suspended in the air, varying in size, composition, and origin. High concentrations of PM degrade air quality, posing a threat to both ecosystems and human health. PM10 refers to particles with a diameter of up to 10 μm, which can penetrate the upper respiratory tract, causing respiratory and cardiovascular diseases, increasing the risk of lung cancer, and weakening the immune system. These situations become particularly hazardous when concentrations exceed the critical thresholds set by WHO: 50 μg/m³ for short-term exposure (daily) and 20 μg/m³ as an annual average. For this reason, continuous air pollution monitoring is essential to inform the public about air quality and potential health risks. The aim of this analysis is to compare PM10 concentrations in two Andalusian cities: Cádiz (C) and Granada (G), which are approximately 300 km apart in a straight line. Cádiz, located on the Atlantic coast, is influenced by oceanic conditions, whereas Granada, situated inland, has a more continental climate and is close to the Sierra Nevada mountains. Air quality monitoring was conducted at two measurement stations in each city, located 4–4.7 km apart. The analysis covers the years 2020–2024, with PM10 concentration data obtained from AQICN.org. Over the past five years, PM10 levels in both cities have remained relatively stable, with annual average values staying below the EU limit of 40 μg/m³. However, WHO standards were exceeded in Granada and at the Marconi station in Cádiz. While no significant spatial variations were observed within each city, Granada consistently recorded higher annual average concentrations than Cádiz. A detailed analysis of daily values from 2020 to 2024 revealed: in Granada, the number of days exceeding the treshold value ranged from 108 to 116 per year, while in Cádiz, from 23 to 38 days per year. Higher PM10 concentrations in Granada can be attributed to its geographical location near the Sierra Nevada Mountains, which act as a natural barrier to air circulation. This hinders pollutant dispersion, leading to their accumulation. In contrast, Cádiz benefits from strong coastal air circulation, which facilitates pollutant dispersion and helps maintain better air quality compared to Granada. In Granada, maximum concentrations exceeded 400 μg/m³, indicating episodes of severe air pollution. Analysis of air mass trajectories suggests that some of these pollutants were of natural origin—most likely Saharan dust, which reached Granada more frequently than Cádiz. These findings highlight how orographic conditions can hinder efforts to improve air quality, regardless of pollution control measures.

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RADON AND INDOOR AIR QUALITY

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Indoor air quality (IAQ) refers to the condition of the air inside buildings, influenced by various factors such as ventilation, atmospheric conditions (including temperature and relative humidity), and indoor pollutant sources. IAQ significantly affects the health, comfort, and productivity of people occupying these spaces.

It is estimated that we spend approximately 80% of our time indoors, whether in residential buildings, workplaces, or educational institutions. Within these enclosed spaces, certain isotopes pose potential health risks—one of the most concerning being radon-222 (Rn-222). Under specific conditions, Rn-222 can accumulate to elevated concentrations, posing a significant hazard to human health. Radon-222 and its short-lived decay products are naturally occurring pollutants in the indoor environment. These decay products emit high-energy alpha radiation, which, when inhaled, can adversely affect the respiratory system and increase the risk of lung disease, including lung cancer.

The primary goal of the research is to determine the radon concentration levels in indoor environments and estimate the radiation doses absorbed by individuals due to inhalation of this radioactive isotope.

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ASSESSMENT OF AIR QUALITY IN THE WASTEWATER TREATMENT PLANTS DUE TO THE PRESENCE OF HYDROGEN SULFIDE, AMMONIA AND VOLATILE ORGANIC COMPOUNDS

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Wastewater treatment plants (WWTPs), due to the processes carried out in them, are a significant source of offensive odours. The unpleasant olfactory sensations from WWTPs are caused by sulphur compounds (e.g. hydrogen sulphide, thiols), nitrogen (ammonia, amines), as well as other organic compounds (aldehydes, ketones, aliphatic and aromatic compounds). These compounds, even in low concentrations, have a negative impact on humans (e.g. anxiety, depression, eye irritation, headache, respiratory problems, nausea) and the environment (e.g. respiratory problems and nervous system paralysis in animals, air pollution, aquatic pollution, contribution to greenhouse gases) [1].

Measurements were carried out in two WWTPs operating with MBBR technology ($Q_{av\ d}$ = 1200 m^3/d for WWTP 1, $Q_{av\ d}$ = 2800 m^3/d for WWTP 2). Concentrations of hydrogen sulphide (H_2S), ammonia (NH_3) and volatile organic compounds (VOCs) were measured. In the case of WWTP 1, the highest concentra-tion of H_2S (41.86 mg/m^3) was found above the grit chamber. For WWTP 2, the mechanical treatment block was the single point with concentration of H_2S (1.52 mg/m^3). The values of risk assessment for human health (HI) calculated for H_2S exceeded the acceptable level, e.g. for WWTP 1 they varied from 0.26 x 10^3 to 7.0 x 10^3. The average NH_3 concentrations at WWTP 1 oscillating from 0.66 mg/m^3 (over an open grit chamber) to 0.90 mg/m^3 (entry to the WWTP). At WWTP 2, this parameter ranged from 0.40 to 0.64 mg/m^3, with the highest values recorded at the mechanical and biological treatment blocks. The HI values for NH_3 e.g. for WWTP 1 oscillated from 1.2 x 10^{-1} to 9.6 x 10^{-1}, which indicates that they were not higher than the acceptable level of risk. The highest concentration of VOCs in WWTP 1 was recorded at the biofilter outlet (average 113.57 ppm). In the WWTP 2, the highest concen-tration of VOCs was recorded in the air at mechanical treatment block (average 568 ppm).

WWTPs are undoubtedly a source of malodorous substances. It is recommended to implement good practices that enable to reduce the emission of substances hazardous to human health from WWTPs.

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RELATIONSHIP BETWEEN TYPE OF FOREST AND CONCENTRATION OF TERPENES REPRESENTATIVES IN THE AIR: POTENTIAL OF FOREST BATHING

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Studies conducted in various parts of the world show that forests have a positive effect on our well-being and can treat or support the treatment of many mental and physical diseases. This positive effect of the forest on health, through such forms of visits as forest bathing, may be the result of the action of compounds from the terpene group - the largest class of naturally occurring organic compounds that can have anti-inflammatory, anti-cancer or neuroprotective effects. The aim of our research was to determine the chemical composition of the air inside pine and beech forests, including the quantitative and qualitative structure of terpenes. Samples of organic compounds present in the air were collected with the use of Tenax TA sorbent tubes. The process of separation, identification, and determination of the extracted organic compounds was carried out with the use of the gas chromatography technique integrated with a flame ionization detector. Additional identification of the extracted compounds was carried out with the use of the gas chromatography coupled with mass spectrometry. We found that the content of terpenes and terpenoids in forest air was characterized by high variability. The highest concentration of determined representatives of terpenes was observed in June. The highest concentration in all locations was recorded in the case of α-pinene, terpinolene and α-terpineol. In the case of the pine forest, no limonene and farnesol were detected in the samples [1].

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ASSESMENT OF METALS IN CONIFERS NEEDLES GATHERED FROM GREEN SPACES IN URBAN AREAS.

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Urban areas are exposed to numerous pollutant sources that create a complex environmental contamination profile. Industrial processes, energy production, and heavy traffic can emit hazardous substances, including metals like: Cu, Zn, Cd, Pb, Ni, and Cr (Nawrot et al., 2020). These emissions release metals into the atmosphere, from where they find their way into our environment, depositing on various surfaces, including the needles of coniferous trees. Heavy metals pose significant risks not only to public health—by deteriorating air, water, and soil quality but also to plant life. Excessive accumulation of metals in plant tissues can disrupt physiological processes, damage the photosynthetic apparatus, reduce photosynthetic capacity, and induce oxidative stress. Such effects can weaken plants, hinder growth, and compromise the ecosystem services they provide, including air purification (Kiran et al., 2022). Coniferous trees are particularly valuable as bioindicators of long-term atmospheric pollution due to their evergreen nature and extensive needle surface area. Furthermore heavy metals have been shown to negatively affect health (Jomova et al., 2025). Prolonged exposure to these toxic substances is linked to neurological disorders, organ dysfunction, and other serious health complications. Determining the heavy metal content in conifer needles using instrumental techniques, such as atomic absorption spectrometry (AAS), enables precise assessment of air contamination levels and the impact of various emission sources on the urban environment. Evaluating the concentrations of Cu, Cd, Pb, Zn, Ni, and Cr in the needles of conifers from urban green spaces is therefore crucial for monitoring environmental quality, identifying risks to both plant and human health, and informing urban management strategies aimed at managing the negative effects of industrial and traffic-related emissions.

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HARMFULNESS OF PARTICULATE MATTER ON THE EXAMPLE OF NICKEL CONCENTRATION IN MATERNAL VENOUS BLOOD AND UMBILICAL CORD BLOOD OF NEWBORNS IN PODKARPACKIE PROVINCE

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Nickel is an important component of plant, bacterial and human organisms. In plant organisms, it is included in the composition of some plant and bacterial enzymes. Nickel is also essential for the proper functioning of the human body, including by participating in erythropoiesis and influencing the activity of calcineurin, a signaling pathway component in the activation of T lymphocytes. Nickel also exhibits immunotoxic and carcinogenic effects [1]. Nickel carbonyl, which is easily absorbed through the skin and from the alveoli, is considered one of the most toxic components of particulate matter [2]. In order to gain a better understanding of the human body's exposure to this element in particulate matter, nickel concentrations (in maternal venous blood and umbilical cord blood of newborns born in the Podkarpackie province) were analyzed in relation to: 1. the location of the road in the immediate place of residence of the subjects: direct vs. nearby vs. distant; 2. the distance from the road due to the county inhabited: ropczycko-sędziszowski vs. rzeszowski vs. łańcucki vs. other counties).

The material consisted of 69 mother-child blood samples, in which nickel concentrations were determined by graphite furnace atomic absorption spectrometry (GF-AAS). The determination of each sample was carried out in two measurement series. Nickel concentrations were compared with values in plasma, which is a certified reference material. The results obtained were subjected to statistical analysis, taking $p<0.05$ as significant.

It was found that the mean concentration of nickel in maternal blood and cord blood of newborns according to the location of the road in the residence (mother: 159.8±216.6 nmol/l vs. 105.6±72.7 nmol/l vs. 93.9±80.9, p=0.356; newborn: 85.6± 80.1 nmol/l vs. 91.4± 71.5 nmol/l vs. 115.6± 56.5, p=0.758) and distance from the road by county of residence (mother: 100.1±214.7 nmol/l vs. 171.3±196.1 nmol/l vs. 110.5±51.5 nmol/l, p=0.686; newborn: 94.9± 87.1 nmol/l vs. 113.5±180.2 nmol/l vs. 119.0± 52.4 nmol/l vs. 186.8± 326.4 nmol/l, p=0.302) differentiated the groups from one other, although they did not show statistical significance.

This preliminary study signals, increased exposure to nickel of mothers and newborns living near the provincial road (which runs through the districts of Rzeszow, Łańcut, Przeworsk, Jaroslaw and Przemysl), which may endanger the health of mothers and their offspring.

[1] Ding AL, Hu H, Xu FP, Liu LY, Peng J, Dong XD. Pregnancy complications effect on the nickel content in maternal blood, placenta blood and umbilical cord blood during pregnancy. World J Clin Cases. 2021;9(28):8340-8348.
[2] Gates A, Jakubowski JA, Regina AC. Nickel Toxicology. 2023 May 20. in: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. PMID: 37276284.

Ministry of Science and Higher Education
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Regionalna Inicjatywa Doskonałości

The Excellent Sub-Carpathian region – a comprehensive environmental study at the University of Rzeszów for the benefit of the region

AIR CONDITIONS IN LVIV REGION OF UKRAINE

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The air pollutions are getting of the two main ways: natural and anthropogenic ways. The natural pollutions are provoked by the natural processes and they are changing evolutionally. Anthropogenic pollutions are mainly caused of the pollutant emissions. According to the data of the Lviv State Department of Ecology and Natural Resources [1,2] the volume of the air pollution by the enterprises of the region in 2020 was 76.0 thousand tons and comparing to the 2019 the number was decreased by the 14.5 %. The air pollution for 1 square kilometer in the Lviv region is about 3 ton of the pollution or about 30 kilograms per one human. The most of the pollution is the methane (47 % of the pollution) and Sulphur dioxide (29 %). The index of the air quality in the state of 2023 the level of the air pollution in the biggest cities of the region was satisfactory or medium-polluted [3]. The less polluted air is peculiar for the Carpathian part of the region.

The air quality assessment is conducted permanently at the four main points, where are rating the 7 main contaminate substances like dust, Sulphur dioxide, fluoride hydrogen and Nitrogen dioxide. For example, the concentration of the polluted substances in the Lviv city in the 2022 was decreased compared to 2021 for all main air pollution substances [1].

One of the instruments for the air improvement and decreasing of the concentration of the pollution substances is the stability of the forests, especially the protected forests, which are stable for the unfavorable conditions and climate changes. In Lviv Region there are 399 nature reserve objects with the area of 180 thousand hectares. For the environment protection in 2020 in Lviv region were spended approximately 19.3 million euros [2], 47% for the water treating, 28 % - for the waste products recycling, 12 % - for the air protection and 9 % - for soils protection.

[1] Current Results. Department of Ecology and Natural Resources of Lviv Regional State Administration. Available from: https://deplv.gov.ua/potochni-rezultaty/# (in Ukrainian); access: 19 March 2025.
[2] State Agency of Statistics of Ukraine. Main Department of statistics of Lviv Region. Available from: https://lv.ukrstat.gov.ua/ukr/sr/announce.php?12763 (in Ukrainian); access: 19 March 2025
[3] Lviv Region Air Quality. SaveEcoBot. Available from: https://www.saveecobot.com/maps/lvivska-oblast (in Ukrainian); access: 19 March 2025

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