Global Environmental Challenges 2025

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Book of Abstracts

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Heavy Metal Pollution in rivers due to Mining Activities in DR Congo: A threat to human health

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Democratic Republic of Congo has more than 2 500 exploited mining sites which play an important role in the country's economy. However, mining activities has led to a high presence of heavy metals that are toxic for humans and animals in aquatic systems. Here we assessed the impact of these pollutants on human health. Water samples were collected from various sites along major rivers surrounded by mining activities in Katanga, South-Kivu and Lualaba provinces. Heavy Metals such as iron (Fe), copper (Cu), cobalt (Co), zinc (Zn), lead (Pb), nickel (Ni), and chromium (Cr) in water samples were determined by using atomic absorption spectrophotometer. Hazard Quotients (HQ), Hazard Index (HI) and the Incremental Lifetime Cancer Risk (ILCR) were used to evaluate the toxicity levels in the local population. The concentration ranges of Cd, Pb, and Ni in water samples were higher than World Health Organization drinking water recommendations and guidelines. The health-risk estimation indicated by HQ, HI, and ILCR were above the acceptable limit, representing carcinogenic risk to the residents via oral intake and dermal adsorption of water near mining sites. The findings highlight the urgent need for effective regulatory frameworks and sustainable mining practices to mitigate heavy metal pollution, preserve aquatic ecosystems as well as local populations, and protect the livelihoods of communities dependent on these vital water ecosystems.

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Permafrost thaw and mercury mobilization in freshwater of the Arctic: Sink to source

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Accelerated permafrost thaw due to a warming climate will impact cycling of contaminants such as mercury (Hg). Permafrost has typically been a sink, where Hg accumulates and is sequestered. However, it could be released with thawing. This is of concern due to the potential accumulation of Hg in country foods. This review synthesizes the results of a variety of studies done in the past 15 years on the impact of permafrost thaw on the mobilization of mercury in Arctic freshwater sources. The literature review was conducted based on a paper of interest regarding the biogeochemical cycling of Hg in thawing permafrost. Then, relevant papers that were cited by this study of interest, and papers that cited the main study were reviewed. Results show that thawing permafrost mobilizes previously sequestered Hg into freshwater systems via water and sediment. However, the production of methylmercury (MeHg) from this newly mobilized Hg is not uniform. Depending on the type of formation created by the permafrost thaw, MeHg hotspots may occur, but in other cases, MeHg does not increase with the concentration of total Hg. Concentrations of Hg were also found to be correlated to the concentration of dissolved organic carbon. Reviewing existing work makes it clear that the impacts of permafrost thaw on the cycling of Hg in the Arctic are not uniform, and monitoring of MeHg in aquatic country foods of the Arctic will be critical in the future.

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Effects of climate change and nutrient inputs on the fish mortality in rivers: Case study of the Oder River disaster in 2022 - Dana Bücher

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On 14 July 2022 deceased fish in the river Oder were observed. In the following weeks the occurrences grew in frequency and resulted in thousands of dead fish. It was crucial to find the cause of the high fish mortality to hinder further negative development and prevent future disasters. Besides the high number of dead fish, large amounts of the algae Prymnesium parvum were observed, which excretes a substance, that is toxic for fish. From 10 August till 03 September.2022 the temperature, pH, level of dissolved oxygen and the conductivity were measured daily at seven monitoring sites to determine the cause of the algae occurrence, that lead to the high rate of fish mortality.
Between 17 and 21 August a swift decrease of dissolved oxygen was observed to a minimum of 0.6 mgO2/l bringing the river water to a hypoxic state. The temperatures and conductivities measured were particularly high. Correlations between the low oxygen levels and a high temperature and the concentration of nutrients, specifically phosphorus led to the formation of the algae and hypoxia. Those factors are impacted by climate change, agriculture and point source inputs of domestic and industrial origin. The parameters measured help to detect changes early and prevent further incidents.

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Causes of Eutrophication in an Eastern Florida Costal Lagoon and Possible Solutions

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The state of Florida in the United States is surrounded by coastal estuaries and lagoons which represent important ecosystems for both native species and human settlements. The Indian River Lagoon (IRL) is one such water ecosystem which stretches for 250km along Florida's east coast and is home multiple endangered species. Over the past few decades the IRL has been in a state of decline due to repeated eutrophication events and high nutrient concentrations. Current studies into the health of the IRL ecosystem have shown that there are multiple factors that contribute to the eutrophication of the lagoon, resulting in highly variable harmful algal blooms (HAB). The diverse problems presented in the IRL have resulted in traditional methods of limiting HAB to prove ineffective in preventing the continued decline of this ecosystem. This presentation will go in details of what is causing the eutrophication of the IRL, why these details are important, and what methods might be used in the future to prevent further eutrophication of the IRL and other coastal estuaries.

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Health Implications of Seasonal Haze in Southeast Asia

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Seasonal haze has plagued Southeast Asia for years. It originates from the agricultural practice of clearing the land by burning that releases particulate matter of less than 2.5 micrometer (PM2.5). PM2.5 is light enough to be transported by wind to neighbouring countries, and small enough to penetrate the alveoli in lungs. However, public awareness of its health implications are still lacking. This presentation aims to increase awareness on the issue by giving an overview of multiple studies. A number of studies have aimed to investigate the health implications of haze. These included observation studies from clinical reports during haze periods and modelling studies of mortality counts. It has been shown that incidences of haze correlates with respiratory distress particularly on aggravating asthma, especially for children and elderly. An estimated 75,000 premature deaths are due to chronic exposure to seasonal haze. However, inconsistent results between different studies and the lack of long-term studies makes it hard to define the causal relationship between haze and its health effects. This makes it hard to push for a campaign against this seasonal haze. Transboundary haze is a serious issue and more toxicological studies needs to be done to improve results and spur a greater need for action.

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Impact of Climate Change on Glacial lake outburst (GLOF) in Northern Pakistan

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Northern Pakistan's glaciers, located in the Hindu Kush Himalayan region, are critical for sustaining South Asia's water resources and ecosystems. However, these glaciers are rapidly melting due to global warming, primarily driven by human activities such as fossil fuel combustion, deforestation, and industrial processes. Glacier melting, a significant effect of climate change, has increased the risk of Glacial Lake Outburst Floods (GLOFs) in northern Pakistan. The melting of glaciers in the Hindu Kush, Himalayas, and Karakoram mountains resulted in the formation of 3,044 glacial lakes, with 33 identified as highly vulnerable to GLOFs. Remote sensing and Geographic Information System (GIS) methods were used to map and analyse these risks.

Data on the size, volume, and depth of the lakes were analysed to develop equations estimating potential flood impacts. Hydrological models (HEC-RAS and HEC-GeoRAS), integrated with GIS tools, were applied to assess the extent and depth of flooding under different scenarios. The analysis showed that 20.56 km² of land was at risk of flooding, with 14.80 km² affected by Chitral-GL2 and 5.79 km² by Swat-GL31. Flood depths ranged from less than 5 meters to over 15 meters, impacting 2.7 km² of built-up and agricultural land and 8.93 km² of barren land.

These findings emphasized the urgent need for strategies to manage and reduce the risks of GLOFs, which threaten communities, farmland, and infrastructure in northern Pakistan.

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India and climate change due to CO2 Emission: To view the issue from our perspective

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The future of humanity is seriously threatened by the changes in the climate over the past few years. In this sense, Research on environmental issues and international trade has been dominated by consumption-based carbon emissions This study looks at the relationship between carbon emissions and methods for controlling them. It also explores carbon emissions in global value chains linked to India. Extreme weather events have become more frequent in India, endangering populations. The nation faces severe air pollution in major cities and has become the world's most populous country with 1.4 billion people, consuming natural resources at a rising rate. CO2 emissions and industrial production have a short-term positive correlation but a long-term negative correlation and statistical insignificance. The paper provides an overview of carbon capture techniques, from pre-combustion to direct air capture, chemical absorption, membrane separation, and adsorption. Carbon is utilized in chemical synthesis, fuel production, and creating carbon-based materials, offering financial and ecological benefit. These applications' financial and ecological benefits showcase CCU's transformative impact on sustainability. Officials must focus on reducing pollution in high-emission nations. Countries reducing coal and oil should transition to cleaner energy sources like natural gas. A determined effort is needed to overcome barriers and utilise CCU's potential for global carbon reduction.

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Microorganisms and heavy metals associated with atmospheric deposition in a congested urban environment of a developing country: Sri Lanka

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Atmospheric deposition plays a crucial role in the cycling of pollutants, including heavy metals(HMs), bacteria, and polycyclic aromatic hydrocarbons(PAHs). While many studies have focused on HMs or bacteria individually, simultaneous investigations of both in urban atmospheric deposition remain limited. This study examined the presence of bacteria and heavy metals in atmospheric deposition in Kandy,Sri Lanka, an urban area with significant traffic congestion. Both dry and wet deposition samples were analysed for heavy metals like Al, Cr, Mn, Fe, Ni, Cu, Zn, Cd, and Pb. Their concentrations were measured using the US EPA method 200.8 and an Agilent 8800 Triple Quadrupole ICP-MS. High concentrations of Al and Fe were detected, potentially resuspended by vehicular activity. Toxic metals like Cr and Pb in dissolved forms were observed. Significant Zn levels were linked to vehicle emissions and Zn-coated roofing materials.The concentrations varied across four sampling sites, with traffic significantly influencing metal loadings. Bacterial investigations identified nine species of culturable bacteria, including opportunistic pathogens like Sphingomonas sp., Pseudomonas aeruginosa, and Klebsiella pneumonia. Pigmented and endospore-forming bacteria were abundant in atmospheric depositions, likely due to their ability to withstand harsh conditions. This study highlights the potential risks posed by harmful bacteria and heavy metals to human health and the environment.

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Elevated heavy metal contamination of the Innerste River catchment due to historical mining activities in the Harz mountains, Germany

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Heavy metal contamination in the Harz mountains is a legacy of historical metal ore mining, processing and smelting. Since heavy metals exhibit toxic effects towards ecosystems, knowledge of heavy metal concentrations in the environment is important for assessing environmental risks. The aim of this study was to investigate the contamination of the Innerste River catchment of the Harz mountains. Therefore, a literature review was conducted assessing the state of heavy metal contamination in soils and river water. Studies from this review measured heavy metal contents of Cd, Pb, Zn, Cu, Ni and Cr in soil samples from eleven floodplain sites along the Innerste River. Pb, Cd, Zn and Cu exceeded the precautionary limits by the German Federal Soil Protection and Contaminated Sites Ordinance and can therefore be classified as highly contaminated. Additionally, heavy metal concentrations in blackberry leaves were examined and proposed for biomonitoring as indicators for Pb and Zn pollution of topsoils. Heavy metal loads of the Innerste River, measured 2007 until 2017 by the Lower Saxony Water Management, Coastal and Nature Protection Agency (NLWKN), showed similar heavy metal concentrations for Cu, Pb and As whereas Cd, Ni, Zn and Cr showed reduced loads. Environmental quality standards were exceeded for Pb and Zn indicating poor water quality. The concentrations of heavy metals still present demonstrate the lasting impacts of former mining activities and the need for monitoring.

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Environmental and Health Impacts of Mercury Use in Artisanal and Small-Scale Gold Mining in Sierra Leone.

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Artisanal and small-scale gold mining (ASGM) is a vital source of income for many rural communities in Sierra Leone, particularly young people and single mothers. However, the sector's reliance on mercury for gold extraction poses significant environmental and health challenges. Mercury is used for amalgamation due to its efficiency and low cost, but its release into water bodies, soil, and air causes widespread contamination, harming aquatic ecosystems and biodiversity. These pollutants bioaccumulate in the food chain, affecting human and environmental health beyond the mining sites. This study employs a mixed-methods approach, integrating quantitative data, qualitative insights, and geographical analysis from both primary and secondary sources. Findings reveal that while ASGM provides critical financial stability, the diminishing availability of near-surface gold has forced miners to dig deeper, increasing costs and risks. Approximately 4,000 artisanal miners collectively use an estimated 156 kilograms of mercury annually, exacerbating the environmental toll. Limited access to financial resources, technical expertise, and administrative support, combined with dependence on informal gold-purchasing networks, perpetuates unsustainable practices and non-compliance with environmental regulations. The study calls for targeted interventions to address economic reliance and environmental degradation, such as promoting mercury-free extraction technologies and supporting miners.

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Need to Develop Soil-Quality-Index to Understand Distribution and Amount of Soil Organic Carbon in Texas

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Land-cover change (LUCC) affects soil quality and soil organic carbon (SOC) distribution. SOC sequestration is dependent on climate. Studies in Texas were interested in SOC distribution, how it is influenced by long-term management practices, and understanding their effects on total carbon (C) distribution. There is a need to develop a SOC distribution and LUCC intersecting index for Texas. The study investigated the impact of residue management on SOC distribution and total C mass across northwest to southeast Texas. Long-term research plots were sampled at three locations. SOC was measured to evaluate distribution and mass. Results indicated that no-tillage management increased SOC concentration and mass in the surface by 0.07 m compared other methods. Fertilization showed minimal impact on SOC sequestration across sites. SOC sequestration is feasible under Texas's climatic conditions, but the potential amounts appear limited. The results determined SOC sequestration is feasible under Texas climatic conditions, and the need to optimize residue and tillage practices for sustainable carbon management in warm regions. Compared to a study that developed a Soil Quality Index (SQI) to compare six types of land use, SQI was interpolated at landscape scale. A quality model merging both studies' methods, assessing types of land use and impacts of residue management related to SOC could show clear differences in SOC and SQI values for various landscape covers.