

ECWS-8
2024
Conference

The 8th International Electronic Conference on Water Sciences

14–16 October 2024 | Online

Program and Abstract Book

An abstract graphic of a water splash, rendered in shades of blue and purple, flowing from the top left towards the bottom right. The splash is dynamic, with several droplets and bubbles visible, set against a solid light blue background.

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Topics

The 8th International Electronic Conference on Water Sciences

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Welcome from the Chair

Dear Colleagues,

We are delighted to welcome you to the **8th International Electronic Conference on Water Sciences (ECWS-8)**, which will be held online and promoted by the open-access MDPI journal *Water* (ISSN 2073-4441; IF 3.0).

In recent years, seven International Electronic Conferences on Water Sciences (ECWS-1, ECWS-2, ECWS-3, ECWS-4, ECWS-5, ECWS-6 and ECWS-7) have addressed various important water-related issues. The seventh conference focused on adaptive water resource management, policies and governance to tackle the challenges of the ongoing climatic, environmental and social changes. The ECWS-8 will explore and discuss the following key issues: adaptive water resources management; new technologies in water science; enhancement of water safety and security for humans, their economic activities and the environment; and the formulation of new numerical methods and structures for water resources adaptation, management and development.

The ECWS-8 invites researchers from academia, as well as water practitioners, to contribute original findings, novel ideas, scientific concepts and new technologies and experiences to deal with water resource management, policies and governance, with a special focus on sustainability, resilience, uncertainty, risk and adaptation, making reference to the following topics:

- 1 Rivers, Dams and Reservoirs;
- 2 Hydrodynamics, Hydraulic Transients, Hydropower and Pumped Storage in Water-Energy Nexus;
- 3 Estuaries, Coasts and Ports;
- 4 Urban Water, Systems Efficiency, and Smart Water Grids and Technology;
- 5 Numerical and Experimental Methods, Data Analyses, Digital Twin, IoT Machine Learning and AI in Water Sciences;
- 6 Water Resources Management, Floods and Risk Mitigation.

The conference will be held entirely online, allowing people from all around the world to participate without any concerns about travel or related expenses. An electronic conference offers a platform for quick and direct exchanges of the latest research findings and innovative ideas.

The water scientific community's support and enthusiasm are greatly appreciated, as you play a crucial role in ensuring the success of this 8th edition of ECWS. Your contribution will pave the way for many more successful editions in the future.



Prof. Helena M. Ramos
Conference Chair

Instituto Superior Técnico, University of Lisbon,
Lisbon, Portugal



water

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Impact Factor: 3.0 (2023); 5-Year Impact Factor: 3.3 (2023)

Keynote Speakers



Prof. Dr. Aitazaz A. Farooque

Department of Engineering School
of Sustainable Design Engineering,
University of Prince Edward Island,
Charlottetown, Canada



Dr. Luis R. Vieira

CIIMAR - Centro Interdisciplinar de
Investigação Marinha e Ambiental,
Universidade do Porto, Porto,
Portugal

Invited Speakers



**Dr. Oscar E. Coronado
Hernández**

Universidad de Cartagena.,
Cartagena, Colombia

Program at a Glance

	Morning	Afternoon
DAY 1	S1. Rivers, Dams and Reservoirs	S5. Numerical Experimental Methods, Data Analyses, Digital Twin, IoT Machine Learning and AI in Water Sciences
DAY 2	S6. Water Resources Management, Floods and Risk Mitigation	S2. Hydrodynamics, Hydraulic Transients, Hydropower and Pumped Storage in Water-Energy Nexus S3. Estuaries, Coasts and Ports
DAY 3	S4. Urban Water, Treatment Technologies, Systems Efficiency and Smart Water Grids	

ECWS - 8 Program

14 October 2024 (Monday)

S1. Rivers, Dams and Reservoirs

Time: 9:00 (CEST, Basel) | 03:00 (EDT, New York) | 15:00 (CST Asia, Beijing)

CEST Time	Speaker	Title
09:30–09:40	Prof. Helena M. Ramos Event Chair	<i>Welcome Speech from the Event Chair</i>
09:40–09:50	Dr. Lampros Vasiliades and Dr. Luis Garrote Session Chairs	<i>Welcome from the Session Chairs</i>
09:50–10:05	Athanasios Karantakis Selected Speaker	Identification, Delineation and Mapping of Riparian areas
10:05–10:20	Gepraxia Tsiatsiari Selected Speaker	Ecosystem Services of Riparian areas of Pinios River basin
10:20–10:35	Eleftheria Tzimika Selected Speaker	Impact of the dam breach mechanisms and characteristics on dam break flood wave and flooded area. Application in Tsiknias dam
10:35–10:50	Theodora Kalaryti Selected Speaker	Effect of submerged vegetation on spatial structure of open-channel flow
10:50–11:05	Daniel Carril Rojas Selected Speaker	Improving hydrological dam safety analyses by using 2D hydrodynamic simulation to estimate the magnitude of historical floods with uncertainty
11:05–11:20	Sara Araújo Selected Speaker	Unveiling the Mystery of Biofilm Formation: Insights from Klebsiella isolated from Hospital Wastewater vs. Surface Water
11:20–11:35	Zuhal Zengin Selected Speaker	Bacterial Community Composition in a Deep Lake During Spring Turnover with Toxic Cyanobacteria Bloom
11:35–14:30	Break	

S5. Numerical Experimental Methods, Data Analyses, Digital Twin, IoT Machine Learning and AI in Water Sciences

CEST Time	Speaker	Title
14:30–14:40	Prof. Dr. Junye Wang Session Chair	<i>Welcome from the Session Chair</i>
14:40–15:10	Prof. Dr. Aitazaz A. Farooque Keynote Speaker	Application of Advanced Modelling Techniques for Sustainable Water Management
15:10–15:25	Sergio Ricardo López-Chacón Selected Speaker	Interpretation of variables in a machine learning model for short-term streamflow prediction
15:25–15:40	Suhalla Kamal Selected Speaker	Assessing stream flows and dynamics of the Athabasca River basin using machine learning
15:40–15:55	Mohamed Naim Selected Speaker	Meteorological Drought Management in the Mediterranean: Integrating Satellite and Reanalysis Data for Enhanced Early Warning Systems in the Tensift River Basin
15:55–16:10	Melvin Alfonso Garcia-Espinal Selected Speaker	Synthetic Year Generation for Irrigation Systems: Optimizing Networks using a Distribution-based Methodology in MATLAB
16:10–16:25	Alberto Enrique Molina Lozano Selected Speaker	Enhanced Photoelectrochemical Degradation of Dyes in Water Using Pulsed Electrodeposited CeO ₂ -TiO ₂ Nanorod Photoanodes
16:25–16:40	Teera Gnaneswar Gude Selected Speaker	Predicting per- and polyfluoro-alkyl substance uptake by agricultural crops using machine learning tools

15 October 2024 (Tuesday)***S6. Water Resources Management, Floods and Risk Mitigation****Time: 9:00 (CEST, Basel) | 03:00 (EDT, New York) | 15:00 (CST Asia, Beijing)*

CEST Time	Speaker	Title
09:00–09:10	Prof. Dr. Athanasios Loukas Session Chair	<i>Welcome from the Session Chair</i>
09:10–09:25	Prof. Rodrigo Maia Invited Speaker	TBD
09:25–09:40	Stylianios Voudouris Selected Speaker	Assessing the vulnerability of water resources to drought by applying the Standardized Drought Vulnerability Index (SDVI) to the Lake Karla basin
09:40–09:55	Mike Spiliotis Selected Speaker	A Fuzzified Multicriteria Approach for Water Resource Management Based on the French School of Multicriteria
09:55–10:10	Aikaterini Lyra Selected Speaker	Propagation of Climate Model Variability to Coastal Groundwater Simulations under Climate Change
10:10–10:25	Isa Ebtehaj Selected Speaker	Advanced Flood Classification Using Rapid Machine Learning Techniques: Insights from Saint-Charles Station, Quebec
10:25–10:40	Marios Mpillios Selected Speaker	Regional frequency estimates of annual rainfall maxima and sampling uncertainty quantification
10:40–10:55	Gülşah Kılıç Selected Speaker	Flood Risk Map For Büyükçekmece District Based On Socioeconomic Factors
10:55–11:10	Alexandra Megahed Selected Speaker	The Impact Of Climate Changes On The Hydrological Conditions In The Zarqa Main Hydrographic Basin (Dead Sea)
11:10–14:30	Break	

S2. Hydrodynamics, Hydraulic Transients, Hydropower and Pumped Storage in Water-Energy Nexus***S3. Estuaries, Coasts and Ports***

CEST Time	Speaker	Title
14:30–14:40	Dr. Vicente S. Fuertes-Miquel Session Chair	<i>Welcome from the Session Chair</i>
14:40–14:55	Dr. Oscar E. Contrando Hernandez Invited Speaker	Novel Tools for Analysing Filling and Emptying Operations in Water Distribution Networks
14:55–15:10	Cristian Alexander German Selected Speaker	Computational Enhancement of Water Distribution Network Analysis and Optimization Models through Topological Simplification
15:10–15:25	Duban A. Paternina-Verona Selected Speaker	Computational Fluid Dynamics for Simulation of Large-Scale Pipeline Filling Processes
15:25–15:40	João Soares Tavares Coelho Selected Speaker	Multi-criteria optimization modeling of hybrid energy solutions for the water–energy nexus
Start	S3. Estuaries, Coasts and Ports	
15:40–15:50	Dr. Borja G. Reguero and Dr. Cristina Sousa Session Chairs	<i>Welcome from the Session Chairs</i>
15:50–16:15	Dr. Luis R. Vieira Keynote Speaker	Emerging Pollution in Estuaries, Coasts and Ports: Innovative Solutions and Stakeholder Action to Tackle Marine Litter
16:15–16:30	Asimakis Nestoras Karagiannis Selected Speaker	Assessing Coastal Vulnerability to Oil Spills Using GNOME and GIS Analysis
16:30–16:45	Alexandra g. Aspioti Selected Speaker	The effect of wind on tidal circulation in the Gulfs of Patras and Corinth
16:45–17:00	Vânia Amorim Selected Speaker	Per- and Polyfluoroalkyl Substances (PFASs) on marina surface waters from the Douro River, Portugal

16 October 2024 Wednesday)***S4. Urban Water, Treatment Technologies, Systems
Efficiency and Smart Water Grids******Time: 9:00 (CEST, Basel) | 03:00 (EDT, New York) | 15:00 (CST Asia, Beijing)***

CEST Time	Speaker	Title
09:00–09:10	Dr. Marco Ferrante and - Prof. Carmen Teodosiu Session Chairs	<i>Welcome from the Session Chairs</i>
09:10–09:25	Tiago Correia Selected Speaker	Towards Net-Zero Carbon in the Water Sector: The case of Maderia Island's water supply system
09:25–09:40	Cristina M. Monteiro Selected Speaker	Impact of urban green roofs on downstream system design
09:40–09:55	Roberto Gueli Selected Speaker	Optimizing Energy Use in Water Supply Networks: Minimizing Pump Consumption and Ensuring Water Quality
09:55–10:10	Camila Garcia Selected Speaker	Evaluation of sdgs using indicators in urban water systems
10:10–10:25	Iolanda-Veronica Ganea Selected Speaker	Eco-Innovative Magnetic Nanostructures: Pioneering Solutions for Mining Wastewater Challenges
10:25–10:40	Rana Waqar Aslam Selected Speaker	A Novel Approach to Urban Groundwater Quality Assessment: Combining Geospatial Analysis, Geostatistics, and Multi-Criteria Evaluation of Water Quality Indices
10:40–10:55	Roberto Gueli Selected Speaker	Energy Optimization for Water Distribution Networks
10:55–11:10	PELİN SOYERTAŞ YAPICIOĞLU Selected Speaker	Techno-economic performance assessment of malt-dust-derived biochar application for municipal wastewater treatment: A water reuse strategy
11:10–11:25	Iris Correia Selected Speaker	Adsorption studies of ibuprofen by alginate spheres containing activated carbon and first trials using wastewater treatment plant effluent as matrix
11:25–14:30	Break	
14:30–14:40	Dr. Marco Ferrante and - Prof. Carmen Teodosiu Session Chairs	<i>Welcome from the Session Chairs</i>
14:40–14:55	Fabiano Castrogiovanni Selected Speaker	Advanced wastewater treatment through the combination of a self-forming dynamic membrane with electro mbr
14:55–15:10	Amir Noori Selected Speaker	Pressure Reduction Forecasting in Urban Water Distribution Systems Using EPANET and Machine Learning Models
15:10–15:25	Dean Song Selected Speaker	The acid and base catalytic oxidation of permanganate towards antibiotic pollutants
15:25–15:40	João Pedro Magalhães Selected Speaker	Local Scale Integrated Approaches for Enhancing Water Reuse: Constructed Wetland Case Study
15:40–15:55	Alex Javier Garzón-Orduña Selected Speaker	Optimization of Drinking Water Network Management: Traditional and Innovative Approaches for Leak Detection and Management
15:55–16:10	Santhana krishna kumar Alagarsamy Selected Speaker	Magnetic nanoparticles decorated with synthetic zeolite derived from coal fly ash: Application to removal of heavy metals and organic dyes
16:10–16:25	Dan Dai Selected Speaker	Water quality and Ecosystem Services degradation in intensively urbanized arid regions versus Wastewater Treatment infrastructure development plans
16:25–16:40	Lin guo Selected Speaker	The effect of citric acid on enhancing metal (Cu^{2+} , Ni^{2+} and Pb^{2+}) uptake in duckweed

ECWS - 8 Program

16:40-16:55	Ana Rita Pereira Selected Speaker	Impact of Methylparaben on <i>Stenotrophomonas maltophilia</i> Colony Biofilm Architecture and Tolerance to Chlorination and Antibiotics.
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Session 1. Rivers, Dams and Reservoirs

sciforum-103087: Specular and Quasi-Specular Echo Analysis for Flood Monitoring in Pakistan's Indus River Basin

Farkhanda Noor^{1,*}, Nek Muhammad Shaikh¹, Stefano Vignudelli², Arjumand Zaidi³ and Tauqeer Ali³

¹ Institute of Physics, Faculty of Natural Sciences, University of Sindh, Jamshoro, 76060, Pakistan

² Institute of Biophysics Pisa Italy

³ US-Pakistan Center for Advanced Studies Mehran University of Engineering and Technology Jamshoro

Continuous monitoring of water extent at inland water surfaces is necessary during any season. However, it is not often possible due to the unavailability of flood gauges, inaccessible locations, and other hazardous situations in flooded areas. Despite this, advanced satellite radar altimetry-derived water surface elevations may be utilized to supplement in-situ data. Synthetic Aperture Radar (SAR) high-resolution mode has replaced pulse-limited low-resolution mode (LRM) in satellite radar altimetry in recent years. In Pakistan, radar altimetry satellite data is used to find and compare the level of the water surfaces of the River Indus near the Sukkur barrages and analyzed that altimetry performed better in flat areas as compared to mountain areas. In this study Sentinel 3 L2 datasets on inland water surfaces were evaluated and applying pulse masking using the global water surface explorer facilitated isolating the pulses in the waveform over water and land in Sindh near Sukkur Barrage for a rainy year August 25, 2022 (Inundation Period). Echoes were found highly specular during inundation while quasi-specular during dry months. Waveform shapes were separated in different months. Time series of the water level of these months were also evaluated and compared with In-Situ gauge data taken from the Sindh Irrigation Department (SID). The accuracy evaluation uses variate differences, pass-to-pass repeatability, and comparison to gauge measurements. We have proposed a straightforward rule to separate Specular, Quasi-Specular, and non-Specular echoes for floodplains. Furthermore, radar altimetry may provide information about flood water depth. This study will help to map inundation extent and depth at inaccessible locations during all weather conditions.



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sciforum-102808: Investigation of Uranium species in water near Uranium Sludge Storage using cascade filtration methods

Olga Shvartseva ^{1,*}, Daria Mashkova ² and Anatoly Boguslavsky ²

¹ International Integrated Research Laboratory for Climate Change, Land Use and Biodiversity, X-BIO Institute, University of Tyumen, 6 Volodarsky st., Tyumen 625003, Russia

² V.S. Sobolev Institute of Geology and Mineralogy, Siberian Branch Russian Academy of Science, 3 Prospect Academician Koptug, Novosibirsk 630090, Russia

The disposal of low-level radioactive waste at uranium ore mining and processing sites is currently considered unsafe due to complex pollution near uranium sludge storage facilities. The relevance of this study is related to the need to search for possible ways to remove uranium from migration in water flows to minimize the harm from the release of nuclear fuel to the environment. One of the ways to study the radionuclide species in water is the use of the cascade filtration method, whereby a water sample is sequentially filtered through a set of membranes with decreasing pore size.

In this work, we collected samples of surface and groundwater in the area near the sludge storage of the Novosibirsk Chemical Concentrates Plant. The concentrations of HCO_3^- and Cl^- were determined using the titrimetric method, while the concentration of SO_4^{2-} was measured using the turbidimetric method. To determine the concentration of cations and trace elements, the ICP MS method was used. The uranium species were determined using the method of cascade fractionation using Sartorius vacuum filter systems and membranes with pore sizes of 1.2, 0.45, 0.2, 0.1, and 0.05 microns.

As a result of the experiments, it was established that when uranium enters water flows, the leading form of migration is suspensions (1.2-0.45 μm) and large colloids (0.22-0.45 μm). At a sufficiently high concentration of bicarbonate in waters, uranyl-carbonate complexes are formed. With increasing distance from the sludge storage site, as a result of water dilution, sorption and sedimentation processes, the uranium concentration decreases, the pH value increases, while the Eh decreases, and the geochemical situation is reduced. As a result, carbonate complexes with uranium break down; part of the uranium passes into sediment, forming uranium oxide; and suspensions and large colloids again become the leading form of transport.



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sciforum-097317: Identification, Delineation and Mapping of Riparian areas

Athanasios Karantakis ^{1,*}, Athanasios Loukas ¹ and Dimitrios Fotakis ²

¹ Department of Rural and Surveying Engineering, Faculty of Engineering, Aristotle University of Thessaloniki, Greece

² Forest Research Institute, Hellenic Agricultural Organization "DEMETER", Vasilika, Greece

Riparian zones undoubtedly provide valuable ecosystem functions. Their proximity to water makes them vitally important areas. Thus, it is considered very important to identify and map the riparian areas. This study focuses on the importance of these areas by making attempts to delineate them using various methods and Geographic Information Systems. Three methods proposed in the international literature have been used for the identification and delineation of riparian areas. These methods have been developed and applied in the U.S.A. The first method (Holmes et al., 2011), is essentially a functional delineation model that relates the terrain relief with riparian areas. The second method (Wenger, 1999), focuses on slope, land use, potential flood – prone areas and wetlands. The third method (Abood et al., 2019,) is a more complicated method using a large number of criteria and a specific G.I.S. tool to determine the riparian zones. The methods have been applied to Pinios River basin with an area of about 10,000 km², located in Central Greece. The data used in the applied methods, were adapted to the corresponding data of the Pinios River basin. In order to assess and evaluate the results of the applied methods, it was necessary to find a benchmark method. This was the method proposed by the Copernicus program. According to this method, the riparian zones are delineated using high-resolution satellite data for the whole European Union. Comparisons were made for streams of different stream orders of Pinios River basin for the three applied methods. Each one was also compared separately with the riparian areas of the Copernicus method. The findings of the present work indicate that, methods based on fixed widths of riparian areas are inadequate, because they take into account only the river network and no other significant parameters such as geomorphology, vegetation and soil characteristics.



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sciforum-097356: Impact of the dam breach mechanisms and characteristics on dam break flood wave and flooded area. Application in Tsiknias dam, Lesvos Island, Greece

Eleftheria Tzimika *, Athanasios Loukas and Evangelos Findanis

Department of Rural and Surveying Engineering, Faculty of Engineering, Aristotle University of Thessaloniki, Greece

This study aims to investigate the impact of the dam breach mechanisms and characteristics on the flood wave effluxing through the breach. The failure mechanisms, the geometric characteristics, and the development time of the breach are estimated with the five empirical equations provided by HEC-RAS. The flood routing is simulated with the HEC-RAS 2D model using the Eulerian-Lagrangian Shallow Water equations (SWE-ELM), derived from St. Venant differential equations. A finite volume grid was utilized to discretize the St. Venant equations. Then, the routing of the flood wave through the inundated area is performed by estimating the flood depth and the flow velocities for every wet cell of the grid for a given period. As a case study, a hydraulic 2D routing model was built to examine various breach scenarios of the Tsiknias dam, an earthen dam with a central clay core located northeast of Kalloni town of Lesvos Island. The dam is equipped with an Ogee Crest safety spillway which has a length of 50 m. The results show that the most unfavorable scenario of dam breach due to soil piping is the one that uses the Froelich 1995a equation. In this scenario, the maximum peak outflow from the breach is $Q_{peak} = 8225.5 \text{ m}^3/\text{s}$ and Kalloni town is inundated within 40 minutes after the breach. This time window is essential for the evacuation plan of the citizens in the case of a dam breach. Inside Kalloni town, the flood depths range from 2 to 5 m, whereas the flow velocities reach up to 6 m/s, which implies that the flood wave generated by the breach may inflict major damage to the infrastructure of Kalloni town. In Kalloni Bay, outside of the town, the flood depths reach up to 2 m and the flow velocities up to 3 m/s.



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sciforum-102769: A Conceptual Study of Multi-functional Coastal Reservoirs in Major Estuaries of the Mekong Delta, Vietnam

S.H Truong ^{1,*}, T.D Nguyen ², L.K Phan ³ and T.H Le ⁴

¹ Faculty of Civil Engineering, Department of Hydraulic Structures, Thuyloi University

² Southern Institute of Water Resources Planning, Ho Chi Minh, Vietnam

³ Faculty of Civil Engineering, Department of Geotechnics, Thuyloi University

⁴ Faculty of Civil Engineering, Department of Coastal Engineering, Thuyloi University

The Mekong Delta, a vital agricultural and ecological region in Vietnam, experiences serious challenges from flooding, saltwater intrusion, and freshwater shortages. These issues, worsened by climate change and upstream developments, are endangering the region's sustainable development and are causing great concern for the local population and authorities. This study examines traditional strategies for addressing challenges to freshwater availability, tidal flooding, and saltwater intrusion in this area. The disadvantages of different strategies are highlighted, and a novel approach involving the construction of large multi-functional barriers in the main estuaries of the Mekong Delta is presented. The idea has been preliminarily considered for the Ham Luong estuary region in Ben Tre province, which is among the most vulnerable to the abovementioned threats. The large barrier at the main estuaries can be integrated with river and sea dikes to form new coastal reservoirs, offer flexible operational capabilities to manage saltwater intrusion, and protect the landside from tidal inundation as well as storm surges. Moreover, a schematized model of the Ham Luong estuary was developed using Delft3D to assess the hydrodynamic impact of the proposed barriers. The numerical results indicate that strategically positioning the opening and closing gates in alignment with flood and ebb flow patterns and increasing the structure's opening can considerably mitigate the adverse effects of the estuarine barriers. This research highlights the potential of an innovative multi-functional flood defense system at the main entrance of the estuary to ensure water security and support sustainable development in the Mekong Delta.



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sciforum-097129: A Revolutionary Concept of Ground Water Conservation: Shirpur Pattern

Dr. Tushar Anil Shinde ^{1,*}, Dr. Vijay S. Shivankar ¹, Dr. Sandip P. Patil ² and Rajendranath D. Parsi ¹

¹ Department of Centre for Textile Functions, SVKMS, NMIMS University, Mukesh Patel Technology Park, Shirpur, Maharashtra, India, Postal Code - 425405

² Department of Microbiology and Biotechnology, R. C. Patel Arts, Commerce and Science College, Shirpur, Maharashtra, India, Postal Code - 425405

Water is one of the most important elements for every human being in our ecosystem. The earth's water level is falling, despite the growing need for water every day. Therefore, Shri. Amrishbhai Patel of Shirpur (Dist. Dhule, Maharashtra) invented a novel concept of Pani Adava pani Jirava permanently fix this problem. The majority of the Khandesh region realised in the summer that there was a water shortage. The inconsistent rainfall is also a major contributing factor. Deeper and deeper subsurface storage is being depleted because of farmers harvesting underground water for agriculture. Main goal is to save the rainwater we obtain during the monsoon and its retreat by utilising the Shirpur Pattern.

In Dhule district and Shirpur tahsil cover under black soil layers, acting as a barrier to water percolation and reducing the pace at which subsurface water sources recharged. It permanently resolves the issue of water scarcity. Here, the key idea is to divert extra water into canals rather than allowing it to run into the Tapi River. Cement Nalla Bandhara (CNB) is the building that accomplishes these goals. Today, 305 CNBs have been constructed and these dams prevent the extra rainwater from being used carelessly and unevenly. It allows the barest amount of water for farming. The water that was being drained from the Tapi River is now stored by CNB.

In the past, farmers could only harvest one crop annually from their fields. Fisheries is going to be a new sector shortly. Fish are cultivated using the effluent as fertiliser. Such happiness will come from farming, and the next generation of farmers will double their earnings. Making Shirpur one of India's towns with the quickest rate of growth. In addition to fortifying the foundation, the innovative idea will support future prosperity with honour.



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sciforum-097517: Assessing Dam Site Suitability Using an Integrated AHP and GIS Approach: A Case Study of the Purna Catchment in the Upper Tapi Basin, India

Shravani Yadav^{1*}, Usman Aliakbar Mohseni², Mohit Dashrath Vasave³, Advait Sanjay Thakur³,
Uday Ravindra Tadvi³ and Rohit Subhash Pawar³

¹ PhD Research Scholar, Department of Hydrology, Indian Institute of Technology Roorkee, Roorkee, Uttarakhand, 247667, India

² PhD Research Scholar, Department of Civil Engineering, Indian Institute of Technology Roorkee, Roorkee, Uttarakhand, 247667, India

³ UG Student, Department of Civil Engineering, Viva Institute of Technology, Mumbai, Maharashtra, 401305, India

In the present study, dam site suitability mapping was carried out for the Purna sub-basin of the upper Tapi basin. Constructing dams in strategically chosen locations is a crucial water management approach to alleviate flood risks and water scarcity. Selecting appropriate dam sites requires considering criteria such as precipitation, elevation, soil properties, slope, geomorphology, geology, lithology, stream order, distance from road, and fault tectonics. To address this complex problem, integrating Multiple Criteria Decision-Making (MCDM) techniques with Geographic Information Systems (GISs) has become increasingly prevalent. Among these techniques, the Analytic Hierarchy Process (AHP) is particularly effective for addressing water-related challenges. In this study, we developed a Dam Site Suitability Model (DSSM) by evaluating ten thematic layers: precipitation, stream order, geomorphology, geology, soil, elevation, slope, land use and land cover (LULC), and major fault tectonics. The AHP technique was employed to assign weights to these thematic layers, which were then used in an overlay analysis to create a suitability map with five classes ranging from high to low suitability. This study revealed that approximately 14% of the Purna sub-basin falls into the very high suitability category, while 27.2% is classified as highly suitable. This cost-effective approach not only simplifies the traditional method of dam site selection but also enhances decision-making accuracy. This methodology can be universally applied to identify potential dam sites, aiding flood mitigation and addressing water scarcity exacerbated by global and regional climate change. The DSSM, leveraging GIS and AHP, can significantly improve dam management and promote sustainable, environmentally responsible water resource management practices worldwide.



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sciforum-095536: Bacterial Community Composition in a Deep Lake During Spring Turnover with Toxic Cyanobacteria Bloom

Zuhal Zengin, E. Gozde Ozbayram *, Latife Köker, Meriç Albay and Reyhan Akçaalan

Department of Marine and Freshwater Resources Management, Faculty of Aquatic Sciences, Istanbul University, Istanbul, 34134, Turkey

The composition of bacterial communities typically varies greatly in freshwater ecosystems, and the presence of toxic cyanobacterial blooms poses significant concerns for ecosystem and human health. In this study, we aimed to monitor the vertical bacterial community profile in a natural lake used for drinking water. We collected samples in March 2023 from the water column (surface, 1 m, 5 m, 10 m, 15 m, 20 m) where water is abstracted for the drinking water treatment plant. The bacterial community profile was examined by 16S rRNA amplicon sequencing using MinION Mk1C (ONT). The water temperature was $9.8^{\circ}\text{C} \pm 0.37$, the dissolved oxygen level was $11 \text{ mg/L} \pm 1.44$, and pH was 7.2 ± 0.27 as expected for the spring turnover period. The bacterial community was dominated by Cyanobacteria and its abundance decreased gradually throughout the water column in which the maximum abundance was 88% at the surface, while the minimum was 73% at 20 m. The result was in line with the historical data of this lake, showing that Cyanobacteria were an important component of the microbial community. The majority of the Cyanobacteria reads were assigned to *Planktothrix rubescens*. Toxic *Planktothrix rubescens* blooms have been observed in Lake Sapanca since the 1990s, highlighting the critical need for ongoing monitoring studies. *Planktothrix agardhii* and *Synechococcus* sp. were also detected at all depths. Moreover, the abundance of Pseudomonadota increased throughout the water column, reaching a maximum of 18% at 20 m. The results indicated that Cyanobacteria, which can produce toxins, taste, and odor, were abundant throughout the water column during the spring turnover together with Pseudomonadota and Actinomycetota species, which can degrade complex organic compounds. Since the study area is a drinking water resource, monitoring studies integrated with a metagenomics approach are needed to effectively mitigate Cyanobacteria blooms and microbial community dynamics.



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sciforum-095483: Bioaccumulation of heavy metal contaminants in the water, sediments, and tissues of *Tor putitora* (Golden Mahseer) collected from the Zhob River

Tanzeela Hashim ¹, Zubia Masood ^{1,*} and Sofia Alvi ²

¹ Department of Zoology, Sardar Bahadur Khan Women's University, Quetta, Balochistan, 873000, Pakistan

² Pakistan council of scientific and industrial research (PCSIR) Laboratory, Karachi city, Pakistan

Introduction

Unpolluted freshwater is a crucial component for maintaining human health. The present study aimed to investigate the bioaccumulation of heavy metal contaminants (Fe, Cd, Cr, Cu, and Pb) in water, sediments, and tissues of *Tor putitora* for assessing their suitability for human consumption.

Methods

Fish, water, and soil samples were collected from the Zhob River, and Flame Atomic Absorption Spectrometry (FAAS) was employed to assess the level of heavy metal contamination.

Results

Water quality parameters (temperature and pH) were within suitable ranges, but electric conductivity and turbidity exceeded permissible limits. High concentrations of Fe and Cd in soil and Pb in both water and soil were noted, surpassing WHO and USEPA standards. Despite elevated Fe levels, the examined metal concentrations in fish tissues were below FAO/WHO limits, indicating safe human consumption. Estimated daily intake (EDI) showed no health risk for the local population. Non-carcinogenic risk assessment indicated individual metal consumption safety, but combined metal intake may pose potential health risks. Carcinogenic risk assessment for Cd, Cr, and Pb revealed no cancer risk for consumers. Multivariate analysis, including the correlation matrix, revealed strong and significant correlations ($P < 0.05$) among heavy metal pairs (Fe/Cr, Fe/Pb, Cr/Fe, Cr/Pb, Pb/Fe, and Pb/Cr). Hierarchical cluster analysis and principal component analysis (PCA) identified the origins of these metals, attributing their presence to the nearby weathering of rocks and mining, municipal, and agricultural activities. These factors were recognized as potential sources of heavy metal bioaccumulation in riverine fish.

Conclusions

This study concluded that the Zhob River was contaminated with heavy metals, emphasizing the need to prevent domestic and industrial sewage inflow. Monitoring these metals in the food chain is crucial for reducing associated health risks. This study provides the first report on heavy metal distribution in the Zhob River's highly abundant and edible mahseer fishes.



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sciforum-103070: Climate Change Vulnerability and Adaption Strategies for Water Resources in Bari Doab

Muhammad Hassan Ali ^{1,*}, Dr. Naeem Saddique ¹, Shahbaz Nasir Khan ² and Mannan Aleem ¹

¹ Department of Irrigation and Drainage, University of Agriculture, Faisalabad

² Department of Structure and Environment engineering, University of Agriculture, Faisalabad

The Bari Doab region in Pakistan, an important agricultural area, is increasingly threatened by climate change, leading to severe water scarcity. This study employs sophisticated hydrological modeling techniques, including the Soil and Water Assessment Tool (SWAT), to predict the impacts of changing precipitation patterns, rising temperatures, and extreme weather events on water availability. By incorporating statistical downscaling of General Circulation Models (GCMs), the research provides localized manageable climate projections for enhancing the accuracy of forecasts for this specific region. The study assesses changes in water resources and evaluates risks of floods and droughts which offers a comprehensive view of future challenges. Socioeconomic vulnerability indices are developed to gauge the region's resilience to water-related hazards, considering factors such as economic stability, infrastructure, and social support systems. Based on these analyses, the study proposes several adaptation strategies which includes the adoption of advanced water use efficiency techniques, the implementation of early warning systems for extreme weather events, and the diversification of livelihoods to reduce reliance on agriculture alone. These strategies aim to improve sustainable water management and ensure food security in Bari Doab by providing actionable, evidence-based insights for climate change adaptation planning, thus enhancing the region's overall resilience to environmental stresses.



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sciforum-102724: Distribution and aquatic ecotoxicological risks of metal(loid)s in surface sediments of headwater streams on the Central African Copperbelt

Kennedy O. Ouma^{1*}, Agabu Shane², Concillia Monde Monde¹ and Stephen Syampungani^{3,4}

¹ Department of Zoology and Aquatic Sciences, School of Natural Resources, Copperbelt University, P. O. Box 21692, Kitwe, Zambia

² Department of Environmental Engineering, School of Mines and Mineral Sciences, Copperbelt University, P. O. Box 21692, Kitwe, Zambia

³ Chair-Environment and Development, Oliver R Tambo Africa Research Chair Initiative (ORTARChI), Copperbelt University, P. O. Box 21692, Kitwe, Zambia

⁴ Forest Science Postgraduate Program, Department of Plant and Soil Sciences, Plant Sciences Complex, University of Pretoria, Private Bag x20, Hatfield, Pretoria-0002, South Africa

Globally, stream ecosystems draining mining landscapes experience alarming metal(loid) pollution, threatening the attainment of “2030 UN-SDGs 6 and 14”. This study was conducted monthly in the north-western Zambian Copperbelt between May 2022 and April 2023 to investigate the spatiotemporal distribution and ecotoxicological risks of As, Cr, Cu, Ni, Pb, and Zn in stream sediments. Pb (12.7), Cu (2073), and Zn (126.6) mg/kg were highest in the dry season. Generally, metal concentrations (mg/kg) followed the order Pb (5.98) As (6.98) Zn (49.6) Ni (99.7) Cr (109.2) Cu (418.3). Streams with anthropogenic inputs were most impacted by Cu (1691–2073 mg/kg), up to 28% above the local background value. Cu, Ni, and Cr exhibited “moderately-severe” enrichment and “moderate” and “low-to-medium” contamination. The contamination factor (CF) ranged from “low-to-moderate” to “very high” [Pb (0.63) >As (0.81) >Zn (1.33) >Ni (2.39) >Cr (6.16) >Cu (46.01)]. KSC sediments were enriched from “none-to-minor” to “very severe”, with increasing enrichment (EF) [Pb (0.64) >Zn (0.89) >As (1.48) >Ni (1.82) >Cr (2.59) >Cu (30.45)]. Ecological risk assessment indicated a “low risk” (mPERI 41.7–47.4), while the toxicity risk index (TRI, 13.1–19.3) depicted “moderate-to-considerable” ecotoxicological risk to benthic biota. Based on the sediment quality guidelines, As and Cr concentrations were “potentially hazardous”; Cu and Ni were “hazardous”, while Pb and Zn were “non-toxic”. While the overall ecotoxicological risk was considerably low, proactive interventions must be instituted to mitigate anthropogenic metal pollution for the effective and sustainable management of CACB aquatic ecosystems.



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sciforum-097108: Drinking Water Contamination: The Case of Lead (Pb) in Selected Samples in Southwest, Nigeria

Francis Olawale Abulude ^{1,*}, Akinyinka Akinnusotu ², Samuel Dare Oluwagbayide ³, Ademola Adamu ⁴ and Kikelomo Mabinuola Arifalo ⁵

¹ Environmental and Sustainable Research Group, Science and Education Development Institute, Akure, Nigeria

² Department Science Laboratory Technology, the University of Medical Sciences, Ondo City, Nigeria

³ Department of Agricultural and Bio-environmental Engineering, Federal Polytechnic, P.M.B. 50, Ilaro, Ogun State, Nigeria

⁴ Department of Chemical Sciences, University of Education, Science, and Technology, Ikere, Ekiti State, Nigeria

⁵ Department of Chemistry, University of Education, Science, and Technology, Ikere, Ekiti State, Nigeria

Introduction

Access to clean and safe drinking water is essential for human health. However, in many regions, including Southwest Nigeria, drinking water contamination remains a critical issue. Lead (Pb) contamination, in particular, poses significant health risks, such as neurological damage and developmental issues in children. This research is novel as it provides a comprehensive assessment of lead levels in drinking water across a diverse region with varied socio-economic activities and environmental conditions. The primary aim of this study is to assess lead (Pb) contamination levels in drinking water samples from Ondo, Osun, and Ekiti States in Southwest Nigeria and the contamination factor (CF), enrichment factor (EF), and index of potential ecological risk (Eif).

Methods

Water samples were collected from various sources, including wells, boreholes, rivers and streams, in the locations. The samples were analyzed for lead content using Atomic Absorption Spectroscopy (AAS).

Results

The lead levels (0.003-0.077 mg/L) were then compared with National Environmental Standards and Regulations Enforcement Agency (NESREA) and World Health Organization (WHO) safety standards. The results indicated that a significant proportion of the water samples contained lead levels exceeding both NESREA and WHO safety standards. The results also depicted: All samples but one exhibited low Degree of Contamination and Contamination Factor, low EF and Eif. The highest contamination level was found in sample from a stream, likely due to proximity to a car wash shop, nearness to a moderately busy road, and the use of lead-containing materials in water distribution systems within the environ.

Conclusions

The study concludes that lead contamination in drinking water is a pervasive issue in Southwest Nigeria, posing serious public health risks. The findings underscore the need for regular water quality monitoring, public awareness campaigns, and the implementation of stricter regulations to ensure safe drinking water.



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sciforum-097289: Ecosystem Services of Riparian areas of Pinios River basin, Greece

Gepraxia Tsiatsiari ^{1,*}, Athanasios Loukas ¹ and Dimitrios Fotakis ²

¹ Department of Rural and Surveying Engineering, Faculty of Engineering, Aristotle University of Thessaloniki, Greece

² Forest Research Institute, Hellenic Agricultural Organization "DEMETER", Vasilika, Greece

Riparian zones are transitional environments between terrestrial and freshwater ecosystems. Preserving and restoring natural habitats could be instrumental in maintaining and enhancing ecosystem services vital for both environmental health and human well-being. The aim of this study is the spatial analysis of ecosystem services in the hydrographic network of Pinios River basin, Greece. Initially, the riparian zones were delineated using the Riparian Buffer Delineation Model v6.1 (Abood and Maclean, 2011). The model creates variable-width riparian buffer zones that tend to vary in width based on the stream order. Ecosystem services were estimated using the Integrated Valuation of Ecosystem Services and Tradeoffs 3.1 (InVEST) software (Natural Capital Project, 2024). Mapping and valuing ecosystem services were conducted for the Habitat Quality Model, the Carbon Storage Model, and the Sediment Delivery Ratio Model (Natural Capital Project, 2024). Specifically, in order to create habitat quality maps, land cover maps were analyzed in conjunction with threats to species habitats. Regarding carbon storage, the model utilizes land use maps along with stocks in four carbon pools (aboveground biomass, belowground biomass, soil organic carbon, and dead organic matter) to estimate the quantity of carbon stored in a landscape. Furthermore, the Sediment Delivery Ratio (SDR) model was used to quantify and map the generation of sediment on land and its subsequent delivery to streams or water bodies. The required input data are Digital Elevation Model, erosivity factor, soil erodibility factor, land cover map cover-management factor (C), and support practice factor (P). The results demonstrated a clear correlation between the level of human intervention and the provision of these services. Specifically, forests and semi-natural areas were identified as significant contributors to ecosystem services, showcasing higher levels of habitat quality, carbon storage, and lower erosion.



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sciforum-096972: Effect of submerged vegetation on spatial structure of open-channel flow

Theodora P. Kalaryti ^{1*}, Nikolaos Th. Fourniotis ¹ and Efstratios E. Tzirtzilakis ²

¹ Department of Civil Engineering, University of the Peloponnese, 26334 Patras, Greece

² Department of Mechanical Engineering, University of the Peloponnese, 26334 Patras, Greece

Vegetation plays a vital role in natural open channels such as rivers, streams or artificial channels. In this work, a turbulent, sub-critical, open-channel flow ($Fr = 0.2$) with submerged rigid vegetation is numerically studied, using the ANSYS FLUENT code. The VOF method for free-surface treatment and the standard $k-\varepsilon$ turbulence model were used for the numerical simulation of the flow. The vegetation was modeled as vertical, rigid cylinders fixed at the bottom of the channel. Regarding the arrangement of the stems, two cases were examined. In the first case, a single vegetative stem was considered to be in the center of the channel, while in the second, a series of three equidistant vegetative stems were located transversely at the center of the channel. In both cases, the height of the stems was equal to one third of the flow, based on the normal depth of the corresponding open-channel flow. The results showed that the vertical velocity profile in the submerged vegetation layer is significantly different from that in the upper non-vegetation layer, which reasonably followed the log law. Specifically, the vertical velocity profile for the submerged vegetation layer shows an 'S'-shaped curve with its inflection point being close to the vegetation height. Furthermore, a slight drop in the free-surface where the vegetative stems are developed was observed. The structure of turbulence essentially affected in the neighborhood of the stems, leading to higher values of eddy viscosity at the near-crest area of each stem.



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sciforum-101735: Endemics and Invasives: a recent history of distributional range shifts in the fish fauna of the lower New River drainage, USA.

Stuart Welsh ^{1,*}, Daniel Cincotta ² and Nathaniel Owens ³

¹ U.S. Geological Survey, West Virginia Cooperative Fish and Wildlife Research Unit, West Virginia University

² West Virginia Division of Natural Resources (Retired)

³ West Virginia Division of Natural Resources

Invasive species are often central to conservation efforts, particularly when concerns involve potential impacts on rare, endemic native species. The New River drainage, which represents the upper reaches of the ancient Teays River, is delineated by Kanawha Falls, a well-documented zoogeographic barrier to fish distributions. The New River drainage begins in North Carolina, flows through western Virginia, and ends in southern West Virginia. The lower New River system in West Virginia is naturally depauperate of native fish species and it is nearly saturated with nonnative fish species: 32 natives including at least 8 endemics, and 62 nonnatives. Herein, we conducted time-series data analysis to examine chronological shifts in fish species distributions. Specifically, we documented range contractions of four endemic species in the lower New River system: Kanawha Minnow (*Phenacobius teretulus*), New River Shiner (*Miniellus scabriceps*), Appalachia Darter (*Percina gymnocephala*), and Candy Darter (*Etheostoma osburni*). We contrasted these findings with five nonnative species that have recently undergone rapid range expansions: Telescope Shiner (*Notropis telescopus*), Whitetail Shiner (*Cyprinella galactura*), Rainbow Darter (*Etheostoma caeruleum*), Roanoke Darter (*Percina roanoka*), and Variegated Darter (*Etheostoma variatum*). The endemic species are of conservation concern given limited distribution ranges and documented population declines. Although among-species comparisons of range shifts do not support causal inference, the documentation of changes in distribution ranges of endemic and invasive species are critical to inform conservation efforts.



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sciforum-097678: Evaluation of Meteorological and Hydrological Drought Indices and Their Effect on Hydroelectric Power Plants

Andres F. Villalba Barrios ^{1,2,*}, Oscar E. Coronado Hernández ³, Alfonso Arrieta ³ and Modesto Pérez Sánchez ⁴

¹ Hydraulic and Environmental Engineering Department, Universitat Politècnica de València, Valencia, 46022 Spain

² GICA Group, Department of Civil Engineering, Universidad Pontificia Bolivariana Campus Montería, Montería 230002, Córdoba, Colombia

³ Instituto de Hidráulica y Saneamiento Ambiental, Universidad de Cartagena, Cartagena 130001, Colombia

⁴ Hydraulic and Environmental Engineering Department, Universitat Politècnica de València, Valencia, 46022 Spain

Abstract: Climate change is a challenge for humanity. Meteorological drought is a climatic anomaly that is caused by a significant decrease in the amount of precipitation below normal averages, which affects the intakes of water supply systems and ecosystems. It can be evaluated through indices such as the Standardized Precipitation Index, Palmer Drought Severity Index, and Standardized Evaporation and Precipitation Index, among others. Hydrological droughts are a consequence of meteorological droughts and anthropogenic changes, which have a duration of about the time of concentration of the basins and can be measured through the Standardized Runoff Index. Drought indices in combination with mathematical models and models for future estimations can be used to provide tools for decision-making in general water resources management and specifically influence the establishment of operation policies for hydroelectric plants as important agents for the regulation of maximum and minimum flows in rivers. This research presents the analysis of drought indices for different regions of the world with rivers of controlled and uncontrolled flows by power plants, evaluating the incidence of droughts in the production of clean energy and water supply and their impact on ecosystems. From the current review, it has been observed that, in the dry periods evaluated in different regions of the world, the different drought indices have shown that in recent years, there has been an increase in the severity of droughts, where there has been a considerable decrease in rainfall and hydrological flows for the years evaluated, leading to greater difficulties in the impacted regions in terms of the provision and delivery of water for people, agricultural production, and the production of sustainable energies.



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sciforum-102835: Exploring Biodiversity in Macao's Urban Wetland Ecosystems through e-DNA Analysis

Leong Mikael Mei Kei *, Calheiros Cristina, Lau Yolanda Ieng Hou and Tagulao Karen

Institute of Environmental Science, University of Saint Joseph, Macau, China

Introduction

Macao, a densely populated region in China's southern coast, has experienced rapid urbanization, leading to significant fragmentation of wetland ecosystems. This transformation threatens local biodiversity and ecosystem services. Despite their diminished size, urban wetlands provide ecological benefits in the city. However, traditional biodiversity assessment methods are often impractical in these urban settings due to limitations. This study employs environmental DNA (eDNA) analysis to explore biodiversity in Macao's urban wetlands, aiming to provide comprehensive insights for conservation strategies in developed urban areas.

Methods

Water samples were collected from urban wetlands in Macao, sampling was conducted across multiple sites to account for the diversity of microhabitats and ensure comprehensive coverage. eDNA was extracted from the water samples and analyzed using metabarcoding techniques. Multiple genetic markers were used to identify various aquatic and terrestrial species. Bioinformatics pipelines were employed to process the sequencing data and match DNA sequences to taxonomic databases. Biodiversity indices were calculated to assess the complexity and structure of the biological communities in these urban wetlands.

Results

While specific results are pending, we hypothesize that eDNA analysis will reveal diverse species, including some previously unrecorded in traditional surveys. We expect to find native and non-native species, reflecting the complex dynamics of urban ecosystems. In addition, it integrates eDNA analysis with water quality assessments, focusing on key nutrient indicators. By abundance with water nutrient levels, this multi-faceted approach allows us to explore potential relationships between nutrient concentrations and biodiversity patterns.

Conclusions

This research demonstrates the potential of eDNA as a powerful tool for biodiversity assessment in urban wetlands. The findings will contribute to understanding biodiversity patterns in highly urbanized environments and targeted conservation efforts. By providing a comprehensive snapshot of Macao's wetland biodiversity, this study supports sustainable urban planning and water resource management in the face of ongoing development pressures.



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sciforum-097632: Improving hydrological dam safety analyses by using 2D hydrodynamic simulation to estimate the magnitude of historical floods with uncertainty

Daniel Carril Rojas ^{1,*}, Ramtin Sabeti ², Thomas R. Kjeldsen ² and Luis Mediero ¹

¹ Department of Civil Engineering: Hydraulics, Energy and Environment, Universidad Politécnica de Madrid, Madrid, Spain

² Department of Architecture and Civil Engineering, University of Bath, Claverton Down, Bath BA2 7AY, United Kingdom

The use of historical information about floods is crucial for improving and reducing uncertainty in hydrological dam safety analyses. Traditionally, hydrological analyses for estimating flood frequency curves have been based on simplified hydrometeorological methods and models with limited data, leading to flood quantile estimates with great uncertainties. However, historical information such as water level marks for high-magnitude floods too old to be included in contemporary flood time series recorded at gauging stations are usually available in settlements near existing dams. Incorporating the information about such floods could improve flood quantile estimates associated with high return periods, reducing estimate uncertainties and improving hydrological dam safety analysis.

Therefore, the aim of this study entails using 2D hydrodynamic simulations to estimate flood magnitudes associated with historical floods. A given water level can be generated by a set of flood hydrographs with differing peak flows, flood volumes, and durations. Two-dimensional hydrodynamic simulations allow us to characterise the uncertainty of flood peak and hydrograph volume estimates for historical floods. Such information is incorporated in flood frequency curve estimates.

This study was carried out in the River Douro in Spain. In this area, information about historical water level marks for several floods in the past are available in the reach between the San José Dam and the city of Zamora.

This first step focuses on the calibration and validation of the hydraulic model in the current situation, which were performed using the hydrological data available. It focuses on obtaining a suitable mesh, time step, and landcover for optimal simulation.

With the validated model, simulations will be conducted on historical flood events for which flood marks are available. Given flood hydrograph shapes will be rescaled with varying peak flows and durations to determine the flood hydrographs leading to the recorded water level heights of the flood marks.



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sciforum-097598: Investigation into the relationship between annual precipitation and runoff to the Tsimlyansk reservoir in the context of potential climatic changes

Vitaly Ilinich * and Vladimir Buber

"Land reclamation and water management complex" department, Federal Research Center of Hydraulic Engineering and Land Reclamation named after A.N. Kostyakov, Moscow, 127550 Russia

Many reservoirs employ multi-year regulation operational regimes. This raises the problem of the relationship between annual runoff and the primary runoff-forming factor (precipitation), as well as their long-term variability due to possible climatic changes.

The present study concerns the water balance of the Tsimlyansky reservoir, situated in the lower reaches of the Don River, which is subject to multi-year flow regulation. The objective of this study is to quantify the relationship between precipitation and inflow to the reservoir, expressed as annual values.

Statistical methods, including correlation analysis and data smoothing using moving averages, as well as wavelet transform filtering, were used to address the set tasks.

This study employed multi-year time series observations of precipitation and runoff to the reservoir, comprising a 56-year series for precipitation and a 142-year series for annual runoff. All series were formed as water management years (a 12 month cycle, from April to March of the following calendar year), in accordance with the water users' requirements.

In the course of this research, the correlation coefficient between the precipitation time series and a part of the annual runoff series of corresponding duration (years 1966/67-2021/2022) was determined. The correlation coefficient was found to be equal to 0.46, with a mean square deviation of 0.13, indicating a significant relationship between annual precipitation and annual runoff to the reservoir.

The studies also revealed cyclic components in both precipitation and runoff time series with a period of approximately 12 years. Cyclic components in the time series were detected using the following two distinct methodologies: a combination of data filtering using the moving average method with calculation of autocorrelation functions of smoothed series, and filtering the data using wavelet analysis methods. The presence of such components requires the results obtained to be taken into account when modelling the long-term use of reservoir water resources.



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sciforum-103334: Plastic Additives in Two Macroinvertebrate Species of the Ganga River: A Case Study Across the Habitat of the Endangered Gangetic Dolphin

Ruchika Sah *, Syed Ainul Hussain, Gautam Talukdar and Ruchi Badola

Ganga Aqua Laboratory, Ecotoxicology Laboratory, Wildlife Institute of India, Dehradun, Uttarakhand, 248002, India

Plastic pollution presents a critical environmental challenge, with plastic waste infiltrating natural ecosystems and posing severe threats to biodiversity and human health. The issue is further amplified by the leaching of plastic additives (PAs) into rivers from inadequately managed terrestrial plastic waste. This study examines the occurrence and bioaccumulation potential of selected PAs in two freshwater macroinvertebrates inhabiting the habitat of the endangered Gangetic Dolphin, within a densely populated, agriculturally intensive, and tourism-driven landscape.

This study focuses on the *Lamellidens marginalis* (bivalve) and *Filopaludina bengalensis* (gastropod) to assess their suitability as biological monitors of PA contamination in an effluent-impacted stretch of the Ganga River. Samples were collected along a 25 km stretch of the Middle Ganga Reach, and seven PAs, including Dimethyl phthalate (DMP), Diethyl phthalate (DEP), Di-n-butyl phthalate (DnBP), Butyl benzyl phthalate (BBP), Bis(2-ethylhexyl) phthalate (DEHP), Di-n-octyl phthalate (DnOP), and Bisphenol A, were quantified using UHPLC-MS/MS and GC-MS-MS.

The bioaccumulation patterns observed in both the macroinvertebrate species were DnBP > DEHP > DEP > DMP > BPA, with BBP and DnOP concentrations observed below detection limits. *L. marginalis* showed particular promise for site-specific assessments due to its sedentary nature, limited mobility, ease of sampling, and longer lifespan, which are advantageous for reflecting localized contamination and understanding long-term trends. Using *L. marginalis* as biomonitors for PA contamination can provide critical insights into pollutant levels and sources in the Ganga River, enabling targeted remediation efforts, assessing habitat quality, identifying pollution hotspots, and informing conservation strategies.

This study is the first to investigate PAs in wild macroinvertebrates of the Ganga River, providing critical insights that can inform targeted remediation efforts and support conservation strategies for the endangered Gangetic Dolphin by improving habitat quality and reducing pollutant exposure.



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sciforum-096683: The impact of degradation of linear water and sewage systems on the contamination of the aquatic environment with plasticizers

Małgorzata Kida *, Sabina Ziembowicz and Piotr Koszelnik

Politechnika Rzeszowska im. I. Łukasiewicza

Plastic pollution is now considered a global threat. Plastics introduced into the environment remain there for dozens or even hundreds of years. They gradually break down into smaller and smaller fractions, the so-called microplastics (MPs) that enter various environmental ecosystems such as soil, water and air. It is estimated that between 19 and 23 million tonnes of plastic end up in the ocean each year, representing less than 3% of the total amount of mismanaged plastic waste. In turn, the amount of this waste that is released into the environment is ten times greater (about 30% of the total). MPs entering rivers, lakes or dam reservoirs from land may pose a threat to the living organisms inhabiting them and entire ecosystems. The breakdown of microplastics in aquatic ecosystems leads to the release of toxic chemical substances into the aquatic environment. These substances, which are components of plastics, include plasticizers, stabilizers, pigments and flame retardants. This study presents research on the potential emission of plasticizers into the aquatic environment from water and sewage installations, such as sewer pipes and accompanying elements (gaskets). The conducted research confirmed that, depending on environmental conditions, phthalate esters are leached from microplastics originating from water and sewage systems. The reaction environment temperature and incubation time significantly influenced the degree of plasticizer leaching from the polymer matrix. An additional negative aspect of microplastic degradation in the aquatic environment was the emission of greenhouse gases, such as carbon dioxide and methane. To determine the parameters that had the greatest impact on the emission levels of the analyzed contaminants from microplastics, an environmental model sensitivity analysis was conducted based on Hellwig's information capacity index analysis.



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sciforum-103133: The influence of lowland pre-dams on riverine water quality - the cascade on the Cybina River in Poland case study

Renata Dondajewska-Pielka *, Michal Rybak and Emilia Matuszak

Department of Water Protection, Faculty of Biology, Adam Mickiewicz University in Poznan, Poland

A cascade of four preliminary small lowland reservoir was created in the course of the Cybina River in Poznan (Western Poland) in the end of the XXth century in order to improve the water quality before it reaches to the Maltanski Reservoir, where international rowing and canoeing competitions are held each year. The deposition of suspended solids together with planktonic cells as well as the uptake of dissolved nutrients by phytoplankton proliferating in the shallow reservoirs were supposed to aim at water transparency improvement and nutrient concentrations decrease. Unfortunately, thirty years after the cascade was formed, reservoirs became a highly eutrophic, with severe blooms during summer. The chlorophyll-a content reached over 300 mg m^{-3} in 2023, severely affecting the primary production in the reservoir situated below the cascade. At the same time, nutrient loads increased in the river downstream the cascade, as the ponds periodically supplied the river with additional 1,5 kgP per day and over 13 kgN per day. Climate changes, influencing the shortage of water in the Cybina River during warm months, also affect the water quality by increasing the water retention time and thus extending the blooms period. These results indicated an urgent need to undertake additional actions to improve the water purification in the system in order to maintain good water quality in the Maltanski Reservoir. Nature-based solutions shall be considered e.g. increasing the role of macrophytes in nutrient assimilation in the shallow reservoirs.



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sciforum-102973: Time series monitoring of Bakhtegan Lake changes and factors affecting it using satellite images on Google Earth Engine

Mina Mohammadi ^{1,*} and Reza Shah-Hosseini ²

¹ School of Surveying and Geospatial Engineering, College of Engineering, University of Tehran, Iran

² School of Surveying and Geospatial Engineering, College of Engineering, University of Tehran

Surface water monitoring using remote sensing images is important for understanding the impact of water on global ecosystems and climate change. Environmental changes and human interventions lead to significant environmental impacts that must be considered. Today, remote sensing satellite images have helped to monitor changes in various issues, including environmental issues. Using Landsat-5 and Landsat-8 images and the NDWI index, this research has investigated the changes in Bakhtegan Lake over two decades. The results show that the lake has dried up and, according to the "from-to" maps, a large percentage of the water has turned into salt, so the calculated lake's water surface area has decreased from 505 square kilometres in 2000 to almost 0 square kilometres by 2022. Therefore, the potential factors affecting lake changes were investigated using MODIS, GPM, FLDAS, and GRACE data. The results indicate that the changes in temperature, evaporation, and transpiration did not play an important role in the drying of the lake, but the reduction in the underground water level due to the digging of deep wells is known as the main cause of the drying of the lake. In order to restore the lake and prevent the transformation of salts into dust, it is suggested to prevent the extraction of water through well pumping in the catchment area of the lake and to limit its use for agricultural purposes.



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sciforum-103009: Transboundary rivers and their protection

Gulnara Mursal Hasanova

Azerbaijan Republic Ministry of Science and Education, Institute of Microbiology, Laboratory of Water microbiology.

Research was conducted in the Kura, Araz, Ganikh, and Okchuchay transboundary rivers. Seasonal monitoring was carried out in order to study the physico-chemical and microbiological condition of water in the studied rivers. River water temperature, pH, dissolved oxygen, nitrate, nitrite, ammonium, phosphorus concentration, and physico-chemical indicators of heavy metals, as well as the quantitative variability of microorganisms, saprotrophic, pathogenic, oil-phenol-absorbing bacteria and those involved in the nitrogen cycle bacteria, have been studied. Kura and Ganikh rivers are transboundary rivers that pass from the territory of Georgia to Azerbaijan. During the microbiological monitoring of rivers, it was determined that the amount of saprotrophic bacteria in river water corresponds to the classification of highly polluted waters from an ecological point of view. Thus, the results of chemical and microbiological analysis of water were higher than the TLV. Starting from Armenia, Okchuchay flows through the territory of Azerbaijan and joins the Araz River, which is the natural border between Iran and Azerbaijan, before flowing into the Caspian Sea. On the Armenian side, there are two large mining plants: Gajaran-Zangazur copper-molybdenum and Gafan iron ore processing plant. The waste water of these plants is regularly discharged into the river without treatment. As a result of our research, it became clear that the amount of saprotrophic bacteria, biogenic elements, and heavy metals in river water is extremely high; in particular, the amount of nickel is 5-7 times higher than normal, iron is 3-4 times higher, and copper-molybdenum is 2 times higher. Environmental pollution of river waters has a negative effect on biodiversity in the river, mainly causing mass destruction of trout and other fish in the river. From the research conducted in all four rivers, it can be concluded that the chemical and microbiological pollution in these rivers is at a high level.



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sciforum-097775: Unveiling the Mystery of Biofilm Formation: Insights from *Klebsiella* isolated from Hospital Wastewater vs. Surface Water

Sara Araújo ^{1,*}, Vanessa Silva ^{2,3,4,5}, José Eduardo ^{2,6,7}, Carlos Faria ⁸, Luis Maltez ^{2,7,9}, Gilberto Igrejas ^{3,4,5} and Patricia Poeta ^{2,5,6,9}

¹ Microbiology and Antibiotic Resistance Team (MicroART), Department of Veterinary Sciences, University of Trás-os-Montes and Alto Douro (UTAD), 5000-801 Vila Real, Portugal

² Microbiology and Antibiotic Resistance Team (MicroART), Department of Veterinary Sciences, University of Trás-os-Montes and Alto Douro (UTAD), Vila Real, Portugal

³ Department of Genetics and Biotechnology, University of Trás-os-Montes and Alto Douro, Vila Real, Portugal

⁴ Functional Genomics and Proteomics Unit, University of Trás-os-Montes and Alto Douro (UTAD), Vila Real, Portugal

⁵ Associated Laboratory for Green Chemistry (LAQV-REQUIMTE), University NOVA of Lisboa, Lisboa, Portugal

⁶ Veterinary and Animal Research Centre, Associate Laboratory for Animal and Veterinary Science (CECAV), University of Trás-os-Montes and Alto Douro (UTAD), Vila Real, Portugal

⁷ Associate Laboratory for Animal and Veterinary Science (AL4AnimalS), University of Trás-os-Montes and Alto Douro (UTAD), Vila Real, Portugal

⁸ Diretor do Serviço de Instalações e Equipamentos do CHTMAD, Constantim, Vila Real, Portugal

⁹ Veterinary and Animal Research Centre, Associate Laboratory for Animal and Veterinary Science (AL4AnimalS), University of Trás-os-Montes and Alto Douro (UTAD), Vila Real, Portugal

The worldwide increase in antimicrobial-resistant bacteria (ARB) presents a significant medical challenge and has emerged as one of the most critical concerns of our era. Antibiotic-resistant *Klebsiella* has emerged over the past few decades as a major public health threat. The prevalence of bacterial infections associated with biofilm formation is significant, accounting for approximately 65-80% of all cases. Given this scenario, this study investigates the prevalence of biofilm formation in *Klebsiella* isolated from surface waters and hospital wastewaters. In total, 77 samples were collected from surface waters in North Portugal, of which 33 *Klebsiella* (14 *Klebsiella* spp. and 19 *K. pneumoniae* strains) were isolated. Furthermore, 44 samples were collected from hospital wastewaters in Northern Portugal, of which 41 *Klebsiella* (25 *Klebsiella* spp. and 16 *K. pneumoniae* strains) were isolated. Biofilm production was evaluated using the microtiter plate assay. In surface waters, isolates of *Klebsiella* spp. and *K. pneumoniae* produced moderate biofilm biomass, with similar averages of biofilm formation percentages (83.1% and 86.9%, respectively). In *K. pneumoniae* strains, 65% (n=13) were confirmed as weak producers, 10% (n=2) were moderate, and 25% (n=5) were strong biofilm producers. Likewise, regarding *Klebsiella* spp., 35.7% (n=5) were weak producers, 57.1% (n=8) were moderate, and 7.1% (n=1) were strong biofilm producers. These were positive results, as the presence of biofilm-producing strains complicates infection treatment, given that antibiotics cannot eliminate the biofilm, only addressing the infection symptoms. With this, it is concluded that understanding and addressing biofilm formation is crucial for developing effective strategies for preventing and treating bacterial infections. Furthermore, detecting and controlling the spread of these and employing a One Health approach are vital for managing this problem effectively.



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Session 2. Hydrodynamics, Hydraulic Transients, Hydropower and Pumped Storage in Water-Energy Nexus

sciforum-096946: Optimizing Water Resources for Enhanced Electricity Production: A Case Study in Croatia's Karst Region

Krešimir Pavlič * and Borna-Ivan Balaž

Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb

The Dinaric karst, a globally recognized geological phenomenon, is prominent in the Republic of Croatia; it is characterized by numerous karst fields known for their exceptional water quality and quantity. This region hosts the highest concentration of hydroelectric power plants in Croatia, reflecting its significance in electricity production. With increasingly extreme precipitation events and surface runoff patterns, there is a growing interest among energy institutions to optimize water utilization. Leveraging natural features like karst fields as managed retentions presents a viable solution.

A specific focus lies on the catchment area surrounding the Gojak hydroelectric power plant near Ogulin, Croatia, where several karst fields experience seasonal flooding. However, uncontrolled water runoff leads to Lake Sabljaci overflowing. To address this issue, a proposal involves controlled water release from the Drežnica field to minimize losses and enhance water management efficiency. The initial step includes sealing the abyssal zone of the field and constructing a hydrotechnical facility for regulated water release.

By integrating the Drežnica field as a retention area alongside the existing infrastructure at the Gojak hydroelectric power plant, a more efficient water management system can be established. This coordinated approach aims to maximize the utilization of water resources for electricity generation, while reducing wastage through uncontrolled overflow. Ultimately, this strategy underscores the sustainable utilization of natural resources to enhance energy production in the region.



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sciforum-088421: Advancing the Water–Energy Nexus: Hydropower's Role in Poland's Renewable Energy Strategy

Paweł Kut ^{1,*} and Katarzyna Pietrucha Urbanik ²

¹ Department of Heat Engineering and Air Conditioning, Rzeszow University of Technology, Al. Powstancow Warszawy 6, 35-959 Rzeszow, Poland

² Department of Water Supply and Sewerage Systems, Faculty of Civil, Environmental Engineering and Architecture, Rzeszow University of Technology, Al. Powstancow Warszawy 6, 35-959 Rzeszow, Poland

This paper investigates the integration of hydropower within Poland's waterenergy nexus, emphasizing its contribution to the country's renewable energy mix and sustainability goals.

Introduction

Amidst Poland's energy transition, hydropower presents an opportunity to balance renewable energy production with water management practices.

Methods

Utilizing a mixed-methods approach, we analyze data from Poland's energy sector, policy documents, and case studies of hydropower projects.

Results

The analysis underscores hydropower's potential to enhance Poland's energy stability, reduce carbon emissions, and support sustainable water management. However, it also identifies barriers such as environmental concerns and regulatory challenges.

Conclusions

Hydropower is pivotal in Poland's energy landscape, offering a renewable solution that aligns with both energy security and environmental sustainability objectives. For optimal integration into the national energy strategy, future efforts should focus on innovative technologies to minimize ecological impacts and enhance the efficiency of hydropower systems. This study highlights the necessity for policy frameworks that support the development of hydropower within the water–energy nexus, ensuring Poland's successful transition towards a more sustainable and resilient energy future. For optimal integration into the national energy strategy, future efforts should focus on innovative technologies to minimize ecological impacts and enhance the efficiency of hydropower systems. This requires a collaborative approach involving stakeholders across sectors to address regulatory, environmental, and technological challenges. Additionally, the adoption of advanced hydropower technologies and practices can serve as a model for other countries looking to harness the water–energy nexus for sustainable development.



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sciforum-103345: Air Management in Pressurized Water Systems: Practical Considerations

Elias Tasca * and Helena M. Ramos

Department of Civil Engineering, Architecture and Georesources, CERIS, Instituto Superior Técnico, University of Lisbon, 1049-001 Lisbon, Portugal

The conveyance of water typically involves the transport of dissolved air, air bubbles, or air pockets that naturally occur or are introduced during the operation of the system. Air management in pressurized systems is complex due to various intervening factors, making comprehensive solutions challenging to achieve. Solutions include taking advantage of the dissolution of air in water, utilizing flow drag to carry air, employing protective equipment like air valves, and implementing monitoring strategies and operational controls. The wide range of potential situations involving air, along with their dependence on system characteristics and operational procedures—which can vary considerably during the system's lifetime—highlights the complexity of air management in pressurized systems. The interactions between air and water—either beneficial or detrimental—during unsteady, quasi-steady, and steady flows, including air admission, expulsion, forward and backward air movement, stagnation, and dissolution and release, remain critical areas of scientific and practical interest. This work aims to systematize the inspection and assessment of pressurized systems to identify air sources and management solutions, ultimately providing a framework for enhancing system efficiency, reliability, and safety. Moreover, this work provides practical examples from engineering practice and from experimental and numerical studies that highlight relevant issues related to air in pressurized water systems.



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sciforum-097679: An approach to the dominant frequency of coherent structures in macroturbulent flows

Claudio Antonio Fattor ^{1,*} and Raúl Antonio Lopardo ²

¹ Hydraulic Structures Division, Hydraulics Laboratory, National Water Institute (Argentina)

² Former President of National Water Institute (Argentina)

The macroturbulent dissipation in hydraulic jumps is accompanied by pressure fluctuations that act on the component structures of the stilling basin (slabs and anchors, walls) and on the forced dissipation elements (chute blocks, baffle piers and end steps) and may exposed them to fatigue, vibrations and cavitation due to pressure pulses. The National Water Institute (Argentina) has developed extensive research on pressure fluctuations in macroturbulent flows, contributing to define the influence of fluctuating pressures on the design of hydraulic jump stilling basins.

Macroturbulent energy dissipation generates dynamic actions on the component slabs, which are exposed to small relative displacements and the kinetic energy can be partially transformed into additional sub-pressure. Dimensionless coefficients related to fluctuating forces and moments were obtained by means of instantaneous measurements on piezometric taps distributed on an area that represents different rectangular slabs. Free hydraulic jumps on horizontal stilling basins downstream of a vertical sluice gate were considered, with Froude numbers between 3 and 6.

The characteristics of the coherent structures of the hydraulic jump downstream of a bottom gate were contemplated, considering the longitudinal position along the stilling basin. The autocorrelation coefficients of fluctuating forces were analyzed for different sizes of slabs, determining the magnitude of the time scale of the turbulence and the peak frequency of main vortices at different positions along the bottom.

A first conclusion is that Strouhal numbers coincide with those determined through energy density spectra obtained from records of fluctuating pressures. In addition, the slabs are subjected to stresses whose frequency is approximately constant for values of dimensionless size of slabs less than a critical value, and invariant with a distance up to 70% of the length of the hydraulic jump, adopting a monotonically decreasing trend towards downstream. Finally, pressure wave celerities are somewhat higher than those determined for jumps formed downstream of spillways.



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sciforum-103228: Computational Enhancement of Water Distribution Network Analysis and Optimization Models through Topological Simplification

Cristian Alexander German ^{1,*}, Pedro Luis Iglesias Rey ² and Francisco Javier Martínez Solano ²

¹ Doctorado en Ingeniería del agua., Dpto. de Ingeniería Hidráulica y Medio Ambiente, Universitat Politècnica de València, Camino de Vera, s/n, 46022 Valencia, Valencia, España

² Escuela Técnica Superior de Ingeniería Industrial, Dpto. de Ingeniería Hidráulica y Medio Ambiente, Universitat Politècnica de València, Camino de Vera, s/n, 46022 Valencia, Valencia, España

Water distribution network models are crucial for the effective management and operation of water distribution systems. Current technology enables the creation of detailed models of complex networks, often requiring the use of optimization tools for the repeated analysis of network behavior. Simplifying these models offers several advantages, including reduced computational time and easier decision-making for network managers. This paper presents a methodology based on six simplification algorithms that achieve up to an 80% reduction in network elements, while maintaining a high efficiency index for validation and using set point curves to represent the simplified elements.

The methodology employs graph theory to analyze and optimize water distribution networks. Simplifications range from the elimination of parallel pipes and terminal nodes to the sectorization and simplification of blocks with multiple inputs and outputs. The simplification process ensures hydraulic equivalence between the simplified model and the original network.

The impact of network simplification on the management and operation of water distribution systems is evaluated through various operational scenarios with different control elements and allowable error percentages. The results indicate that the proposed simplification methodology provides practical tools for network managers, contributing to better practices in water resource management and enhancing the efficiency and effectiveness of water distribution network operations.



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sciforum-101576: Computational Fluid Dynamics for Simulation of Large-Scale Pipeline Filling Processes

Duban A. Paternina-Verona ^{1,*}, Oscar E. Coronado-Hernández ² and Vicente S. Fuertes-Miquel ³

¹ School of Civil Engineering, Universidad del Sinú, Cartagena / 130014, Colombia

² Instituto de Hidráulica y Saneamiento Ambiental, Universidad de Cartagena, Cartagena / 130015, Colombia.

³ Department of Hydraulic Engineering and Environment, Universitat Politècnica de València, Camino de Vera S/N CP, 46022 Valencia, Spain.

Computational fluid dynamics has been used as a tool to simulate multiphase fluids in pressurized pipelines. This tool has been limited for the simulation of experimental-scale processes by different authors to understand transient phenomena in pipes with pressurized flow with entrapped air. Today, few CFD models have been used in the industrial sector and in research for hydraulic operations in large-scale pressurized pipelines with entrapped air, since there are some gaps in the pursuit of an adequate protocol for the simulation of hydraulic processes in pressurized pipelines from an industrial approach and cases that can be used to test CFD modelling.

This study shows the use of a two-dimensional CFD model to understand the filling processes of a large-scale pipeline, taking hydraulic conduction in Valencia, Spain, which has a length of 485 m and an air valve, as a case study. This CFD model is performed using a VoF method for air and water. The model is also calibrated by means of mesh quality analysis, according to some hydraulic modelling protocols stipulated by some expert researchers in hydraulic infrastructure simulation, and subsequently validated with pressure and velocity measurements. This CFD model shows relevant information on the processes of interaction between air and water, allowing pressurized flow conditions, and free flow in some sections of the pipeline, as well as air expulsion processes through the air valve, to be identified.

The study contributes to the foundation of the hydraulic modeling of large-scale networks using CFD tools, allowing the visualization of air--water interactions, which is difficult to analyze in existing or planned pipeline infrastructures, as well as the identification of new insights that can improve the design and operational strategies of large-scale pipeline infrastructures.



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sciforum-097152: Hydraulic assessment of treatment wetlands using CFD-DEM simulations

Lineker Max Goulart Coelho ^{1,*} and Kesley Antônio dos Santos ²

¹ Technical University of Denmark - DTU, Dept. of Engineering Technology, Ballerup, 2750, Denmark

² Post-Graduation Program in Civil Engineering, Centro Federal de Educação Tecnológica de Minas Gerais, Belo Horizonte, MG, Brazil

A treatment wetland (TW) is a nature-based solution for wastewater treatment that utilizes engineered systems to enhance processes that naturally occur in the environment. Computational Fluid Dynamics (CFD) is a consolidated technique used to design and perform the optimization of wastewater treatment systems. However, few CFD studies have addressed TW as this requires additional assumptions to properly include the porous flow modeling. This study aims to investigate the hydraulic patterns in horizontal subsurface flow treatment wetlands by using CFD coupled with the discrete element method (DEM), which provides a detailed representation of flow movement and porous media. The simulations were carried out in the software CFD-DEM. In terms of model settings, laminar flow and unsteady simulation were assumed. A case study using a 2 m long pilot-scale treatment wetland was used, as this model was previously validated for this setup. In order to support the design of a system with higher flow rates, three different flow rates were applied to check the differences in the system from the point of view of hydraulic behavior, in terms of flow direction, preferential flows, and hydraulic retention time. The results of the three scenarios were compared and a significant change was noted in the hydraulic behavior from the lower to the higher flow rate applied. The CFD-DEM simulations were effective to model the hydraulic patterns of the case under study and shown to be a good approach to accurately investigate hydraulics in TW, enabling operation optimization.



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sciforum-097169: Hydrogen and pumped energy storage impact in hybrid systems for small communities: Marruge case study

José Ernesto Quintos Fuentes ^{1,*}, Alban Kuriqi ² and Helena M. Ramos ²

¹ Mechanical Engineer department (DEM), Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisbon, Portugal

² CERIS, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais 1, 1049-001, Lisbon, Portugal

Remote communities face challenges related to traditional power grids and distribution systems. Centralized generation and long-distance transmission cause energy losses and higher tariffs, and they affect the lifestyle in these villages. Local energy generation based on hybrid renewable sources and storage systems offers a solution. This approach not only reduces losses but is also a solution to the recent wave of negative or no electricity prices on the spot electricity market, as it adds flexibility and reliability to the system. By generating their electricity, communities can reduce their reliance on a centralized grid, mitigating the impact of price volatility. Microgrids that combine renewable energy with storage methods give communities further options. This study is divided into two main parts. The first part is a theoretical study on the integration of energy storage systems, particularly pumped storage power plants and hydrogen storage, in decentralized systems with more than one renewable generation source (hydropower and/or wind power and/or solar energy), detailing the main requirements and the technologies involved. The second part focuses on the application of these systems to an existing energy development plan for Marruge, a small municipality in northern Portugal threatened by desertification. Based on the generation and surplus forecast, two storage systems were dimensioned and optimized through simulations with the WaterGems/Hammer software. The main storage system is a pumped storage system supplemented by a hydrogen storage system. Improvements to the storage system were achieved by integrating a ram pump to increase the pressure in the hydrogen system using a hydropneumatic tank. Compared to a scenario without storage, better adjustment of the demand and supply curves was demonstrated. In the context of a local hydrogen economy, additional benefits for the community could be achieved by extending the payback period and shortening the payback period.



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sciforum-102599: Multi-criteria optimization modeling of hybrid energy solutions for the water-energy nexus

João Soares Tavares Coelho ^{1,*} and Helena Ramos ^{2,3}

¹ Instituto Superior Técnico

² CERIS – Civil Engineering Research and Innovation for Sustainability, Instituto Superior Técnico

³ DECivil – Instituto Superior Técnico

The developed model is a mathematical algorithm that manages different energy sources for the water-energy nexus. The work comprises the definition of the model and the mathematical algorithm that executes the system's simulation. Subsequently, the optimization algorithm is defined for Excel Solver (single-objective) and Python (multi-objective). The model is designed to be applicable to a diverse range of hybrid energy systems, particularly in conjunction with pumped hydropower storage. It focuses on the energy and water balance between subsystems to manage and simulate the performance throughout time. To conclude the algorithm development, the model was tested on a case study. The experiment was conducted on a 24-hour consumption irrigation field. The model was used to explore a variety of scenarios involving different energy sources, including photovoltaic, wind, PHS, grid, and battery (off-grid) technologies. The results demonstrated that a system integrating photovoltaic, wind, PHS, and the grid is the most economically and environmentally viable option, exhibiting the lowest grid consumption compared to a scenario solely relying on PV and PHS. A third scenario was tested, in which the grid was replaced with a battery energy storage system (BESS), thus providing an off-grid solution. Despite reducing carbon emissions, the system encountered challenges in meeting the full demand for water and energy. The scenarios that envisage the implementation of the electric grid permit the sale of surplus renewable energy, including photovoltaic (PV) and wind, during periods of low demand. This contributes to a reduction in costs. It is the scenario with both solar and wind that benefits the most from these conditions, as it can reproduce a positive grid cash flow throughout the year for higher water allocations.



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sciforum-096961: Navigating the water – energy nexus: a mathematical approach

Moses Kayanda Kiteto ¹ and Cleophas Achisa Mecha ^{2,*}

¹ Renewable Energy, Environment, Nanomaterials and Water Research Group, Department of Chemical and Process Engineering Moi University, P.O. Box 3900-30100, Eldoret, Kenya

² University of Arizona

As the demand for water and energy increases, the interdependency between these two resources, known as the water-energy nexus, becomes a pressing concern. Energy is required for water treatment and distribution, while virtually all energy production processes require significant amounts of water. Renewable energy sources now make up nearly 38% of the world's total energy consumption, indicating a sharp increase in recent years driven by the growing awareness of the depletion of non-renewable energy and the destructive impact of fossil fuels. However, these energy plants require substantial amount of water, primarily for cooling, stressing the already limited water resources. Conversely, the emergence of new persistent contaminants has necessitated the use of advanced, energy-intensive water treatment methods. Coupled with the energy demands of water distribution, this has significantly strained the already limited energy resources. Therefore, it is important to understand both the water footprint of renewable energy technologies as well as the energy consumption associated with water treatment and distribution. Regrettably, no straightforward, universal model exists for estimating water usage and energy consumption in power and water treatment plants respectively. Current approaches rely on data from direct surveys of plant operators, which is often unreliable and incomplete. This study evaluates the potential of mathematical modeling and simulation in the water-energy nexus. We formulate a mathematical framework and subsequent simulation in Java programming to estimate the water use in hydroelectric power and geothermal energy and the energy consumption of the advanced water treatment processes, particularly the advanced oxidation processes (AOPs) and membrane separation processes and water distribution considering the hydrodynamics and hydraulic transients. The paper also addresses the challenges and prospects of actualizing mathematical modeling and simulation to the water-energy nexus. The findings of this study demonstrate mathematical modeling and simulation as reliable approach in navigating the complexities of the water-energy nexus.



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sciforum-103225: Optimization of gravitational water vortex turbine design using Computational Fluid Dynamics simulation analysis

Syam Kishor K S

Department of Physics, Government College, Ambalapuzha, University of Kerala

Gravitational Water Vortex Power Plants (GWVPPs) are an innovative and sustainable energy solution that harnesses the kinetic energy of water vortices created in basin structures, which can be either cylindrical or conical. This study aims to enhance the performance of the vortex turbine, a critical component of GWVPPs, by optimizing its design parameters. In this study, we used the conical basin structure. The research was conducted using Computational Fluid Dynamics (CFD) simulations in COMSOL Multiphysics, focusing on various configurations of the turbine blades. Specifically, we analyzed the effects of blade length, blade inclination angle, and turbine height on the turbine's efficiency and flow behavior. Through detailed simulation studies, we observed that the performance of the vortex turbine is significantly influenced by these parameters. The optimal configuration was found to be a blade inclination angle of 8 degrees, a blade length of 28 cm, and a turbine height of 35 cm. This configuration achieved the highest efficiency, reaching up to 55%. The simulation results provide valuable insights into the relationship between the turbine's geometric design and its performance metrics, highlighting the potential of GWVPPs as a low-cost, environmentally friendly power generation option. This study's findings contribute to the advancement of renewable energy technologies by demonstrating the feasibility and efficiency of using optimized vortex turbines in GWVPPs, thereby supporting sustainable energy initiatives.



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sciforum-097770: Pump hydro storage in the integration of intermittent renewables in water drinking systems

Miguel Tavares ^{1,*}, Modesto Sánchez ², Dídía Covas ³ and Helena M. Ramos ³

¹ Instituto Superior Técnico, University of Lisbon

² Universitat Politècnica de València

³ Instituto Superior Técnico, Ceris, University of Lisbon

This research aims to study the best technical-economic solution, for a hydropower plant located on Madeira Island. In this system exists three reservoirs. The first is in Covão, which supplies water for a small community and the others are located in Socorridos, where there is a turbine and a pump, and in Santa Quitéria, which contains another turbine. From Covão to Socorridos, there is only one pipe, which means the water is pumping and turbinning along the operation day.

Simulations were developed in EPANET, to understand the pressure and velocity variations, along the entire system depending on the population needs. For these simulations, it was defined the pump and turbine characteristic curves.

This case study integrates solar and wind energy to compensate the pumping costs. Several scenarios were tested, to obtain the best solution.

In the optimization multipurpose project, it was used the Excel Solver to estimate the operation of the system and to increase the NPV. To solve this problem six different solutions were tested, varying the daily volume to turbine in Socorridos.

It was studied the integration with other energy renewable sources and selected a small land with approximately 5 ha near Covão, to install these energy sources. It was considered an average wind speed at 10 m height and the energy that is possible to produce by each solar panel with 787 Wp, along the day, for the selected location.

Based on this information, it was calculated the minimum number of wind turbines and solar panels, that is necessary to satisfy the energy consumption, for each scenario. The optimal solution was obtained based on the optimization function to maximize the NPV or the profit.



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sciforum-087551: Sustainable Water–Energy Nexus Solutions for Pakistan

Muhammad Faizan * and Rana Ammar Aslam

Department of Structures and Environmental Engineering, University of Agriculture Faisalabad, 83060, Pakistan

Water and energy are each recognized as indispensable inputs for the sustainable development and economic growth of any country. Efficient water management and renewable energy can improve sustainable development and energy efficiency by advocating for the multifaceted integration of systems to optimize the utilization of water and energy resources.

The proposed integrated systems include smart water management for the real-time monitoring of water flow and quality, coupled with a leak detection mechanism to reduce wastage and associated energy costs. The incorporation of on-site renewable energy sources, such as solar or wind, is used to power the water treatment plants, thereby reducing reliance on convenient energy, as is the implementation of the pumps-As-turbine (PAT) system for energy recovery from the water networks. In a real case study in Africa, the Nampula water supply system, located in Mozambique, was selected as having promising potential for energy recovery. The application of a pumps-as-turbine (PAT) systems allows for a reduction in the initial system costs and its environmental impacts,. The micro-hydropower (MHP) project, with a capacity of ~23MWh/year, indicates significant efficiency gains. The economic analysis reveals an impressive internal Rate of Return (IRR) of ~40%, dependent on the energy selling price. The environmental benefits are also significant, with the potential avoidance of over 12 tons of CO₂ emissions and a reduction in real losses by more than 10,000 m³/year, contributing to a total economic benefit of 7604 EUR/year, particularly in the African context.

This study emphasizes the need for proactive policy and regulatory frameworks that incentivize the adoption of water and energy-efficiency technologies. Public awareness and education campaigns play a crucial role in promoting responsible consumption practices and reducing overall resource demand. By integrating these technologies into a cohesive strategy, not only Pakistan, but also similar developing countries, can optimize water and energy use, promoting sustainability and environmental stewardship.



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sciforum-097519: The Design and Analysis of a Water Distribution Network Using WaterGEMS in an Urbanised Area

Usman Aliakbar Mohseni ^{1,*}, Sahil Harshal Acharya ², Makarand Vijay Kadam ², Rutik Nana Dighe ² and Rajesh Sambhaji Kumbhare ²

¹ PhD Research Scholar, Indian Institute of Technology Roorkee

² UG Student, Viva Institute of Technology

Water is an essential requirement for all, and is particularly critical in urban areas like Virar's Chikhaldongari, where the demand is significant. The water distribution network plays a crucial role in supplying water to all users amidst the city's growing population. To meet increasing demands, advanced computing systems, including modern hydraulic modeling and design software, are essential. In this study, WaterGEMS software was employed to evaluate and enhance the water distribution system's serviceability in Chikhaldongari. This includes steady-state analysis to determine hydraulic parameters such as pressure, velocity, head loss, and flow rate. Rapid urbanization exacerbates the pressure on existing networks, necessitating a forecast-based assessment of future water requirements. Therefore, to account for the growing population, this study also projects a population of approximately 28,783 by 2031 using arithmetic and geometric methods, growing to 39,773 and 40,189 by 2061, respectively. These data notify the need to design a new distribution system to meet future demand, assess current flaws, and optimize system efficiency. The WaterGEMS model incorporates 94 pipes covering 17.917 km and 94 demand nodes serving 17,792 end users. The simulation identifies critical areas with inadequate water supply pressure, guiding targeted infrastructure improvements. The main achievement of this research is that the new distribution system not only satisfied the anticipated water demand, but also made sure that the water delivery system would be durable and long-lasting. The research's novelty is characterized by its use of sophisticated modeling tools, dynamic simulation, comprehensive network analysis, future demand forecasting, focus on safety and sustainability, and targeted infrastructure improvements. In conclusion, the application of advanced modeling tools like WaterGEMS is pivotal in enhancing water distribution networks, ensuring they meet evolving demands sustainably. This proactive approach not only addresses current challenges but also prepares the infrastructure for future growth, thereby supporting the community's well-being and development.



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Session 3. Estuaries, Coasts and Ports

sciforum-100599: Predicting Water Scarcity and Drought with a Deep Learning Integrated Model: A Comprehensive Analysis of Hydrological Data

Zhenqing Su * and Ziyao Fang

The Graduate School of Global Business, Kyonggi University, Suwon-si 16227, Republic of Korea

Water resource management is critical for sustainable development and is essential for the smooth functioning of ecosystems and human activities. Yet, water scarcity and drought can severely impact water supplies and agricultural productivity. Consequently, there is an urgent need for accurate predictions of water scarcity and drought conditions. Despite this, few studies have used machine learning to predict water scarcity and drought accurately. Therefore, this study collected daily hydrological data from January 1, 2016 to March 24, 2023, totaling 21,120 observations. In light of this, we developed a deep learning integrated model (CNN-BILSTM-AM) that combined an attention mechanism (AM), a convolutional neural network (CNN), and a bi-directional long-term and short-term memory network (BILSTM) to predict water scarcity and drought. The outcomes demonstrate that the integrated CNN-BILSTM-AM model effectively captures the nonlinear and time-varying characteristics of water scarcity and drought. With excellent adaptability to random sample selection, data frequency, and sample structure breaks, its prediction accuracy (with a value of 95.09%) significantly outperforms that of the traditional and single models. This study expands the knowledge of machine learning in water resource management and extends the research into the prediction of water scarcity and drought. It provides decision support and risk management tools for water resource managers, agricultural stakeholders, and government decision-makers.



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sciforum-097713: Mapping of the distribution of ecosystem services in the Ebro Delta

Ana Genua-Olmedo, Jorge Rodríguez Rosa * and Inmaculada Rodríguez-Santalla

Departamento de Biología, Geología, Física y Química Inorgánica, Escuela Superior de Ciencias Experimentales y Tecnología (ESCET), Universidad Rey Juan Carlos, 28933 Móstoles, Spain

Coastal wetlands are rich and dynamic ecosystems that provide a variety of essential ecosystem services. They act as natural filters, improving water quality by retaining sediments, nutrients, and contaminants, which contributes to water quality regulation. They also protect the coast against flooding, buffering the impact of waves during storms and minimizing coastal erosion risks. Additionally, they are important carbon sinks, helping to mitigate climate change by storing large amounts of carbon in their sediments and vegetation. Coastal wetlands provide unique habitats for numerous species of flora and fauna, including many that are endemic or endangered. The Ebro Delta, located on Spain's Mediterranean coast, is one of the largest and most biodiverse wetlands in Europe, offering numerous ecosystem services beyond those already mentioned. This region is a productive agricultural area, known for its high-quality rice. Furthermore, its coastal waters are rich in fish and shellfish, providing an important source of food and employment for local communities. However, the Ebro Delta faces significant challenges due to human activities, such as the regulation of the Ebro River, and climate change, with large floods associated with storms that have caused the loss of extensive areas of its coastline. These conditions underscore the need for conservation and sustainable management strategies to preserve its valuable ecosystem services. The purpose of this work is to establish a detailed cartography of the distribution of ecosystem services and their role in the natural system of the delta, as a crucial tool to address effective conservation and management strategies appropriate to the delta space. Additionally, there should be an emphasis on educational efforts to gain the support of the delta's inhabitants and their involvement in the management of its resources.



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sciforum-102848: A schematised numerical model of beach cusp evolution in My Khe beach, Da Nang, Vietnam

Minh Anh Vu ¹, Hong Son Hong Truong ² and Khanh Linh Phan ^{3,*}

¹ Faculty of Civil Engineering, Department of Coastal Engineering, Thuyloi University

² Faculty of Civil Engineering, Department of Hydraulic Structures, Thuyloi University

³ Faculty of Civil Engineering, Department of Geotechnics, Thuyloi University

The formation, maintenance, and development of beach cusps are among the most challenging morphological and physical processes in hydrodynamics and coastal morphology. Many unanswered questions remain despite extensive research, data collection, measurement, and modeling of these coastlines. A study of the My Khe coastal region revealed that beach cusps, ranging from 150 to 200 meters, mainly form during the transitional period from the southwest monsoon to the northeast monsoon. To gain further insight, a two-dimensional numerical experiment model for beach cusp formation was constructed using the elevation and hydrodynamic data of the area in the Xbeach model. Simulation results show the crescent-shaped cusps' initial formation and subsequent development trends from an initially flat state during the transitional period. The horn and bay features of the beach cusps first formed in the offshore area. The size and spacing of these cusps match the observed scales in reality. The initial period, when the water level first rises, is when the formation and development of the cusps seem most pronounced. As the water level increases, the cusps shift gradually towards the shore. This process is hypothesized to repeat when the sea level drops in the next cycle. As a result, a series of cusps gradually moves towards the shore.



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sciforum-103280: Artificial Reef Design: Integrating Biological and Aesthetic Features for Conservation and Water Management

Ricardo Luz ^{1,2,*}, Cristina Sousa Coutinho Calheiros ² and Ermanno Aparo ¹

¹ ESTG, Escola Superior de Tecnologia e Gestão, Instituto Politécnico de Viana do Castelo, Viana do Castelo, Portugal

² Interdisciplinary Centre of Marine and Environmental Research (CIIMAR/CIMAR), University of Porto, Portugal

The growing disconnection between people, economic activities, and natural ecosystems weakens the relationship with the environment and its intrinsic value. In the face of climate, energy, and biodiversity crises, it is essential to seek new approaches to mitigate the negative effects of human practices. This study intends to evaluate the integration of artificial reefs implemented in two ways: in-water (ARIW) and out-of-water (AROW). ARIW has the function of protecting ecosystems and promoting biodiversity, while AROW acts as a decorative consumer good, financing ARIW and increasing consumers' environmental awareness. In addition, ARIW can be designed with sensors to monitor aquatic habitats and incorporated into bioactive systems to contribute to water management and purification in hydrological systems.

The objectives include evaluating how artificial reefs with biological and aesthetic characteristics influence communities' connection to water ecosystems and increase environmental awareness, examining the viability and durability of the materials used to produce the reefs, and developing guidelines for implementing replicable reefs in different ecological systems and water bodies. The methodology covers a literature review, material selection, digital modeling, and prototype iteration, with the support of experts in aquatic biology. This project aims at demonstrating how design can be a catalyst for sustainable value chains and innovative business models, promoting conscious consumption, water management, and environmental conservation.

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sciforum-103376: Assessing Coastal Vulnerability to Oil Spills Using GNOME and GIS Analysis

Asimakis Nestoras Karagiannis * and Dimitra Kitsiou

Laboratory of Environmental Quality and Geospatial Applications, Department of Marine Sciences, School of Environment, University of Aegean, University Hill, 81100, Mytilene, Greece

Oil spills are a serious hazard to coastal ecosystems and communities, with severe socio-economic and biological consequences. In Greece, with a coastline of more than 15,000 km and exceptionally active maritime traffic, there is a high possibility of accidents that could cause oil spills. In this paper, three different oil spill scenarios of different severities were modeled using GNOME (General NOAA Operational Modeling Environment), a set of modeling tools for predicting the trajectory and fate of marine pollutants and determining which coastlines would be most affected by an accident. The incidents modeled occurred in Saronikos Gulf, Thermaikos Gulf, and near the island of Kithira. Additionally, wind and current data were incorporated into the process to predict the trajectory and impact of the spills. An Environmental Sensitivity Index (ESI) was used to assess which parts of the affected areas were most vulnerable to the pollution using the socio-economic, physical, and biological characteristics of the coastline. The model outputs were finally compared to the Environmental Sensitivity Index to delineate areas where high oil concentrations overlapped with those of high vulnerability.

The oil spill modeling showed that in Saronikos Gulf, high concentrations of oil reached vulnerable and non-vulnerable areas. For Kithira, oil reached Antikithira Island, although with a minimal impact. In Thermaikos Gulf, low concentrations of oil reached the vulnerable coastline of the beach close to Katerini. These results showed that the proposed methodology was able to assess the impact of an oil spill on the coastline by modeling its fate and identifying the vulnerability of the area. The presented methodology could help to improve emergency response strategies, as well as dealing with the impact of marine pollution.



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sciforum-104683: Diagnosis of the Presence of Plastic Pellets on Beaches in the Bay of All Saints/Bahia

Lusanira Nogueira Aragão de Oliveira ^{1,*}, Alarcon Matos de Oliveira ² and Celia Regina de Gouveia Souza ¹

¹ Department of Geography, Faculty of Philosophy Letters and Human Sciences, University of São Paulo. São Paulo, São Paulo Brazil, CEP 05508-080

² Earth sciences, State University of Bahia – UNEB Campus II – Alagoinhas, Bahia, Brazil, CEP 48005-880

Coastal and marine environments are being impacted by the significant presence of marine debris, particularly plastics. Plastic pellets (small beads/spherules of polymer resins produced from chemical processing for the base plastic industry) serve as an example of materials or waste that may be inadvertently released into the environment during manufacturing, transportation, and storage processes. This study aimed to develop a preliminary assessment of the presence and dispersion of plastic pellets on beaches in the Bay of All Saints (BAS). Eight beaches within the BAS were selected, with six located within the bay and two facing the Atlantic Ocean. These beaches were chosen because many are close to sources of pellet emissions, such as ports and plastic-producing industries, as well as oil and petrochemical platforms. The research methods employed included bibliographic research, cartographic analysis, and fieldwork conducted during the winter of 2023. A total of 74 sampling points were established across the eight beaches in the BAS for sand collection. The results indicate the presence of pellets on seven of the eight studied beaches. Starting from ports and industries as the primary sources of emissions, a correlation was observed between the distance from these sources and the beaches, the occurrence of meteorological-oceanographic events (storm surges), spatial distribution, and general characteristics, with the highest concentration gradients observed at Praia do Farol da Barra, Praia da Costa, Barra Grande, Cabuçu, Praia do Sol, Itaparica, and São Tomé de Paripe. No pellets were found at Praia de São Francisco do Conde.



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sciforum-096968: Estimation of suspended sediment concentration with MODIS images in coastal mangrove areas

Hai Trung Le ^{1,*}, Hùng Anh Nguyễn ², Son Hong Truong ³ and Khánh Duy Mai ⁴

¹ Faculty of Civil Engineering - Thuyloi University, 100000, Ha Noi, Viet Nam

² Vietnam Academy of Water Resources, 100000, Ha Noi, Viet Nam

³ Faculty of Civil Engineering, Thuyloi University, 100000, Ha Noi, Viet Nam

⁴ Institute of Civil Engineering - Thuyloi University, 100000, Ha Noi, Viet Nam

Coastal areas are where land interacts with the sea, with many complicated processes taking place, especially where mangroves exist. Governed by various drivers, sediment movement also plays an important role regarding hydrodynamics, the ecological environment, aquaculture, fisheries, etc. The suspended sediment concentration (SSC) is often considered to affect water quality, mangrove development and sometimes landscape attraction. To determine the SSC, direct measurements and/or sampling and laboratory tests are required. Therefore, it is costly to estimate the SSC continuously and in large areas.

In contrast, Remote Sensing (RS) inversion can possibly provide observations simultaneously at a large scale and within a specific period. As a result, the inversion of the SSC in the surface layer of coastal areas using RS techniques has become more and more reliable and popular. The Moderate-Resolution Imaging Spectroradiometer (MODIS) is a satellite-based sensor that is used for measurements of the Earth and climate. This study singularly retrieves the red band of MODIS images to provide the values of reflectance, along with data derived from field measurements, for a coastal mangrove area of Bac Lieu province, part of the Mekong Delta. These two datasets are then analyzed to explore any relationship between them. As a result, a regression model is proposed to predict the values of the SSC at the same location for periods without field data.



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sciforum-103333: Floating wetland Islands in Port marinas

Cristina Sousa Coutinho Calheiros ^{1,*}, Cristina Marisa Ribeiro Almeida ² and Ana Paula Mucha ²

¹ Interdisciplinary Centre of Marine and Environmental Research (CIIMAR/CIMAR), University of Porto

² Interdisciplinary Centre of Marine and Environmental Research (CIIMAR/CIMAR), University of Porto, Novo Edifício do Terminal de Cruzeiros do Porto de Leixões, Avenida General Norton de Matos, S/N, 4450-208 Matosinhos, Portugal

Floating Wetland Islands (FWIs) are innovative, nature-based solutions designed to improve water quality and enhance biodiversity in aquatic environments. These artificial islands float on water bodies and are typically constructed using buoyant materials like recycled plastics, foam, or natural substances such as cork. The surfaces of FWIs are planted with a variety of aquatic and semi-aquatic plants, creating a floating garden that mimics natural wetlands. The plants and associated microorganisms play a crucial role in phytoremediation, providing water depuration when contaminants are present, such high concentrations of nitrogen and phosphorus, heavy metals, and others.

In port marinas, FWIs can be particularly valuable. These environments often face challenges such as water pollution from boat traffic and runoff containing hydrocarbons and other contaminants. By installing FWIs, marinas can improve water quality and create more attractive and ecologically rich spaces. The research and development of FWIs is expanding, with ongoing studies focusing on optimizing plant species selection, island design, and placement to maximize ecological and aesthetic benefits. As a versatile and sustainable tool, FWIs are gaining recognition for their potential to enhance ecosystem services in various aquatic environments, from freshwater lakes to saline coastal areas. *Acknowledgments: Authors are thankful to Strategic Funding UIDB/04423/2020, UIDP/04423/2020 and LA/P/0101/2020 through national funds provided by FCT.*



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sciforum-097477: Investigating the Dynamics of Microplastics in Marine Water and its Uptake in Fish: A Comparative Study of Waterborne Contaminants

Pardha Saradhi Ayyangar Eyyunni

Department of Zoology, Andhra University, Andhra Pradesh 530003, India

The dynamics and prevalence of microplastics in marine water and their absorption by fish in these habitats is a major threat to marine ecosystems. This study focuses on investigating microplastic dynamics in marine waters and their uptake in fish. Water and fish samples were collected from Kumbhabhishekam Port, Kakinada, which is a coastal region with significant industrial and maritime activities. Sampling density was ensured by collecting samples at five strategic points, including areas near industrial discharges, commercial ports, and relatively cleaner zones, with sampling intervals of 1.5 km along the coast. Water quality was assessed using the Water Quality Index (WQI), which integrates parameters such as pH, dissolved oxygen, turbidity, nitrates, and phosphates. The samples are collected and comprehensively analyzed for microplastics. Fourier transform infrared (FTIR) spectroscopy and Gravimetric analysis were employed to identify and quantify microplastics. We found significant accumulation of microplastics in the sea water, as well as within the gills, tissues, and gut of fishes. These particles have the propensity to adsorb harmful pollutants, thereby exacerbating the overall water pollution levels. The presence of microplastics in the water body and their accumulation in fish raises concerns about the transfer of contaminants to higher trophic levels of the food chain and their associated food webs, including humans. This study highlights the impact of waterborne contaminants to marine water. These alarming results underscore the importance of proactive measures to protect our water resources and emphasizes the urgent need for comprehensive mitigation strategies to combat the hazardous accumulation of microplastic dynamics, which, along with their absorption, poses a significant threat to biodiversity and ecological balance and their potential implications for our marine ecosystem.



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sciforum-097228: On Assessing the Exposure of Urban Coastal Areas to Storm Surge Flooding: Application at Miami Metropolitan Area (Florida, USA)

Christos V. Makris ^{1,*}, Yannis S. Androulidakis ¹, Zisis C. Mallios ¹ and Villy H. Kourafalou ²

¹ School of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki 55124, Greece

² Rosenstiel School of Marine Atmospheric and Earth Science, University of Miami, Miami 33149-1031, Florida, USA

The scope of this study is to evaluate the interannual spatial variability in impacts from coastal inundation due to seawater flooding over characteristic urban settings and important residential areas of Miami (South Miami-Dade County, Florida, USA). Our analyses refer to the recent 30-year period from 1994 to 2023. The aim is to identify in great detail (i.e., at the property and building scales) all the important environmental and socioeconomic implications recognized as important factors in the sustainability of coastal environments. In this work, we also validate an updated version of the CoastFLOOD model for littoral inundation and apply it in very high resolution (dx=1-2m) throughout the densely populated urban area around Biscayne Bay, including Miami Beach areas that are more exposed to the storm surges of the Atlantic Ocean. Moreover, we investigate the long-term variability in and trends of Sea Level Elevation measured by tide-gauge records. We further assess the 50- up to 1000-year return values of Total Water Level (TWL) on the coast, and finally we map the respective inundation patterns over coastal low-land areas. New metrics of exposure to flood impacts at the building and property levels are introduced and post-processed for portrayal via high-resolution GIS maps. The main motivation of this study is to contribute to a better understanding of climatic impacts along the exposed coastal areas of Miami supporting local stakeholders' and real-estate actors' needs for focused research on the impacts on public plot-holdings and implications for individual properties' prices and insurance fees.



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sciforum-102695: Per- and Polyfluoroalkyl Substances (PFASs) on marina surface waters from the Douro River, Portugal

Vânia E Amorim ^{1,*}, António César Ferreira ², Catarina Cruzeiro ³ and Patrícia G Cardoso ⁴

¹ Department of Biology, Faculty of Sciences, University of Porto, Porto, Portugal

² Centro de Biotecnologia e Química Fina (CBQF), Laboratório Associado, Escola Superior de Biotecnologia, Universidade Católica Portuguesa, Rua Diogo Botelho 1327, 4169-005 Porto, Portugal

³ Faculdade de Engenharia da Universidade do Porto

⁴ Interdisciplinary Centre for Marine and Environmental Research (CIIMAR/CIMAR), University of Porto, Matosinhos, Portugal

PFASs, often referred to as "forever" chemicals, are widespread in various environments, including soils and aquatic systems, due to their extensive use. Surface waters in several European countries, particularly in marinas and ports with heavy boat traffic, need further investigation as potential sources of contamination. Reliable methods for the extraction and quantification of these emerging compounds are crucial. This study aimed to enhance an existing solid-phase extraction method for analyzing surface water from marinas and ports with varying salinities (2, 9, and 17 PSU).

The objectives were to 1) optimise the solid-phase extraction method, considering matrix salinity effects and cross-contamination; 2) validate the extraction and quantification method for 18 EPA 537.1 PFASs in estuarine surface waters, using Ultra-High-Performance Liquid Chromatography–Quadrupole Time–Of–Flight Tandem Mass Spectrometry, and 3) apply the optimised method to PFAS quantification in three Portuguese marinas.

All the ICH criteria were successfully validated at 9 PSU. The limits of quantification ranged from 117.80 ng/L to 385 ng/L, with the exception of that for PFHpA (645.85 ng/L). The PFAS levels (PFOA, HFPO-DA, PFBS, PFHxS, and PFOS) were relatively low, with a maximum of 0.32 ng/L observed only for PFOA. In Freixo Marina, the total average concentrations were slightly higher (Σ PFAS= 1.02 ng/L) compared to those found in Cais da Ribeira Port (Σ PFAS= 0.94 ng/L) and Afurada Marina (Σ PFAS= 0.81 ng/L). The PFOS concentrations were below the limit values set by the Environmental Quality Standards (36000 ng/L of PFOS for inland surface water), similar to findings in other Portuguese river studies. This study facilitated the development of a precise and reliable method for the extraction and quantification of PFASs in estuarine surface waters, particularly from marinas. This method can be readily applied to analyzing PFASs in other estuarine samples.



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sciforum-097090: Sediment Dynamics in a Semi-Arid Mediterranean Area and Their Impact on Coastal Stability: A Case Study of West Cyprus

Stamatia Papasarafricanou ^{1*}, Giada Varra ², Luca Cozzolino ² and Ourania Tzoraki ³

¹ Department of Science and Technology, University of Napoli Parthenope

² Department of Engineering, University of Napoli Parthenope

³ Department of Marine Sciences, University of the Aegean

The coastal sediment supply of insular basins involves a dynamic process influenced by intermittent rivers and has a crucial role in shaping beaches. In the Mediterranean, many areas are semi-arid and have intermittent rivers with low sediment regimes. The nature of sediment delivery from these rivers influences coastal stability and ecosystem services. The coastal area of Coral Bay, Potamia, west Cyprus (~10 km in length) is a tourist zone facing coastal erosion issues, according to previous studies. The sediment budget depends on four small intermittent rivers that flow into this coastal zone, covering a total drainage area of ~66.0 km². Human actions impact the sediment balance; for example, the Mavrokolympos stream has been dammed upstream, trapping sediments in the reservoir. Estimating the amount of sediment transported from the watershed to rivers is vital for evaluating catchment erosion, as well as for understanding the supply dynamics to the adjacent coastal zone. This study uses the empirical method of USLE (Universal Soil Loss Equation) to estimate soil erosion from basins to rivers. Subsequently, the SDR (Sediment Delivery Ratio) module estimates river sediment supply to their outlet. Sediment yield is of particular importance because it is directly related to the quantity of sediment that is transported and accumulated on the beach. The annual soil loss for the basin is 9.23 t ha⁻¹ yr⁻¹, and the annual sediment yield deposited at the basin's outlet is 325 t km⁻¹ yr⁻¹. The results reveal the relationship between watershed processes and coastal zones in terms of sediment transport and coastal conservation. By balancing sediment supply, we can mitigate negative impacts and promote sustainable development in coastal and riverine environments.



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sciforum-096910: The effect of wind on tidal circulation in the Gulfs of Patras and Corinth

Alexandra G. Aspioti * and Nikolaos Th. Fourniotis

Department of Civil Engineering, University of the Peloponnese, 26334 Patras, Greece

The Gulfs of Patras and Corinth, located in central western Greece, bordering with the Ionian Sea to the east and the Corinth Canal to west, are examined as a unified system. This semi-enclosed hydrodynamic system is divided by the Rio-Antirio strait, which is a microtidal environment. Based on 3D simulations using MIKE 3 FM (HD), the combined action of wind- and tide-induced flow was studied in the whole basin of the system. At the open boundaries, tidal astronomical constituents were used as boundary conditions, and steady light winds of 4 m/s for all the directions of the wind were considered. The action of the tide under the effect of wind generates a characteristic structure of the flow. Cyclonic and anticyclonic eddies form in the Gulf of Patras and in Nafpaktos Bay, during the ebb tide and under the SW wind; meanwhile, as strong wind-induced currents form near the shore, according to the direction of the wind, and the tidal flow moves from the east to the west of the system. The remaining part of the Gulf of Corinth remains nearly unaffected. The action of the NE wind and the flood tide form a similar flow structure, although the structure of the eddies is altered. Moreover, comparing the exchange flow rate between the gulfs for N, NE, and NW winds with the purely tidal flow, it has been shown that all these winds oppose the exchange flow rate, while S, SE, and SW winds favor the exchange flow rate at the strait. Our study of this system reveals that the Gulf of Patras and the western area of the Gulf of Corinth are mostly affected by the combined action of wind and tide, leaving the central part of the Gulf of Corinth unaffected. The wind action also affects flow characteristics between the gulfs, by opposing or favoring the exchange flow rate at the Rio-Antirio strait.



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sciforum-102910: UAV-Based Analysis of Beach Cusp Morphology and its Relationship to Hydrodynamic Forcing: A Case Study at the Central Coast of Vietnam

Van Luc Nguyen *, Hong Son Truong and Trung Viet Nguyen

Department of Hydraulic Engineering, Faculty of Civil Engineering, Thuyloi University, Zip Code 100000, Ha Noi, Viet Nam

The central coast of Vietnam, characterized by diverse terrain and climate, provides a good natural laboratory for studying beach cusps' complex formation and evolution. This study investigates the key hydrodynamic and morphological parameters that strongly influence beach cusps' formation and evolution mechanism. First, to quantify the morphological characteristics of beach cusps, high-resolution Unmanned Aerial Vehicle (UAV) imagery was captured weekly at multiple sites along the My Khe coast. Key 2D and 3D features of the beach cusp, including cusp spacing, depth, amplitude, and elevation, were extracted from these images and validated using detailed one-meter digital elevation models (DEMs). Concurrently, incident wave characteristics, including wave heights, wave periods, and wave directions, were recorded at each location. Moreover, important hydrodynamic and morphological parameters were collected, such as water level, tidal components, and sediment characteristics. The primary factors driving beach cusp formation and evolution mechanisms are better clarified by examining the spatial and temporal variability of cusp features in relation to hydrodynamic and morphodynamic conditions. A notable finding is the strong relationship between cusp spacing and changes in incident wave direction and energy induced by headlands. The curved coastline sheltered by headlands experiences reduced incident wave angle and energy, resulting in smaller and shallower cusps than exposed areas. The most pronounced beach cusp is recorded in the transition from the protected to the exposed coastline. A conceptual model of the beach cusp was then constructed in a coupled XBeach and Delft3D model. The model integrates field observations and theoretical models that can be used to explore the relationship between incident wave patterns, sediment characteristics, and coastal geomorphology, which contribute to the development of rhythmic shoreline patterns.



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sciforum-095677: Unraveling the community diversity from bacteria to zooplankton in a highly polluted coastal lagoon

E. Gozde Ozbayram ¹, Zuhale Zengin ¹, Ayça Oğuz Çam ¹, Zeynep Dorak ¹, Latife Köker ¹, Ibrahim Halil Miraloğlu ², Reyhan Akçaalan ¹ and Meriç Albay ^{1,*}

¹ Department of Marine and Freshwater Resources Management, Faculty of Aquatic Sciences, Istanbul University, Istanbul, 34134, Turkey

² Massive Bioinformatics R&D Technologies, Istanbul, 34662, Turkey

Coastal lagoons, characterized by their rich biodiversity and productivity, play a vital role in ecosystem services such as climate regulation, food production, etc. Since they have limited water exchanges and long hydraulic retention times, they are ecosystems highly vulnerable to anthropogenic factors and the accumulation of pollutants. In this study, we aimed to investigate the impact of Hydrogen Sulphur (H₂S) concentration and salinity infusion on the community diversities of bacteria, phytoplankton and zooplankton of a hypereutrophic coastal lagoon, Küçükçekmece Lagoon, located in Istanbul (Türkiye). Surface water samples were collected from three sites, along with samples from various depths (surface, 9 m and 18 m) throughout the water column in June 2022. The bacterial community structures were assessed by 16S rRNA gene-targeted sequencing using MinION (ONT), and phytoplankton and zooplankton diversities were analysed by microscopy. The results showed that the communities in the surface waters and the middle layer of the lagoon were quite similar. However, there was a clear shift in the community structure of the samples collected from the deepest part (18 m), which was under anoxic and high salinity conditions. The bacterial community was predominated by *Sulfurimonas* (15%), *Sulfurovum* (7%), and *Draconibacterium*, (7%) which can be related to the anoxic conditions and high H₂S concentration (20.39 mg/L). The results revealed that the responses of phytoplankton and zooplankton communities to the salinity increase were significant. Dominant phytoplankton, *Cylindrotheca closterium*, and dominant zooplankton, *Acartia clausii*, found in the deeper layer with high salinity are generally known as indicators of marine pollution. Although there were historical data on physicochemical properties and zooplankton and phytoplankton community diversities in this lagoon, this research provides the first extensive examination of such community structures, including the bacterial community of this lagoon, and lays the groundwork for future research in this aquatic ecosystem.



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sciforum-097643: Vulnerability and Conservation of Coastal Heritage in the Context of Climate Adaptation and Tourism: A Review

Aliki Gkaifyllia *, Thomas Hasiotis and Ourania Tzoraki

Department of Marine Sciences, University of the Aegean, 80100 Mytilene, Lesvos, Greece

Coastal regions are rich in cultural heritage due to their historical significance as hubs of human activity and play a vital role in enhancing local economies through tourism. The intersection of natural beauty and historical importance creates unique and valuable cultural landscapes. However, these historical sites face risks from natural and human impacts, including climate change (CC), rising sea levels, and industrial development. The Mediterranean coastal regions are rich in cultural heritage, reflecting millennia of human history, diverse cultures, and significant historical events. Therefore, this research focuses on the complex interdependencies between coastal vulnerability, sustainable tourism, ecosystem services, and erosion phenomena due to CC. Recent research shows climate change threatens Mediterranean cultural heritage, with up to 30% of African sites predicted to be at risk by 2050, a 25% increase in vulnerabilities at Nora, Sardinia, and 40% of sites in Basilicata, Italy, at risk from erosion. To assess the susceptibility of coastal heritage sites to climate impacts and develop adaptive strategies for conservation, methodologies such as remote sensing, GIS, 3D photogrammetry, and stakeholder engagement are employed. These approaches help analyze historical and future shoreline changes, air pollution effects, and ecosystem services, offering comprehensive insights into integrated coastal zone management and sustainable development. This work aims to provide valuable recommendations for policymakers, heritage managers, and stakeholders, contributing to the integrated management and preservation of coastal heritage sites in the face of growing environmental challenges.



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Session 4. Urban Water, Treatment Technologies, Systems Efficiency and Smart Water Grids

sciforum-094119: “Optimization of Synthesis Parameters for Enhanced Photocatalytic Degradation of Methylene Blue Dye Using g-C₃N₄/ZnO Nanocomposites: A Study on the Influence of Temperature and Time Interval”

Suneel - - ^{1,*} and Qazi Inamur Rahman ²

¹ Research Lab-B043, Department of Chemistry, Integral University, Kursi Road Lucknow, Uttar Pradesh 226026, India

² Assistant Professor, Department of Chemistry, Integral University, Kursi Road Lucknow, Uttar Pradesh 226026, India

Background

The synthesis temperature and duration were shown to impact the physicochemical properties and photocatalytic performance of the g-C₃N₄/ZnO (g-CN/ZnO) nanocomposites. Higher temperatures ($\approx 400^\circ\text{C}$) and longer reaction times ($\approx 2\text{--}4$ hours) generally led to better crystallinity, surface area, and visible light absorption of the nanocomposites, resulting in improved photocatalytic degradation of MB dye compared to pure ZnO or pure g-CN.

Objective

The primary object of the present work is to synthesise g-CN/ZnO at different temperatures with different time intervals and then assess its photocatalytic activity against methylene blue dyes.

Methods

g-C₃N₄/ZnO nanocomposites will be synthesised with a certain weight of urea and zinc acetate through the thermolysis method by varying the temperature: 400°C for 1 hour (S1), 400°C for 2 hours (S2), 500°C for 3 hours (S3), and 550°C for 4 hours (S4). Properties like functional groups; particle size, shape, surface morphology, and surface area; porosity of the composite; phase purity; crystalline nature; and band gap were analysed using FTIR, SEM, TEM, BET, XRD, UV-visible, and DRS techniques. For Photocatalytic activity tests, 0.001 gram g-CN/ZnO was immersed in 100 mL of the MB solution, and then the solution was continuously stirred in the dark for 20 min to reach the equilibrium state of adsorption, followed by placing it in sunlight.

Results and Conclusions

Fabricated nanocomposites have an appearance of light yellow (S1 and S2), whereas S3 and S4 have a creamy colour. The percentage yields of S1, S2, S3, and S4 are 26.1%, 25.39%, 12.12%, and 3.2%, respectively. The photocatalytic performance of MB dyes in sunlight is S1S2S3, and the results indicate that the temperature and duration of the g-CN/ZnO nanocomposites' synthesis play a key role in determining their structural, optical, and photocatalytic properties for the degradation of methylene blue dye under visible-light irradiation.



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sciforum-103212: Combined removal and degradation approaches for the decontamination of bisphenol A in water

Tolulope Waliu Okuselu ^{1,2,*}, João Lopes ^{2,3}, Ricardo Lagoa ^{2,3} and Dorinda Marques-da-Silva ^{2,3}

¹ ERASMUS MUNDUS Joint Master's Degree in Environmental Contamination and Toxicology; University of Basque Country, Spain

² School of Technology and Management, Polytechnic Institute of Leiria, Morro do Lena-Alto do Vieiro, 2411-901 Leiria, Portugal

³ Laboratory of Separation and Reaction Engineering-Laboratory of Catalysis and Materials, School of Technology and Management, Polytechnic Institute of Leiria, Morro do Lena-Alto do Vieiro, 2411-901 Leiria, Portugal

Bisphenol A (BPA) is an endocrine-disrupting chemical recognized by its inherent toxicity that has been found in the effluent of wastewater treatment plants. Thus, there is an urgent need for decontamination processes targeting wastewater effluent containing BPA. In this work, we combined previous experience using adsorbent materials [1] and catalytic systems [2] to tackle this challenge.

The aim of this study was to implement a combined process for BPA water removal using alginate spheres containing activated carbon (AS-AC), followed by its enzymatic degradation using Laccase as the enzymatic system. For this, AS-AC were prepared as before [1] and tested as adsorbent material for the water removal of 5 mg/L of BPA for 24 h at room temperature. Desorption assays were achieved using ethanol for 24h and followed up by enzymatic catalysis of desorbed BPA with the Laccase enzyme for 24h at room temperature. The quantification of BPA was carried out using a reverse-phase HPLC analytical system containing a C18 column.

The AS-AC were shown to be an efficient material for the removal of BPA from an aqueous solution, attaining removal rates above 90%. The desorption of BPA from the AS-AC using ethanol was achieved with a desorption rate of 60%. And, finally, total degradation of the desorbed BPA was achieved with Laccase in the presence of ethanol, which suggests the efficiency of this enzyme in transforming the pollutant.

In conclusion, it was possible to demonstrate that the sequential combination of different approaches such as adsorption, desorption, and enzymatic degradation allows for BPA elimination from water, which could be very interesting for further applications. Still, the desorption process needs to be improved to obtain better efficiencies, and other emerging pollutants should also be investigated to understand the application spectrum of this system.

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sciforum-103317: A Review on Applications of Water Retention Polymers for Improving Water Use Efficiency in Agriculture

Muhammad Safdar ^{1,*}, Uzair Abbas ², Rehan Mehmood Sabir ¹, Nalain E Muhammad ³ and Hafiz Muhammad Bilawal Akram ⁴

¹ Agricultural Remote Sensing Lab (ARSL), Department of Irrigation & Drainage, University of Agriculture, Faisalabad, 38000, Punjab, Pakistan

² Agricultural Remote Sensing Lab (ARSL), University of Agriculture, Faisalabad, 38000, Punjab, Pakistan

³ Department of Irrigation & Drainage, University of Agriculture, Faisalabad, 38000, Punjab, Pakistan

⁴ Department of Agronomy, University of Agriculture, Faisalabad, 38000, Punjab, Pakistan.

Water scarcity and long-term water management practices are critical in agricultural systems around the world. Water retention polymers (WRPs) provide exciting alternatives for improving agricultural water use efficiency (WUE). WRPs, or hydrogels, are polymer substances that absorb and hold a considerable amount of water. The review investigates the efficiency of several types of WRPs, such as synthetic polymers, natural polymers, & composite materials, in enhancing WUE. WRPs can considerably increase soil water retention, allowing plants to have more water and reducing irrigation intensity. They also aid in the prevention of water loss due to evaporation and runoff, so conserving water resources & lowering environmental impacts. WRPs have a variety of applications, including seed coating, soil supplements, and irrigation systems. Understanding how WRPs interact with soil features is critical for optimizing WRPs and customizing their use to specific soil & crop requirements. However, affordability, impact on the environment, breakdown, and long-term impacts on soil health as well as plant development are all considered. Finally, WRPs have the potential to significantly improve WUE in agriculture by increasing water availability, minimizing water loss, and optimizing irrigation practices. More research and field studies are required to evaluate their efficacy across various agro-climatic areas and cropping systems, and to assess their lasting impact on soil and ecosystem health.



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sciforum-102510: Assessment of public perception on water quality in Islamabad, Pakistan

Muhammad Ahmad ^{1,*}, Asif Sajjad ¹, Akhtar Ali ¹ and Ravabi Tariq ²

Department of Environmental Sciences, Quaid-i-Azam University, Islamabad

Introduction

Water contamination is a pressing challenge at the global scale. Along with other neighbours, Pakistan is not an exception among other countries, where protecting water resources and battling pollution are critical issues. Significantly, urbanization and industrialization due to the exponential growth of the population is intensifying the situation. So, public understanding of pollution and its implications is necessary. This is why this study sought to evaluate the public's understanding of water quality, contamination sources, and related obligations in Islamabad, Pakistan.

Materials and Methods

An investigation of the various sociodemographic elements influencing the perception of water pollution (POWP) was carried out through a questionnaire survey. These variables were used in conjunction with the statistical analysis programs SPSS and R to examine the effects of these variables on the community's opinion of the quality of the drinking water and how it affects human health.

Results

The results show that between 60 and 70 percent of the people in the research region were aware of the quality of the water and the risks that are linked with it. Notably, 76 percent of them agreed that there is a connection between water pollution and health problems. Higher income and educational levels were associated with a noticeably better comprehension of the health effects of water pollution. Worrisomely, diarrhoea turned out to be the most common waterborne illness.

Conclusions

This study highlights the potential use of public perception for policymakers in developing interventions for water management and behavioural change strategies, emphasising social and technological drivers, in addition to tackling the urgent issue of water pollution and scarcity.



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sciforum-102462: Clustered Regularly Interspaced Short Palindromic Repeats technology (CRISPR) novel Bioremediation Tool in Water bodies

Mamatha Bhanu L S

Assistant Professor, Department of Biotechnology, Yuvaraga's College, University of Mysore, Mysore

The increasing demand for water resources and sustainable water supply planning have sparked interest in reusing produced water, offering economic, social, and environmental benefits, especially in water-scarce regions. Genome editing technologies are revolutionizing wastewater treatment, removing contaminants, heavy metals, and hydrocarbons, benefiting water environmental fields and attracting increased interest in the oil and gas industry. Genome editing techniques may lead to the development of microbial bioremediation technologies, crucial for controlling environmental pollution in aquatic environments, despite challenges posed by variable and stressed environments. Genomic engineering techniques optimize microbial metabolic pathways and enhance enzymatic activities, but rely on selectable markers like herbicide, anti-metabolite, and antibiotic resistance genes (ARGs), posing environmental risks. This paper explores the use of TALEN, ZFNs, and especially CRISPR Cas9 as gene editing tools for wastewater bioremediation, focusing on specific microbes. CRISPR technique enhances genome editing efficacy, versatilities, and orthogonalities by complementarity of targeted sequence with gRNA and associated protein's endonuclease activities. CRISPR techniques are not yet widely used in the field of water environment microbiology due to its complexity, heterogeneity, and variability. CRISPR technologies may bring breakthroughs in environmental microbial technologies, but future efforts must minimize off-target cleavage, expand PAM recognition, and mitigate gene release risks. This review highlights the practical application of CRISPR techniques in water environmental microbiological processes, including microbial community balance engineering, wastewater treatment system optimization, and selective pollutant-to-chemical bioconversion.



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sciforum-097372: Photo-degradation of reactive blue dye (171) by $\text{TiO}_2/\text{Fe}_2\text{O}_3$ photocatalysis under visible light irradiation

Zeinab Ahmed Suliman ^{1,*}, Cleophas Achisa Mecha ² and Josphat I Mwasiagi ³

¹ Renewable Energy, Nanomaterials and Water Research Group, Department of Manufacturing, Industrial and Textile Engineering, Moi University, Eldoret, Kenya

² Renewable Energy, Nanomaterials and Water Research Group, Department of Chemical and Process Engineering, Moi University, Eldoret, Kenya

³ Department of Manufacturing, Industrial and Textile Engineering, Moi University, Eldoret, Kenya

Organic dyes are widely employed globally by the chemical and textile industries. The need to handle water effluent from the dyeing process, to mitigate environmental pollution, cannot be overemphasized. For instance, reactive blue dye is extensively utilized in the textile sector, and controlling its disposal and degradation is crucial in safeguarding the environment. Titanium (IV) tetraisopropoxide was used to synthesize titanium dioxide TiO_2 , which was then doped with ferric oxide Fe_2O_3 to create a co-doped $\text{TiO}_2\text{-Fe}_2\text{O}_3$ photocatalyst. This photocatalyst was employed to degrade blue dye in water under sunlight irradiation. The characterization of the photocatalysts was performed using various techniques: Fourier Transform Infrared (FTIR) Spectroscopy to determine the chemical composition, Scanning Electron Microscopy (SEM) to examine the morphology, X-ray Diffraction (XRD) to assess the crystallinity, and UV-vis Diffuse Reflectance Spectroscopy (DRS) to analyze the light absorption properties. Doping TiO_2 with Fe_2O_3 reduced the photocatalyst's bandgap from 3.76 eV (in pure TiO_2) to 2.83 eV, enhancing its absorption properties in the visible light spectrum, as confirmed by UV-DRS. This improvement in light absorption is consistent with the degradation results of the blue dye, achieving a complete 100% removal efficiency after 120 minutes of sunlight irradiation. This study demonstrates that the photocatalyst is chemically stable and can be reused multiple times. After four cycles, the removal efficiency decreased by less than 15%, indicating its durability and reusability. The doped photocatalyst exhibited increased efficiency in harnessing solar energy to generate electron-hole pairs, resulting in superior photocatalytic activity. This method eliminates the need for electricity, making it both eco-friendly and cost-effective.



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sciforum-097546: Revitalizing Pond Waste: A Novel Approach with Floating Wetlands and Electrolysis for Sustainable Agriculture, Including Wastewater Polishing

Amman Khokhar ^{1,*} and Fraz Nayyar ²

¹ University of Agriculture Faisalabad, Faisalabad, Punjab, 38000, Pakistan

² Department of Farm Machinery and Power, University of Agriculture Faisalabad , 38000, Pakistan

Sustainable agriculture requires effective management of environmental challenges, and one such challenge is pond waste. In Pakistan, vast networks of freshwater ponds (approximately 60,470 hectares) are used for fish farming. While this practice produces valuable food, the resulting nutrient-rich wastewater is often discarded, creating a potential environmental burden. However, this very waste holds immense potential for agriculture.

A groundbreaking solution has emerged from NIBGE (a research institution). Their innovative method tackles pond waste using a unique combination of floating wetlands and electrolysis. Floating wetlands act as miniature ecosystems within the ponds. These plant-based systems filter and purify the water by absorbing pollutants and fostering the growth of beneficial microorganisms. Electrolysis takes things a step further by using electricity to break down remaining contaminants and potentially even harvest valuable minerals.

This two-pronged approach offers a dual benefit. First, the process transforms pond waste into a usable, nitrogen-rich sludge. Nitrogen is a vital element for plant growth, making this sludge a valuable organic fertilizer. By replacing synthetic fertilizers, this method reduces reliance on potentially harmful chemicals and promotes sustainable agricultural practices. Second, the method simultaneously cleans and polishes the wastewater, removing impurities and achieving crystal clarity. This treated water becomes a valuable resource, suitable for reuse in irrigation or replenishing aquaculture systems. This not only promotes water conservation but also minimizes the environmental impact of agriculture by reducing reliance on freshwater sources.

By addressing both aspects of pond waste management, NIBGE's innovative method positions itself as a promising solution for sustainable agriculture in Pakistan. This approach promotes organic practices, reduces dependence on chemical fertilizers, conserves water, and minimizes environmental impact. This paves the way for a more sustainable future for Pakistani agriculture.



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sciforum-104593: Techno-economic performance assessment of malt-dust-derived biochar application for municipal wastewater treatment: A water reuse strategy

Pelin Soyertaş Yapicioğlu * and Mehmet Irfan Yeşilnacar

Department of Environmental Engineering, Engineering Faculty, Harran University, Sanliurfa, Turkey

Waste reduction and recycling are two of the main strategies which have favorable effects in terms of a circular economy, and they are one of several environmental remedies included in the European Union's (EU) Green Deal. Also, the EU Blue Deal is aimed at the protection of vulnerable freshwater resources and includes recommended water reuse applications. Biochar is an innovative and effective technology for several environmental applications. From this point of view, malt dust, which is a by-product of the brewery industry, has been used as a biochar feedstock for the treatment of municipal wastewater in order to achieve a reclaimed water quality. A techno-economic performance assessment was carried out to reclaim water using this novel adsorbent. This paper mainly aimed to obtain reclaimed water using biochar application, with an aim of contributing to a circular economy. An average reduction of 41.4% in operational costs was reported compared to an activated sludge system. Turbidity, Biological Oxygen Demand (BOD₅), Total Suspended Solid (TSS), and E. coli analyses were performed to determine the effluent quality. In the end of the biochar adsorption process, a Class B reclaimed water quality according to EU legislation was obtained. This study validated that malt-dust-derived biochar is an efficient and low-cost adsorbent and can achieve a high quality of reclaimed water.



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sciforum-103240: A Novel Approach to Urban Groundwater Quality Assessment: Combining Geospatial Analysis, Geostatistics, and Multi-Criteria Evaluation of Water Quality Indices

Iram Naz ¹, Rana Waqar Aslam ^{1,*}, Abdul Quddoos ¹, Aqil Tariq ² and Asif Sajjad ³

¹ State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing (LIESMARS), Wuhan University, Wuhan 430079, China

² Department of Wildlife, Fisheries and Aquaculture, College of Forest Resource, Mississippi State University, Mississippi State, MS 39762-9690, USA

³ Department of Environmental Sciences, Faculty of Biological Sciences, Quaid-I-Azam University, Islamabad 45320, Pakistan

Lahore, Pakistan's second-largest city, faces significant public health risks due to groundwater contamination in its over-exploited aquifers, which serve as the primary water source for municipal and domestic use. This study introduces a novel, integrated approach to assess groundwater quality across Lahore district, combining geospatial analysis, geostatistics, and multi-criteria evaluation of water quality indices. The research aims to identify spatial patterns of key contaminants, assess their impact on water potability, and evaluate potential remediation strategies. The methodology integrates Geographic Information Systems (GIS) with Multi-Criteria Decision Analysis (MCDA) and water quality indexing. Expert-driven Analytic Hierarchy Process (AHP) was employed to assign weights to various water quality parameters, with arsenic receiving the highest priority (weight 0.28), followed by total dissolved solids (0.22) and hardness (0.15). The GIS-based weighted overlay analysis revealed critical quality hotspots, particularly in urban-industrial areas such as Lahore Cantt, Model Town, and parts of Lahore City, where water quality index values exceeded 150, indicating very poor quality. These findings align with reports of uncontrolled industrial effluent discharge contributing to aquifer contamination. Scenario modeling demonstrated that a 30% reduction in heavy metals, particularly arsenic, could improve water quality indices by up to 20.71% in severely affected areas like Shalimar. Simulations of advanced water treatment processes indicated potential arsenic reduction exceeding 95%, highlighting the need for sophisticated oxidation and filtration infrastructure. This integrated approach offers a powerful decision support tool for visualizing complex contamination patterns, assessing remediation options, and prioritizing risk-mitigation investments. It provides urban planners and water management authorities with crucial insights for developing targeted groundwater quality restoration strategies, including the strategic placement of treatment facilities, improvements in drainage infrastructure, and the implementation of stricter pollutant discharge regulations. The framework's adaptability makes it applicable to other regions facing similar groundwater contamination challenges, offering a robust methodology for data synthesis and quantitative scenario modeling to address widespread water quality issues.



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sciforum-103213: Adsorption studies of ibuprofen by alginate spheres containing activated carbon and first trials using wastewater treatment plant effluent as matrix

Iris Correia ^{1,2,*}, Tolulope Okuselu ^{2,3}, Judite Vieira ^{1,2}, Ricardo Lagoa ^{1,2} and Dorinda Marques-da-Silva ^{1,2}

¹ Laboratory of Separation and Reaction Engineering-Laboratory of Catalysis and Materials (LSRE-LCM), Associate Laboratory in Chemical Engineering (ALiCE), Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal

² School of Technology and Management, Polytechnic Institute of Leiria, 2411-901 Leiria, Portugal

³ ERASMUS MUNDUS Joint master's degree in Environmental Contamination and Toxicology (ECT+)

Ibuprofen is a contaminant of emerging concern (CEC) released into the environment that, due to its overconsumption and low degradation, accumulates in ecosystems. Additionally, conventional wastewater treatment methods are characterized by high energy consumption, greenhouse gas emissions and costs, and the risk of secondary contamination, and they are not effective in removing CECs. In this context, adsorption has emerged as an effective and simple technique that is widely used in water treatment to remove various types of contaminants. This work aimed to study the potential of alginate spheres containing activated carbon for the removal of ibuprofen from aqueous solutions and treated wastewater spiked with the drug. Kinetic assays were carried with different initial concentrations of ibuprofen and three desorption solvents were evaluated: ethanol, methanol, and HCl 0.2M. Ibuprofen quantification was carried out at 222 nm by UV-Vis spectroscopy and reversed-phase HPLC. The spheres showed substantial adsorption capacities around 20 mg/g with high ibuprofen concentrations but also a significant adsorption ability with low mg/L concentrations. For desorption, methanol and ethanol were the most suitable solvents with both achieving a desorption ratio of 100%. Cycles of adsorption/desorption revealed the material maintained its ibuprofen removal capacity after desorption with both solvents. Furthermore, removal superior to 90% was achieved for ibuprofen concentrations close to those found in real environments when using laboratory aqueous solution or wastewater-treated effluent as a matrix. This study indicates alginate spheres containing activated carbon as a sustainable adsorbent material for ibuprofen at concentrations similar to those found in samples of environmental relevance and using a matrix of the wastewater treatment plant effluent. Moreover, the adsorption capacity was maintained after desorption with both ethanol and methanol. In the future, more studies will be conducted to transfer the technology format from batch to fixed-bed column.



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sciforum-102674: Advanced wastewater treatment through the combination of a self-forming dynamic membrane with electro mbr

Fabiano Castrogiovanni

Independent Researcher, 94014 Nicosia, Italy

Studies on wastewater treatments have improved the quality of effluents, minimizing risks to health and the environment. Among significant innovations, membrane bioreactors (MBRs) represents a reliable and efficient technology, which has become an alternative to traditional activated sludge processes.

However, membrane investment costs and membrane fouling, with its consequences for plant maintenance and energy consumption, limit the wide application of MBRs. For this reason, studies are still underway to control fouling and minimize costs.

Recent investigations have shown that the application of electrochemical processes to MBRs (eMBRs) represents a promising technology for fouling control.

In recent years, the scientific community has also focused its attention on the use of low-cost self-forming dynamic membranes (SFDM), whose distinction from traditional membranes is the high pore size (10-200 μm). Using these membranes leads to a significant cost reduction. However, the large pore size limits their application since effluents obtained at the start of the process are not of high quality.

In the present study, the performance of SFDM was investigated, integrating it in a conventional MBR and in an eMBR operating at different current densities. Both pollutant removal efficiencies and fouling control have been assessed as a function of the applied current density. This extremely innovative hybrid system is able to reach high effluent quality, allowing its reuse, reducing fouling significantly, and, at the same time, decreasing the high costs of traditional membranes.



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sciforum-097513: An Assessment of the effects of atmospheric precipitation on water quality in outdoor swimming pools

Rafał Rapacewicz ^{1,*}, Edyta Kudlek ¹ and Katarzyna Brukała ²

¹ Department of Water and Wastewater Engineering, Silesian University of Technology

² Department of Health Policy, School of Health Sciences in Bytom, Medical University of Silesia in Katowice

In the context of contemporary challenges in urban water management, particularly in relation to the scarcity of high-quality water and the amplification of urban floods, the implementation of an innovative approach to rainwater utilization becomes imperative. This approach serves as an alternative water source, mitigating the strain on tap water resources. Embracing rainwater presents an opportunity to diminish dependency on conventional water sources, while fortifying the urban water supply infrastructure in a sustainable and adaptable manner.

An extensive water quality assessment was conducted in outdoor swimming pools to examine the impact of precipitation on water quality within the pool environment. Two public bathing facilities located in Poland were examined. One of the pools under study was equipped with a closed-circuit water treatment system, while the other operated without such a sophisticated setup. The research spanned three summer months, aligning with the annual operating period for outdoor swimming pools in Poland, owing to the region's specific climatic conditions. The research encompassed a detailed analysis of the primary parameters of swimming pool water quality, as outlined in the Regulation of the Polish Minister of Health dated November 9, 2015, pertaining to the specified standards for swimming pool water. Moreover, the analysis extended to supplementary water quality indicators, encompassing, among others, total organic carbon (TOC), conductivity, and the presence of micropollutants (including contaminants of emerging concern).

The research results represent a foundational cornerstone for subsequent inquiry aimed at formulating an innovative methodology permitting the deliberate integration of rainwater into public swimming pools as a primary water source, thereby supplanting conventional tap water usage.

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sciforum-096146: Applicability of banana peel as adsorbent in synthetic solution containing Cd^{+2}

Hakan Çelebi *, İsmail Şimşek, Tolga Bahadır and Şevket Tulun

Department of Environmental Engineering, Aksaray University, Aksaray 68100, Türkiye

It is a known fact that one of the indispensable elements of life is high-quality drinkable water. With climate change and global warming, the increase in water consumption in certain sectors and the irregular distribution of population density negatively affect water quality. Wastes resulting from agricultural and food production activities and wastes generated from household use have structurally similar characteristics. These wastes contain active components and functional groups that can be used in both water/wastewater treatment and the medical/cosmetic sectors. Although it is a very diverse type of waste, the waste of banana fruit, which is consumed extensively all over the world, has been used in water treatment. In this study, banana peels (BnP) discarded as waste were used in powder form to remove Cd^{+2} from the synthetic solution. Cd^{+2} ion is a toxic and bioaccumulative heavy metal commonly found in industrial wastewater. Therefore, this method was chosen due to the simple design of adsorption. For evaluation, at a constant mixing speed (150 ± 5 rpm) and 100 ± 3 mg/L Cd^{+2} dose, the effects of pH (2, 4, 6, and 8), contact time (5, 15, 30, 45, 60, and 90 minutes), BnP dose (0.1, 0.5, 1.0, 2.0, 3.0, and 5.0 g), and temperature (20, 25, 30, and 35 °C) were examined. For adsorption efficiency, Langmuir and Freundlich isotherms, and pseudo-first and second-order kinetics were tested. The experimental results showed that a 70% to 85% efficiency was achieved under optimum conditions for the Cd^{+2} removal of BnP.



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sciforum-097557: Assessing the Effect of Rainwater Harvesting Methods on Water Quality for Future Applications

Edyta Kudlek *, Rafał Rapacewicz and Anna Lampart-Rapacewicz

Department of Water And Wastewater Engineering, Silesian University of Technology

Rainwater is increasingly being used as an alternative water source for households and industries. It can be used for a variety of purposes such as watering plants, rinsing surfaces, and, after proper treatment/disinfection, flushing toilets. Constantly decreasing freshwater resources and climate change encourage the installation of systems for collecting and using rainwater. However, it is crucial to properly select the available solutions on the market to meet consumer needs while considering maintaining the appropriate quality of collected water. This research aimed to assess the quality of rainwater collected from roof surfaces in open and closed above-ground and underground tanks. The tanks, with a capacity of 300 L, were made of polyethylene and equipped with drain valves and an opening flap. Water samples were subjected to physicochemical, chromatographic, and toxicological analyses immediately after collection and after a given period of water storage in tanks. Samples were taken every two days over four months.

It was shown that the residence time of water in retention reservoirs significantly affects the deterioration of their quality in both above-ground and underground reservoirs. It was recorded that the pH of water decreases from 7.6 to 4.3 over time. Moreover, an increase in TOC concentration was observed in both covered and open above-ground tanks. The chromatographic analysis of rainwater samples that was performed immediately after the rainfall was collected in the tanks and after a given storage period showed the presence of organic micropollutants that gradually decompose. The presence of decomposition intermediates was particularly clearly observed in outdoor tanks exposed to solar radiation. The toxicological analysis showed a change in the water from a non-toxic to a low toxic level.

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sciforum-097466: Assessing the Environmental and Economic Footprint of Leakages in Water Distribution Networks

Athanasios Vasileios Serafeim ^{1,2,*}, Anastasios Perdios ^{1,2}, Nikolaos Th. Fourniotis ³, George Kokosalakis ^{1,4} and Andreas Langousis ¹

¹ Department of Civil Engineering, University of Patras, 26504 Patras, Greece

² Dipartimento di Ingegneria Civile, Ambientale ed Architettura Università degli Studi di Cagliari, 09124 Cagliari, Italy

³ Department of Civil Engineering, University of the Peloponnese, 26334 Patras, Greece

⁴ Department of Maritime Transport and Logistics, School of Business and Economics, Deree, American College of Greece, 15342 Athens, Greece

Introduction

All urban and agricultural water distribution networks (WDNs), irrespectively of their physical and operational characteristics encounter substantial leakages, which result in significant water losses, environmental degradation through increased carbon emissions and noteworthy economic burdens. The current work aims to quantify both the environmental impact, estimated in terms of CO₂ emissions, and the economic implications associated with leakages and evaluate the effect of the most widely used leakage reduction strategies.

Methods

The effectiveness of the studied approaches is tasted via a real-world application on the WDN of the city of Patras, in western Greece, which exhibits significant leakage rates (more than 40% of the system's input volume). To estimate the total CO₂ emissions and the water production cost, we utilize energy consumption as well as energy billing data associated with pumping and water treatment. Additionally, we use flow time series from pumping stations and individual district metered areas (DMAs) and/or pressure management areas (PMAs) to estimate the water balance of the network. This comprehensive approach allows us to assess both the environmental and economic impacts of leakages.

Results

The results reveal that the most effective approach for mitigating leakages and their associated environmental and financial costs is by partitioning the network into smaller hydraulically isolated areas, combined with proper pressure management (i.e. design of PMAs). More specifically, the leakage rates and the associated CO₂ emissions and economic costs are reduced up to 40%. These findings highlight the importance of targeted pressure management towards achieving substantial efficiency improvements.

Conclusions

Mitigating water leakages in WDNs is crucial for achieving environmental sustainability and economic efficiency. By reducing leakages through network partitioning and pressure management, water utilities can significantly reduce both the carbon emissions and the operational costs, contributing to global sustainability goals, as demonstrated by a case study in the city of Patras.



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sciforum-103082: Assessment of Groundwater Quality Status using Water Quality Index in National Industrial Zone, Rawat, Pakistan

Akhtar Ali *, Muhammad Abdullah Khan, Asif Sajjad and Muhammad Ahmad

Department of Environmental Sciences /Quaid-i-Azam University, Islamabad/Pakistan

Introduction

Groundwater is crucial for human consumption, agriculture, and industrial uses. Its widespread use in each sector of life makes it a life-saving component in society, but its quality and availability are seriously threatened by pollution and unnecessary usages, particularly industrial activities. In this regard, the National Industrial Zone (NIZ) in Rawat, Pakistan, was taken as the study area. So, we aimed to calculate the quality of water using a Geographic Information System (GIS)-based Water Quality Index (WQI) to address improvements and their implications for public health and the environment.

Methodology

This study involved analyzing 11 physicochemical parameters in groundwater samples from 38 locations within the NIZ. These parameters were evaluated against both national and international water quality standards. Furthermore, the obtained data were processed using GIS to create spatial distribution maps, which were then used to calculate the Water Quality Index (WQI) for the study area.

Results

The analysis revealed that a significant portion of the groundwater in the NIZ exceeded permissible limits for several parameters, including EC, TDS, hardness, and chloride. Specifically, the WQI results indicated that 63% of the groundwater samples fell into the poor-quality category. The spatial distribution maps highlighted areas with the highest levels of contamination. Despite these findings, some groundwater remained within acceptable quality levels and was deemed usable for certain applications.

Conclusions

The findings emphasized the urgency for enhanced regulatory frameworks, improved wastewater treatment, increased public awareness, and ultra-processing techniques at the industrial level to prevent further contamination of groundwater in NIZ. Additionally, sustainable water management practices are required for safeguarding groundwater resources and protecting public and environmental health.



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sciforum-097542: Assessment of Resilience in Irrigation Networks Using Optimization Algorithms

Carmen Mireya Lapo¹ and Francisco Javier Martínez-Solano^{2,*}

¹ Departamento de Ingeniería Civil, Universidad Técnica Particular de Loja, San Cayetano Alto 1101608, Ecuador

² Dpto. de Ingeniería Hidráulica y Medio Ambiente, Universitat Politècnica de València, Camino de Vera, s/n 46022 Valencia, España

The world is facing increasing pressure over the water resources. One of the main water uses is agricultural irrigation. Therefore, the ever-increasing demand for food, coupled with the effects of climate change, is putting increasing pressure on the water resources used for irrigation. Traditional design methods used for irrigation networks only look for economical optimization. This study presents a methodology for the evaluation of the resilience of irrigation networks. It uses two indicators of resilience: RSYS and PHRI indicators. These indicators will be calculated for a pressurized irrigation network that was designed using an optimization method based on dynamic programming, known as the Granados optimization method. The network was operated using the on-demand scheme and the Clément's formulation for demands was used. The values of the supply guarantee (probability of non-exceedance) of the network were modified, allowing us to know its influence on the results of the indicators.

The decision variables in the design problem were the size of the pipes and the objective function, the capital cost of the project, etc. The methodology was applied to an irrigation network in Ecuador, and the resilience indicators at the level of both pressures and demands measured the behavior of the network in the face of disruptive events. The results of the research indicate that the implementation of resilience indicators in irrigation networks allows the irrigation network to be efficiently managed when the operational conditions differ from the design parameters. A suitable combination of economy and resilience during the design process can be an effective strategy when using optimization algorithms. This work evidences this statement.



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sciforum-101012: Assessment of Water Quality from Desalination Plants in Oran (western Algeria): Technologies, Impacts, and Future Directions

Alaoui Fatma ^{1,*}, Alioua Berrabah Amel ² and Ghaffour Noredine ³

¹ Mohamed BOUDIAF University/Department of Natural and Life Sciences /Toxicology, Environment and Health Laboratory

² Laboratory of Toxicology, Environment and Life/ Mohamed Boudiaf University/ Oran

³ King Abdullah University of Science and Technology (KAUST), Water Desalination and Reuse Center (WDRC), Division of Biological & Environmental Science & Engineering (BESE), 4700, Thuwal 23955-6900, Saudi Arab

Desalination plays a vital role in Oran by converting seawater into freshwater to meet local water demands. This scientific paper provides a comprehensive evaluation of the desalinated water quality and its broader impacts.

In Oran, increasing water demand faces limited freshwater resources, highlighting the necessity of desalination despite its environmental and energy challenges.

The study begins with an analysis of the technologies employed in desalination plants in Oran, emphasizing methods such as reverse osmosis or thermal distillation. It examines the effectiveness of these technologies in removing salts and contaminants from seawater to produce potable water.

Furthermore, the paper delves into the environmental and public health impacts associated with desalination. It addresses concerns such as energy consumption, greenhouse gas emissions, and the discharge of brine and chemicals back into the marine environment. Evaluations of the water's chemical composition and potential health implications for consumers are also explored.

In addition to challenges, such as high operational costs and environmental concerns, the research highlights opportunities for improving desalination efficiency and sustainability. Future directions include advancements in technology to reduce energy consumption, enhance water recovery rates, and mitigate environmental impacts.

Overall, the paper aims to provide insights into the current state of desalination in Oran, offering recommendations for optimizing its performance while addressing environmental and health considerations.



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sciforum-087494: Balancing Urban water challenges through integrated solutions

Laiba Fatima * and Rana Ammar Aslam

Department of Structures and Environmental Engineering, University of Agriculture Faisalabad, 83060, Pakistan

In Pakistan, one of the basic challenges the urban areas are facing is the lack of high-quality water for people due to rapid population growth, unplanned urbanization and increasing climate uncertainty. The Indus river system is the major source of water for people and agriculture in Pakistan. Due to dramatic population growth, water demand has also increased but water availability is declining so sharply that in future urban water management may meet with severe challenges. Pakistan is the eighth most climate-vulnerable country in the world. This extreme climatic variability has intensified the need to manage Pakistan's water resources more sustainably. In 2018, the government of Pakistan developed a National Water Policy (NWP) to provide the guidelines for the development of sustainable water management solutions. To implement this policy, there is a decision support tool called the Urban Water Optioneering Tool (UWOT), which aims at facilitating the selection of combinations for water saving technologies and supporting the implementation of integrated and sustainable water management in new developments. The tool is based on a water balance model which enables the investigation and analysis of interactions within the major urban water cycle streams. The technology options are determined by a genetic algorithm (GA) allowing the efficient exploration of decision possibilities. GA is applied to address multiple contaminants in the water system. In essence, UWOT is a tool that aids decision-making by finding the best combination of water-saving technologies to ensure sustainable water management in urban developments. It has been successfully tested in the UK. This tool considers both the quantitative data and qualitative insights, and provides a complete picture of challenges in water management.



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sciforum-096947: Bioremediation of Uranium-Contaminated Water Using Native Microbial Consortia

Volodymyr Brei and Iryna Kovalchuk *

Institute for Sorption and Problems of Endoecology National Academy of Science of Ukraine

A commonly acknowledged environmental issue is the water pollution caused by uranium compounds in areas where uranium is mined and processed. It is known that the bacteria naturally found in radioactively contaminated sites are adapted to polluted environments, particularly in the presence of heavy metal ions and radionuclides. These bacteria can more completely oxidize carbon sources, generating a stronger reducing potential needed to convert hexavalent uranium into its insoluble tetravalent form. Consequently, microbiological methods can be employed in purification technologies for water to remove toxicants.

This investigation aimed to study the possibility of effectively using bioreducers based on a local consortium of microorganisms from the uranium mine regions of Ukraine to purify uranium-containing water.

Microorganisms were sourced from various soil depths (1-3 meters) near the uranium industry tailing in Zhovti Vody City, Ukraine. A consortium of native bacterial cultures was cultivated under anaerobic conditions (Postgate C medium, cysteine, yeast). The formation of a black deposit on the dish walls and the strong smell of hydrogen sulfide indicated the effectiveness of the uranium reduction process. X-ray fluorescence analysis showed a decrease in the uranium concentration in the liquid phase, with the efficiency of water purification from uranium reaching 93%. So, sulfate-reducing bacteria (*Desulfovibrio desulfuricans* and *Desulfovibrio vulgaris*) can reduce uranium by an enzymatic mechanism. The products of these reduction reactions could be U(IV)-oxide minerals such as uraninite. Thus, the results confirm the feasibility of applying the microbiological method to uranium-contaminated water purification.



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sciforum-103423: Can microbes act as a potential treatment to PFAS in water?

Parnab Das

Scientist, Eurofins PSS

Per- and polyfluoroalkyl substances (PFAS) is currently becoming a concern for the adverse health effects in mammals for health scientists and environmental technocrats. PFAS can be found in various type of waters like groundwater, drinking water, surface water, wastewater and in soil and dust from the household. The sources of PFAS can be various that includes but not limited to cleaning products, water resistant fabrics, cookware, personal care products and others. This PFAS contaminated soil and water can get into the bodies of animals and humans and cause various and chronic diseases which can be life threatening at times. There have been various methods of treating this PFAS from water -most of these methods rely on heavy chemical treatments and/or expensive filtration methods. In this review we tried to investigate the possibility for using bioremediation of PFAS by bacteria. Different microbial species have the ability of biodegrade or bio sequester different chemicals from the environment which otherwise be harmful to living species. Different bacterial species including *Desulfovibrio aminophilus* and *Sporomusa sphaeroides* that have been isolated from the nature have proven strong enough to cut the PFAS' chlorine-carbon bond. In turn, that starts a chain of reactions that destroy the structures, rendering PFAS compounds harmless. Some fungal species have also shown enough evidence of degrading the PFAS. Some drawbacks of these research include the lack of data for long term studies. Most of the microbial species that have been used for treating PFAS show slow results for the process. Future aspects of these studies can be expanded for coupling various microorganisms together through batch reactor studies, aiming for a viable biological based solution for treating PFAS from urban water.



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sciforum-096709: Carbon dots-TiO₂ nanocomposites for the visible-light driven photodegradation of organic pollutants

Ricardo Sendão *, Joaquim Esteves da Silva and Luís Pinto da Silva

Centro de Investigação em Química (CIQUP), Instituto de Ciências Moleculares (IMS), Departamento de Geociências, Ambiente e Ordenamento do Território, Faculdade de Ciências, Universidade do Porto, Rua do Campo Alegre s/n, 4169-007 Porto, Portugal

Water is arguably the most crucial resource on Earth. The efficient removal of organic compounds, such as dyes and pharmaceuticals, is essential to preserve our water resources, something at which conventional wastewater treatments are inefficient. As an alternative, photocatalytic technologies may achieve a near-complete degradation of pollutants by harnessing the energy of a light source. Titanium dioxide (TiO₂) is a stable and inexpensive photocatalyst that is widely used across several areas but presents some limitations: requiring high-energy UV radiation, which is only a small fraction of solar radiation; suffering from rapid charge recombination; lowering its photonic efficiency; and poor affinity towards organic compounds.

Combining TiO₂ with carbon dots (CDs) may bridge these limitations. CDs are carbon-based nanoparticles with interesting properties, such as high photoluminescence, broadband absorption, and good water solubility. Their unique properties and the easiness of their preparation enable the use of CDs for several applications, including sensing, LEDs, and photocatalysis.

Herein, we report the integration of CDs with TiO₂ to prepare an efficient photocatalytic nanocomposite for the solar-light-driven photodegradation of organic pollutants. In the first stage, by adding CDs, we developed a composite with an enhanced potential for the photodegradation of methylene blue (MB), increasing efficiency by 367% when compared to bare TiO₂. Building on this, we modified the composite to include corn stover, a major waste material of the corn industry, as part of the CDs. This way, we created high-value products from an otherwise unused waste source, promoting a circular economy, while maintaining catalytic performance. The composite was thoroughly characterized via SEM, FTIR, XPS, NMR, XRD, and UV-Vis and fluorescence spectroscopy. Finally, we tackled the removal of ciprofloxacin using this method, achieving a virtually complete degradation of 20 ppm within 20 minutes of solar-light irradiation, with the CDs significantly improving efficiency when compared to TiO₂.



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sciforum-103152: Comparative analysis of conventional coagulation and electrocoagulation for polluted water treatment

Ronei de Almeida

Department of Sanitary and Environmental Engineering, Faculty of Engineering, Universidade do Estado do Rio de Janeiro/UERJ, Rio de Janeiro/ RJ 20550-013, Brazil

This work investigates the chemical coagulation (CC) and electrocoagulation (EC) processes for polluted water treatment. Polluted synthetic water was prepared ($\text{pH} = 7$, $365\text{--}357 \text{ mg Pt-Co L}^{-1}$). Jar tests were conducted using aluminum sulfate as a coagulant ($100 - 1600 \text{ mg Al}_2(\text{SO}_4)_3 \text{ L}^{-1}$, $\text{pH} = 4 - 9$). The EC test was performed using a lab-scale device. The EC set-up was installed for the first time in the Sanitary and Environmental Engineering/ Uerj laboratory course. The students performed all the experiments. Aluminum electrode plates ($15 \times 3 \times 2 \text{ cm}$) were connected in parallel, and a distance of 30 mm was maintained. The treatment performance was evaluated based on true color removals. Operating costs were calculated based on chemical utilization for CC (aluminum sulfate and sodium carbonate) and EC energy consumption under optimum conditions. Removal efficiencies of 94% and 88% were obtained in CC ($\text{pH} = 7$ and $800 \text{ mg Al}_2(\text{SO}_4)_3 \text{ L}^{-1}$) and EC ($\text{pH} = 7$, 350 mA, and 40 min), respectively. The operating costs of CC and EC were estimated at 0.130 and 0.583 US\$ m^{-3} . As expected, the EC process had higher operating expenses than the CC process. However, EC may be attractive in remote settlements since modular and efficient systems are needed to guarantee drinking water production. No chemicals are required in this process; the treatment is automated, and less sludge is generated. The utilization of alternative energy sources can increase EC's cost-effectiveness. Future studies will focus on integrating EC and membrane-based treatments in modular set-ups. Decentralized water treatments can promote safe potable water, sanitation, and hygiene (WASH) in remote sites. Safe WASH is a prerequisite to health and the development of resilient communities.



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sciforum-097423: Comparison of water consumption in indoor swimming pools in the Silesian Voivodeship, Poland: A case study

Anna Mika-Shalyha ^{1,2,*}, Joanna Wyczarska-Kokot ¹ and Anna Lempart-Rapacewicz ^{1,3}

¹ Department of Water and Wastewater Engineering, Faculty of Energy and Environmental Engineering, Silesian University of Technology, Konarskiego 18, 44-100 Gliwice, Poland

² PPUH Transcom Sp. z o.o., Józefowska 5, 40-144 Katowice

³ PPUH Transcom Sp. z o.o., ul. Józefowska 5, 40-144 Katowice

The provision of sporting amenities, specifically indoor swimming pools, is integral to promoting a healthy lifestyle in today's urban environment. Unsurprisingly, there is a growing demand for such facilities, both within the public and private sectors. However, the development and operation of these establishments place significant strain on municipal water infrastructure, particularly in locales that lack sufficient water distribution systems. Substantial water consumption within indoor swimming pools exacerbates the financial burden on these facilities, affecting their overall profitability and necessitating adjustments to ticket pricing.

A comprehensive comparative analysis was performed on three different indoor swimming pools located in the Silesian Voivodeship in Poland, all adhering to identical design and quality standards. An analysis of the water consumption in indoor swimming pools P1, P2, and P3 was conducted using water meters with impulse overlays to continuously capture consumption data. These facilities are equipped with building management systems that facilitate data collection for the analyses presented.

Despite similarities in facility equipment, the number of pool basins, water attractions, technology, and frequency of use, there were significant discrepancies in water consumption between individual swimming pools. This investigation revealed a strong correlation between the volume of water consumption in indoor swimming pools and the proficiency of facility management, as well as the expertise and qualifications of the staff responsible for their daily operation. The volume of water replenishment depends on the occupancy of the facility. The process of replenishing pool circuits with tap water, considering the frequency of filter backwash, and evaluating the duration and frequency of individual filtration cycles collectively contribute to upholding the required quality of pool water.

In view of the results, comprehensive operational guidelines for technical staff have been formulated. Adherence to these guidelines is recommended to ensure optimal and sustainable management of water and wastewater facilities.



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sciforum-099266: Designing of a water quality management plan. A case study of criterion water treatment works in Bulawayo, Zimbabwe.

Mbuluki Ncube ^{1,*}, Jeremiah Chimhundi ¹ and Hendrik Gideon Brink ²

¹ Department of Civil and water Engineering, National University of Science and Technology, Ascot, Bulawayo,00000, Zimbabwe

² Water Utilisation and Environmental Engineering Division, Department of Chemical Engineering, University of Pretoria, Lynnwood Road, Hatfield, Pretoria 0002, South Africa

Despite being a fundamental human right, many developing countries face challenges in accessing clean and safe drinking water due to various obstacles. The study aimed to develop a water quality management plan (WQMP) for Criterion water treatment works (CWTW) in Bulawayo, Zimbabwe, to address water quality concerns and health risks. Attained through identifying the principal elements of a potable WQMP relevant to the study area. This was done through comprehensive and extensive literature study. The evaluation of CWTW performance assessed water quality and hydraulic capacity, ensuring compliance with WHO and EPA guidelines, and analyzed effluent samples to ensure integrity. The collected samples were then analyzed at the on-site Criterion laboratory. The quality test results were integrated with a Water Quality Index (WQI) calculation, allowing for a comprehensive performance ranking to evaluate the treatment system's performance. Analysis of the Water Quality Index (WQI) revealed that the treatment system ranking was not always within the range of 0-25, signifying the potential need for a WQMP to optimize performance. Furthermore, the average turbidity removal efficiencies of the clarification and filtration processes, at 19.5% and 61.5%, respectively, indicated a shortfall in meeting established EPA and WHO regulations. A review of essential design drawings and construction data for the plant was undertaken. This analysis aimed to identify potential hydraulic capacity complexities that could impact treatment efficiency. Additionally, the hydraulic assessment evaluated compliance with recommended ranges for hydraulic retention times (HRT) and solid loading rates (SLR) within the treatment units. The study used manual measurements and staff interviews to assess hydraulic capacity, revealing significant deviations from recommended HRT and SLR. This overloading, likely due to exceeding the design population capacity, was identified as a contributing factor to water quality challenges, highlighting the need for a Water Quality Management Plan to address these challenges.



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sciforum-086487: Detection of Groundwater Level with Hydraulic Pressure Sensor

Rana Ammar Aslam, Abdullah Nasir * and Hamza Saeed

Department of Structure and Environmental Engineering, University of Agriculture, Faisalabad

Worldwide, about one out of two people depend on groundwater resources to satisfy their drinking water needs. While groundwater is typically of a higher quality than surface water, pollution and geologic conditions may necessitate treating groundwater to meet safe water quality criteria. Groundwater is present under the earth in soil spores or the fractures of rocks. The device that we are building will help us to know about the level of groundwater through various software and by adding different processes. Many devices have been made, but this one will be a successful and efficient device for everyone. Those who are facing problems with such resources can know information about their groundwater level and act accordingly. As the process is based on steps, we will explain it in terms you can readily grasp. We utilized a hydraulic pressure sensor (a water-detection sensor) in the first phase, which will link to an electronic device called an Arduino kit (or another device such as a Nano-device), a 16-bit 12C ADC (Analog to Digital Converter), and a Max 485 module. An extra HC 12 (half-duplex wireless serial communication) module will be connected to a laptop. Power will be provided directly or through batteries. The reading from the sensor is saved on a hard disc or USB flash. On our laptop, we will obtain readings continuously. Our sensor will function and provide a reading in this manner. The value you see in the software will increase depending on the length of the wire you dip the sensor in. The wire's length is completely adjustable.



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sciforum-097099: Detoxification of contaminated water from persistent organic pollutants by homogeneous advanced oxidation processes

Alexandra Spyrou ^{1,*}, Dimitris Vlastos ², Alexandra A. Ioannidi ³, Zacharias Frontistis ⁴,
Dionissios Mantzavinos ³ and Maria Antonopoulou ¹

¹ Department of Sustainable Agriculture, University of Patras, GR-30131 Agrinio, Greece

² Department of Biology, Section of Genetics Cell Biology and Development, University of Patras, GR-26500, Patras, Greece

³ Department of Chemical Engineering, University of Patras, GR-26504, Patras, Greece

⁴ Department of Chemical Engineering, University of Western Macedonia, GR-50132, Kozani, Greece

Flame retardants (FRs) are widely used to reduce the flammability of commercial products. Amongst them, Tetrabromobisphenol A (TBBPA), a persistent chemical, is used extensively in textiles, plastics, electronics, and electrical equipment. TBBPA is frequently detected in aqueous (ranging from 0.14 to 130 ng L⁻¹) and biological samples (up to 1.15 µg L⁻¹ in urine samples). Studies on TBBPA and its degradation products' toxicity have shown their impact in both humans and animals, highlighting their cytotoxic, cardiotoxic, and immunotoxic effects. The conventional treatment processes have often presented limitations, and numerous organic pollutants are highly resistant to them. In recent decades, advanced oxidation processes (AOPs) have been harnessed to efficiently eliminate organic contaminants from water and wastewater.

Therefore, the aim of the present study was to effectively remove TBBPA and its characteristic degradation products using a low-cost and practical AOP combining a widely used oxidant and solar irradiation. High degradation percentages were achieved at the first stages of the treatment, with almost complete removal of TBBPA. The efficiency of the process was also evaluated using certified bioassays that are widely used for the estimation of toxic effects in various organisms of different trophic levels. Based on the results, the treated samples did not induce toxic potential, suggesting the efficiency of using AOPs to remove persistent organic pollutants from water.



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sciforum-101865: Developing an innovative approach for industrial wastewater treatment: Assessing the effectiveness of electrocoagulation in the removal of chromium VI from electroplating

Ahmed Salim ^{1,*} and Omar Tanane ²

¹ Physical Chemistry, Materials and Catalysis Laboratory, Department of Chemistry, Ben M'Sick Faculty of Science, Hassan II University - Casablanca, Morocco

² Laboratory of Physical Chemistry, Materials and Catalysis, Department of Chemistry, Ben M'Sick Faculty of Science, Hassan II University - Casablanca, Morocco

Electrocoagulation has shown remarkable effectiveness in the treatment of industrial effluents, particularly in the removal of metal contaminants. The electrochemical processes occurring in aluminum electrodes have been remarkably effective in this regard. In the present study, electrocoagulation experiments were performed on industrial effluents originating from an electroplating bath located in Casablanca, Morocco. The basic objective was to remove chromium from the effluent and to facilitate the reuse of the treated water for various applications within our facility. To achieve this goal, a systematic optimization of several operational parameters affecting the electrocoagulation efficiency was performed. These parameters included voltage, electrode material, stirring speed, and electrode spacing. Their effects on key response variables, namely pH, conductivity, and chromium concentration, were rigorously evaluated. The experiments were carried out in a well-mixed reactor using a synthetic solution with a high concentration of chromium, namely 1000 mg/L Cr⁶⁺(aq). The chromium removal efficiency was evaluated under precisely controlled conditions, using aluminum electrodes with applied voltages of 6 V and 12 V, an optimal stirring speed of 600 rpm, and an electrode spacing of 2 cm. This study demonstrates the critical operating parameters that maximize the effectiveness of electrocoagulation in the treatment of chromium-laden industrial effluents, providing valuable insights for industrial applications and environmental management.



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sciforum-093851: Eco-Hammam Initiative: Replicating the FSAC Model for Sustainable Wastewater Treatment and Resource Reuse in Dar Bouazza, Morocco

Nihad Chakri ^{1,*}, Btissam El Amrani ², Faouzi Berrada ³, Halima Jounaid ⁴ and Fouad Amraoui ⁴

¹ University of Hassan II- Faculty of Sciences Ain Chock

² Chemistry/ Laboratory of GAIA/ Faculty of Sciences Ain Chock, University Hassan II- Casablanca, Morocco

³ Physic/ Laboratory of GAIA/ Faculty of Sciences Ain Chock, University of Hassan II- Casablanca, Morocco

⁴ Geology/ Laboratory of GAIA/ Faculty of Sciences Ain Chock, University of Hassan II- Casablanca, Morocco

With increasing water scarcity in Morocco, unconventional resources are essential. Urban areas have improved sanitation, but rural areas lack basic infrastructure due to scattered dwellings and limited access. This highlights the urgent need for innovative, sustainable solutions to ensure adequate sanitation for all.

This work focuses on replicating the Faculty of Sciences Ain Chock (FSAC) model for the treatment and reuse of wastewater from a peri-urban traditional hammam in Casablanca, specifically in the municipality of Dar Bouazza. The FSAC model has proven to be successful in managing wastewater effectively within an urban setting, and this study aims to adapt and implement this model in a peri-urban context. This initiative is part of the Eco-Hammam project, which aims to minimize the negative impacts of traditional hammams in terms of the irrational and uncontrolled consumption of water and wood energy resources.

Traditional hammams, while culturally significant, often contribute to significant environmental challenges. They are known for their high water consumption and reliance on wood for heating. Addressing these issues through the Eco-Hammam project involves implementing sustainable practices and technologies that reduce resource consumption and promote environmental stewardship.

To achieve this, a comprehensive environmental diagnosis of all hammams in the municipality of Dar Bouazza, our study site, has been undertaken. Following this environmental diagnosis, a feasibility study is conducted to assess the possibility of replicating the FSAC mini-station to treat the wastewater of the selected pilot hammam, namely, My Yacoub II.

The replication of the FSAC model in Dar Bouazza aims to demonstrate that sustainable water management practices can be effectively implemented in peri-urban and rural areas. By showcasing the successful treatment and reuse of wastewater, the project hopes to inspire similar initiatives across Morocco and beyond, contributing to a more sustainable and resilient future for communities facing water scarcity.



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sciforum-103251: Eco-Innovative Magnetic Nanostructures: Pioneering Solutions for Mining Wastewater Challenges

Iolanda-Veronica Ganea ^{1,2,*}, Alexandrina Nan ³ and Calin Baci ¹

¹ Faculty of Environmental Science and Engineering, "Babeş-Bolyai" University, 30 Fântânele, 400294 Cluj-Napoca, Romania

² National Institute for Research & Development of Isotopic and Molecular Technologies Cluj-Napoca

³ National Institute for Research and Development of Isotopic and Molecular Technologies, 67-103 Donat, 400293 Cluj-Napoca, Romania

Water is an essential element for life; thus, its quality is a key marker of both an individual's and society's overall well-being. In the last century, this environmental factor has become a vulnerable resource; therefore, its management and protection have become top priorities worldwide. Global population increase and agricultural and industrial activities have made a substantial contribution to water contamination. Mining activities in Romania, particularly during the socialist era, have left a significant "legacy" of environmental pollution, especially regarding substantial mining wastewater contamination. Tailings ponds and abandoned mines continue to be major environmental hazards even today. In this context, there is a need to support eco-initiatives that promote a clean environment and mining wastewater decontamination challenges through the use of "green solutions".

This study aimed to prepare and characterize new magnetic core-shell nanoparticles coated with functionalized eco-friendly polymers. The new nanostructures were investigated by Fourier-transform infrared spectroscopy, transmission and scanning electron microscopy, thermogravimetry and magnetization measurements and afterwards were used for the removal of heavy metals from both batch solutions and mining wastewater samples. The heavy metal concentrations were determined by atomic absorption spectroscopy, and the nanomaterials' adsorption capacities/mechanisms were also studied. The high heavy metal removal efficiencies (>80%) obtained indicate the need for newly developed magnetic nanostructures for further applications in the field of wastewater treatment.



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sciforum-097682: Energy Optimization for Water Distribution Networks

Gabriella Colajanni¹, Erica Distefano¹, Roberto Gueli^{2,*}, Antonio Amatore² and Wladimiro Carlo Patatu²

¹ University of Catania, Catania, Italy

² EHT S.C.p.A., Catania, Italy

Introduction

This study addresses the critical need for energy optimization in water distribution networks (WDNs) amidst climate change, drought, and rising energy costs. Efficient WDN management ensures sustainable water supply and reduces operational costs. The research explores the use of digital technologies, such as smart meters and 5G, to enhance real-time data acquisition and control, aiming to minimize energy consumption and improve system efficiency.

Methods

The primary objective is to develop an optimization model to reduce pump energy consumption in WDNs through strategic intermittent water supply. The methodology involves a three-step optimization process. First, a simulation of the WDN using EPANET establishes baseline energy consumption and water demand. Second, an optimization model determines the optimal water volumes to be delivered and stored at each node, considering demand patterns, tank capacities, and energy costs. Finally, the speed of centrifugal pumps is adjusted to further reduce energy consumption while maintaining the required water flows.

Results

The case study on an EPANET network shows significant improvements in energy efficiency. The optimization strategy reduces pump energy consumption by approximately 25.3% compared to the baseline simulation. By scheduling water delivery during periods of lower energy costs and adjusting pump speeds, the model achieves more efficient resource use. Implementing smart meters and digital controls allows for precise and flexible water distribution management, enhancing overall network performance.

Conclusions

This research highlights the potential of digital transformation in the water sector, emphasizing environmental, operational, and financial benefits. The proposed optimization model offers a practical solution for existing WDNs, requiring minimal structural modifications. The findings indicate significant energy savings through strategic water supply and digital technology integration. Future work will refine optimization algorithms and explore renewable energy sources to enhance the sustainability of water distribution systems.



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sciforum-100088: Enhancing Photocatalytic Degradation of Pharmaceuticals with Silver-based Catalysts: A Systematic Review

Rafael Angeleo Miguel M. Villamor ^{1,*}, Kylie Gabriel Cruz Mendoza ^{1,2,3}, Maybeline M. Mamerto ¹, Sophia Rebekkah C. Jimenez ¹, John Francis C. Afionuevo ¹ and Rugi Vicente C. Rubi ⁴

¹ Chemical Engineering Department, College of Engineering, Pamantasan ng Lungsod ng Maynila, General Luna, corner Muralla St., Intramuros, Manila 1002, Philippines

² Nano Society of the Philippines, Taguig City, Philippines

³ Energy Research and Innovation Collaboratory, De La Salle University, Philippines

⁴ Chemical Engineering Department, College of Engineering, Adamson University, 900 San Marcelino St. Ermita, Manila 1002, Philippines

The increase of pharmaceutical contaminants in the aquatic environment, originating from manufacturing processes and human excretion from incomplete metabolism, poses an alarming risk in environment and in health. This results in the necessitating of development of methods for effective water treatment. Traditional water treatment processes have been proven to be inadequate in the elimination of these pollutants. As a result, an attention on the field of photocatalytic degradation has been given, particularly on the utilization of silver-based catalysts. This systematic review delves in silver-based materials used as a catalyst for the photocatalytic degradation of pharmaceutical compounds present on bodies of water. Silver-based catalysts, such as silver nanoparticles, silver-based semiconductors, and silver-based nanocomposites, are analyzed for their physicochemical properties that help enhance its catalytic performance. This review article explores into the factors that influence the efficacy of the silver-based catalysts, such as crystal structure, morphology, surface area, and particle size. Furthermore, the review highlights the silver-based photocatalysts' recent advancements, challenges, and some comparative analysis on other catalysts. By synthesizing the latest studies, this review article presents the potential and limitations of the silver-based photocatalysts to help in guiding future research directions and applications in environmental remediation specifically in solving the problems on pollutants in water.



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sciforum-097502: Enhancing Water Security in Commercial Buildings through Rainwater Harvesting and Innovative Strategies: A Case Study in Dhaka, Bangladesh.

Shahriar Iqbal Raj *, Mujtaba Ahsan and Amity Kundu

Department of Architecture, North South University

Introduction

Bangladesh faces severe climate change impacts exacerbated by its vulnerability to disasters. The Climate Vulnerability Index-2023 ranks Bangladesh as the seventh most disaster-risk-prone country globally. Poor and developing countries like Bangladesh bear disproportionate impacts from climate change, with significant vulnerabilities identified, including sea-level rise, erratic rainfall, and water security issues.

Methods

This study focuses on a commercial high-rise building on Gulshan Avenue, Dhaka, which is recognized for achieving 50% water efficiency compared to similar-sized buildings. The building employs rainwater harvesting, wastewater recycling, and advanced treatment technologies and integrates innovative water grid systems. It is LEED Platinum-certified by the U.S. Green Building Council, marking it as a pioneer in sustainable construction in Dhaka. Data were collected through on-site observations, interviews with the building architects, and a review of LEED certification documentation.

Results

The commercial building at Gulshan Avenue demonstrates substantial water efficiency gains through innovative strategies. Rainwater harvesting, wastewater recycling, and low-flow fixtures supported by innovative water grid systems significantly reduce reliance on groundwater and mitigate water quality issues from contaminated surface sources. The building's LEED certification underscores its leadership in sustainable practices, achieving the highest environmental standards in Bangladesh's commercial building sector.

Conclusions

The case study highlights the importance of rainwater harvesting, wastewater recycling, and intelligent water grid systems in enhancing water efficiency in Dhaka's commercial buildings. The success of the Gulshan Avenue building underscores the feasibility and benefits of adopting comprehensive water management strategies amidst growing water scarcity and pollution challenges. Further promotion and implementation of such integrated systems are crucial for mitigating water-related risks and advancing urban sustainability.



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sciforum-088419: Enhancing Water Supply System Management through Predictive Modeling: A Case Study in Poland

Katarzyna Pietrucha Urbanik

Department of Water Supply and Sewerage Systems, Faculty of Civil, Environmental Engineering and Architecture, Rzeszow University of Technology, Al. Powstancow Warszawy 6, 35-959 Rzeszow, Poland

This study embarks on a comprehensive analysis of a regional Water Supply System (WSS), focusing on the development of predictive models to support the management and modernization of the system. Highlighting the need for advanced predictive models in the face of aging infrastructure and variable demand patterns, I assess the effectiveness of modernization efforts within a WSS through operational data analysis. Methods: Utilizing a case study approach, we applied statistical analyses to failure and recovery data, aiming to extract characteristic parameters crucial for predictive modeling. The data included failure frequencies, recovery times, and their impact on WSS performance. Results: The analysis yielded a global model predicting WSS availability and reliability, incorporating failure and recovery rates to evaluate the system's operational efficiency. The findings demonstrate the model's potential to predict WSS performance, guiding decision-making for future infrastructure investments and operational strategies. Conclusions: The predictive modeling approach offers significant insights into the WSS's management, indicating that such methodologies can enhance the reliability and efficiency of water supply systems. Future work should focus on refining these models with more extensive datasets, considering the variability of external factors like climate change and urban growth on system performance. The predictive modeling approach offers significant insights into the WSS's management, indicating that such methodologies can enhance the reliability and efficiency of water supply systems. Future work should focus on refining these models with more extensive datasets, considering the variability of external factors like climate change and urban growth on system performance. This underscores the importance of integrating predictive models into the strategic planning and operational frameworks of water supply systems to ensure sustainable water management in response to evolving environmental and societal demands.



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sciforum-104922: Evaluating and Ranking Sustainable Water Management Solutions for the Trans Sumatera Toll Road Project

Ihsan Aulia Rahman ^{1,*}, Salsabila Yowinda Putri ², Ines Wahyuniati Riza ¹, Gregorius Aji Sentosa ³ and Eri Dwi Wibawa ⁴

¹ Research Officer, Unit of Engineering & Technology Research, Division of Engineering & Information Technology, PT Hutama Karya (Persero), Jakarta Timur, DKJ Jakarta, 13340, Indonesia

² Student, Department of Civil Engineering, Diponegoro University, Semarang, Jawa Tengah, 50275, Indonesia

³ Executive Vice President, Division of Engineering & Information Technology, PT Hutama Karya (Persero), Jakarta Timur, DKJ Jakarta, 13340, Indonesia

⁴ Vice President, Unit of Engineering & Technology Research, Division of Engineering & Information Technology, PT Hutama Karya (Persero), Jakarta Timur, DKJ Jakarta, 13340, Indonesia

The construction of toll road infrastructure is crucial for driving economic growth and enhancing regional connectivity. One of the largest ongoing projects in Indonesia is the Trans Sumatera Toll Road mega project, developed by PT Hutama Karya (Persero). Despite its promising prospects, the project faces significant challenges, including providing clean water for operational use. Effective water management is essential, impacting project operational costs, worker and toll road user health, rest area functionality, and environmental sustainability.

This study presents an overview of water use in construction and recommends measures to enhance water management practices. It analyzes various solutions for clean water management, ranking them based on efficiency, sustainability, and practicality. Using a multi-criteria decision analysis (MCDA) approach, the research evaluates the potential benefits of each solution, with Hutama Karya's wastewater treatment technology being a key focus.

The results indicate that the proposed solution ensures optimal water availability and quality, particularly in toll road projects and rest areas. Furthermore, this research offers advantages in sustainability and eco-friendly energy use. This technology proves effective, economically viable, and beneficial for sustainable water management. This paper aims to identify and rank the best solutions for clean water management to support the Trans Sumatera Toll Road mega project.



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sciforum-097404: Evaluating the Effectiveness of Vetiver and Alum in Novel Microplastic Filtration Methods

Koneru Neha * and Mani Gudivada

Department of Zoology, Andhra University

The author has withdrawn this abstract, therefore it will not be included in the listing here.

sciforum-102608: Evaluation of hexavalent chromium removal efficiency using natural bituminous coal: A batch and column approach

Emmanuel Papeti¹, Menberu Yitbarek¹, Yohannes Desalegn Wirtu¹ and Fekadu Melak^{2*}

¹ Department of Chemistry, College of Natural Sciences, Jimma University, Jimma, Ethiopia

² Department of Environmental Biotechnology, Institute of Biotechnology, Bahir Dar University, P.O. BOX 79, Bahir Dar, Ethiopia

Chromium (Cr) is a potentially toxic metal considered 17th in the toxicity profile of the Agency for Toxic Substances and Disease Registry (ATSDR). Thus, this study focused on the performance of natural bituminous coal (NBC) from Ethiopia in the uptake capacity of Cr (VI) from aqueous solutions. Batch and column adsorption experiments were performed in order to examine the removal process under various parameters. The parameters were optimized using the one-factor-at-a-time method. Parameters considered at the batch scale include contact time, pH, initial concentration, adsorbent dose, and temperature. These parameters (e.g., pH(2-9), contact time (30-180 min.), dose of the adsorbent (0.25-2 g), initial Cr (VI) concentration (3-150 mg/L), and temperature (20-45 °C), were optimized in triplicate. Similarly, at the column stage, parameters including column height, flow rate, dose, and initial concentration were considered. The adsorbent coal samples were collected from five sites in Delbi, Ethiopia, and composite samples were used for the adsorptive analysis. The adsorbent was then characterized using FTIR and XRF. The results of the study suggested that Cr (VI) ion uptake was pH-dependent and reached its optimum potential at pH 3.0 in the batch process. The capacity of NBC at equilibrium was estimated to be 11.54 mg/g from the Freundlich isotherm model. The isotherm study revealed that Freundlich isotherms explained the adsorption process. It was determined that removal of Cr (VI) was well fitted by second-order reaction kinetics over pseudo-first-order reaction kinetics. The thermodynamics of the adsorption of Cr (VI) were found to be negative, indicating an exothermic adsorption process. The results of the column experiments indicated that NBC could be suitable for treating water contaminated with low concentrations of Cr (VI) at a slow flow rate of 1.25 mL/min. Therefore, the batch and column studies showed that NBC is a favorable adsorbent for the removal of Cr (VI) from an aqueous solution.



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sciforum-096622: Evaluation of SDGs Using Indicators in Urban Water Systems

Camila Garcia ^{1,*}, Helena M Ramos ², P. Amparo López-Jiménez ¹ and Modesto Pérez-Sánchez ¹

¹ Hydraulic and Environmental Engineering Department, Universitat Politècnica de València, Valencia, 46022 Spain

² Civil Engineering Research and Innovation for Sustainability (CERIS), Instituto Superior Técnico, Department of Civil Engineering, Architecture and Environment, University of Lisbon, 1049-001 Lisboa

Ensuring sustainable water management in urban areas is vital due to the increasing demands and resource constraints driven by rapid urbanization. This expansion presents significant challenges for resource management, requiring actions to ensure sustainability and mitigate resource depletion. Water managers must enhance efficiency across the entire water cycle, as processes like water distribution are major energy consumers, with wastewater treatment also being highly energy-intensive. Despite the critical nature of these tasks, there is a notable lack of sustainable methodologies that are applicable to urban water systems (UWSs), highlighting the need for innovative strategies that assess sustainability across all dimensions, not just environmental ones. This research addresses this gap by proposing a new methodology to measure and categorize UWSs based on their contributions to sustainability. The developed methodology assesses water systems and establishes a benchmarking framework on sustainable aspects. The procedure enables the evaluation of the Sustainable Development Goals (SDGs) in any water system, establishing four levels of sustainability benchmarking. These indicators were applied to 110 worldwide case studies, facilitating benchmarking on sustainable aspects and demonstrating the methodology's effectiveness. A specific case study showed a 22% reduction in energy consumption and a 57% achievement of SDG targets in a wastewater treatment plant. Additionally, applying the methodology to six real supply systems in Spain demonstrated a 42% compliance with sustainability targets. These findings provide water managers with a robust tool for decision making, enabling the optimization of system performance across the entire water cycle and alignment with global sustainability goals. This research fills a critical gap by offering a versatile and comprehensive approach to evaluating and improving the sustainability of urban water systems.

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sciforum-103015: Exploring Nature-Based Solutions for Environmental Challenges in Macau: A Pilot Study on Floating Wetlands for Water Pollution Remediation

Cristina Sousa Coutinho Calheiros ^{1,*} and Karen Tagualo ²

¹ Interdisciplinary Centre of Marine and Environmental Research (CIIMAR/CIMAR), University of Porto

² Institute of Science and Environment, University of St. Joseph, Macao SAR, China

Floating wetlands are artificially constructed platforms that support aquatic vegetation growing hydroponically. These systems are considered a nature-based solution (NBS), leveraging the natural processes of plants, microbes, and associated microorganisms to filter and enhance water quality by removing pollutants such as nutrients, heavy metals, and organic contaminants. In Macau SAR, China, a coastal city with significant water bodies, floating wetlands offer a promising solution to mitigate water pollution. Macau faces considerable environmental challenges due to urban runoff, industrial discharge, and limited natural wetlands. The implementation of floating wetlands can effectively address these issues. This study aims to evaluate the use of floating wetlands for the remediation of water pollution, particularly eutrophication, in both freshwater and coastal wetlands. A pilot-scale floating platform, made of bamboo and coconut fibers, was set up as a base for the vegetation. Local coastal mangrove species such as *Kandelia obovata* and *Aegiceras corniculatum*, along with freshwater wetland plants like *Thalia dealbata*, *Canna* sp., and *Iris* sp., were anchored between the bamboo tubes and secured with coconut fibers and polyethylene nets. Nutrient concentrations in the surrounding waters were measured before deployment and monitored thereafter. The growth conditions of the plants and the biodiversity within the floating wetlands are also being monitored. Biofilm from the roots of the plants will be collected and processed for sequencing to identify associated microorganisms involved in phytoremediation. We expect that the presence of floating wetlands will improve water quality and biodiversity in the system. *Acknowledgments:* Calheiros C.S.C. is thankful to Strategic Funding UIDB/04423/2020, UIDP/04423/2020, and LA/P/0101/2020 through national funds provided by FCT.



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sciforum-104082: Floating Treatment Wetland: phytoremediation applied to the Brazilian Semi-arid region

Gabriele de Souza Batista ^{1,*}, Mauro Normando Macêdo Barros Filho ¹, Elis Gean Rocha ¹ and Cristina Sousa Coutinho Calheiros ²

¹ Center for Technologies and Natural Resources (CTRN), Federal University of Campina Grande, Brazil

² Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), University of Porto, Portugal

Floating Treatment Wetland (FTW) is a technique that can be used for the restoration of water bodies based on phytoremediation processes. FTW simulates the natural wetland environment and accelerates the processes that occur there, contributing to ecosystem conservation, pollution, and erosion reduction. Briefly, a typical FTW is composed of a floating structure and plants that interact with microorganisms, water, and the surrounding environment to remove contaminants. In the Brazilian semi-arid region, characterized by natural drought processes, the use of this technology helps mitigate challenges related to water security and quality. This study conducted a survey of selected plant species that can be used in the development of FTW projects in the Brazilian semi-arid region. Through the Web of Science and Google Scholar platforms, 12 publications were collected using the keywords Wetlands, Floating Treatment Wetlands, Phytoremediation, and Brazilian Semi-arid. The species *Cyperus papyrus* (33%), *Canna x generalis* (33%), *Tradescantia zebrina* (25%), *Eichornia crassipes* (25%), and *Iris pseudacorus* (25%) had the highest number of applications and best adaptation; 17% of the studies utilized the species *Typha domingensis*, *Solms* and *Chrysopogon zizanioides*. The results indicate that FTW needs to be further explored through studies on native plants and specific analyses focused on their evaluation.

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sciforum-103366: Floating Wetland Islands as a water treatment technology

Sofia Pereira ^{1,*} and Cristina Calheiros ²

¹ Universidade Católica Portuguesa

² Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), University of Porto, Portugal

Floating wetland islands (FWIs) are innovative nature-based solutions designed to enhance water quality in various aquatic environments, including lakes, ponds, and reservoirs, while restoring their ecological functions. In recent years, FWIs have gained popularity due to their effectiveness, low cost, and low maintenance needs. These systems provide a range of valuable ecosystem services, such as boosting biodiversity, enhancing aesthetic appeal, and improving water quality through phytoremediation. The plants on FWIs absorb excess nutrients like nitrogen and phosphorus, mitigating nutrient pollution, reducing eutrophication, and preventing water body degradation. Additionally, the microorganisms associated with plant roots and floating mats decompose organic matter, while the plants facilitate oxygen transfer into the water. Moreover, FWIs provide essential habitats for wildlife such as birds and insects, thereby enriching local biodiversity.

This study aimed to showcase the implementation of an FWI composed of a polyculture of *Iris germanica*, *Acorus gramineus*, *Caltha palustris*, and *Typha latifolia*, established on a cork agglomerate platform in a freshwater pond. The FWI was installed in 2018, with ongoing monitoring to evaluate improvements in local biodiversity and to assess the long-term effectiveness of the buoyancy in supporting plant growth.

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sciforum-102928: Harnessing Carbon-Based Nanomaterials for Advanced Desalination in Polymeric Membranes

Imran Ahmad Khan ^{1,*} and Nasir Mahmood Ahmad ²

¹ National University of Science and Technology Islamabad Pakistan

² School of Chemical and Materials Engineering (SCME), National University of Sciences and Technology (NUST), H-12 Sector, Islamabad 44000, Pakistan

Membrane-based separation technology has been extensively utilized in desalination, owing to its high efficiency and lower energy consumption. Unlike traditional polyether sulfone membranes, the novel composite membrane features distinct physicochemical structures and properties. The incorporation of carbon-based nanomaterials like activated carbon, carbon nanotubes, and graphene oxide enhances the membrane's separation performance, resistance to diverse feed waters, and operational lifespan. The present study investigated the desalination performance of nanocomposite polyether sulfone (PES) membranes embedded with activated carbon (PES-AC), multi-walled carbon nanotubes (PES-CNT), and graphene oxide (PES-GO) in aqueous solutions of NaCl and Na₂SO₄. Salt rejections were evaluated using a dead-end filtration cell assembly. The PES-AC, PES-CNT, and PES-GO membranes demonstrated salt rejection rates of 42%, 51%, and 60%, respectively, for NaCl aqueous solution at 0.8 MPa. The salt rejection performance for Na₂SO₄ was 47%, 53%, and 58% for the PES-AC, PES-CNT, and PES-GO membranes, respectively. In conclusion, embedding carbon-based nanomaterials significantly enhanced the salt rejection performance of PES membranes, positioning them as a promising solution for advanced treatment of saline water. In conclusion, the integration of carbon-based nanomaterials into polyether sulfone (PES) membranes has markedly improved their salt rejection capabilities. This advancement not only meets the increasing demand for efficient desalination technologies but can also foster the development of sustainable and cost-effective water treatment solutions. Therefore, these modified PES membranes have the potential to significantly contribute to the global effort to provide clean and safe drinking water from saline sources.



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sciforum-101792: Highly competent synergistic elimination of toxic heavy metal oxo-anions and cations using novel 2D mesoporous guanidinium-based ionic covalent organic framework

Fathima Jerosha Ifthikar Ahmed

Nottingham Ningbo China Beacons of Excellence Research and Innovation Institute, University of Nottingham Ningbo China, Ningbo 315000, China

Oxo-anions and cations of heavy metals often exist together in the environment. As they have opposite charges, it is a major challenge to remove them simultaneously and efficiently. In this work, a novel 2D mesoporous guanidinium-based ionic covalent organic framework (iCOF), exhibiting excellent reductivity and stability for the removal of oxo-anions (Cr(VI), V(V), Se(IV)), and cations (Pb(II)) in the pH range of 3–6, was used. In a single medium, rapid removal occurred within one hour with maximum removal capacities of 607.2, 589.6, and 221.6 mg g⁻¹ for Cr(VI), V(V), and Se(IV), respectively, at 30 °C. In addition, the coexistence of Pb(II) with Cr(VI)/V(V)/Se(IV) in the binary medium significantly increased the removal efficiency of both cations and oxo-anions using the iCOF composite. Based on the kinetic and isothermal mathematical models that reveal the chemical nature of adsorption throughout the process. Inspiringly, the system was tested in four types of wastewaters with different pH values to show its practical applicability. The results show that 1 kg of iCOF can decontaminate more than 2000 litres of ~10 mg L⁻¹ Cr(VI), V(V), and Se(IV), at a cost of USD 579 to the EPA's effluent discharge limit. In addition, the comprehensive work carried out for this study has broader applications that can be used to treat toxic cationic and oxo-anionic heavy metal contaminants from a wide variety of wastewaters.



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sciforum-102359: Hydroponic System For Kitchen Gardening

Muhammad Maaz Tanveer *, Mannan Aleem, Ammad Bin Ayub, Ahmad Akram and Ch. Arslan

Department of Structural and Environmental Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad, Pakistan

Agriculture contributes 24% of Pakistan's GDP, serving as the backbone of the country's economy. In 2022, agriculture contributed around 22.5% to the GDP of Pakistan. This sector provides food and raw materials for the people of Pakistan, but it faces many problems despite its importance. In traditional agriculture, soil serves as the growing medium, providing the necessary nutrients and minerals for optimal plant growth. However, fertile land is decreasing rapidly due to soil erosion, land pollution, and urbanization, which reduces agricultural productivity. As fertile land becomes infertile and the world population continues to grow, reaching an estimated 9.7 billion by the end of 2050, alternative solutions are necessary to meet the food demand. This necessity leads us to the hydroponic system, a promising method that relies on a nutrient solution for plant growth. This final year project is an important step in promoting sustainable agriculture and effective food production. In hydroponics, growing media such as perlite, rockwool, and coconut coir are used. The roots are submerged in a nutrient-rich solution, where plants absorb the necessary nutrients. Soil-less farming practices have shown very promising results globally, especially in areas with low fertility, due to improved space and water-conserving techniques that minimize environmental effects. The primary focus of this final year project on hydroponic systems for kitchen gardening is to provide access to fresh, 100% organic homemade vegetables and fruits, regardless of the user's agricultural knowledge. Plants can achieve 20-25% higher yields compared to the traditional soil-based method, with a productivity range of 2-5 times greater.



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sciforum-096002: Impact of Methylparaben on *Stenotrophomonas maltophilia* Colony Biofilm Architecture and Tolerance to Chlorination and Antibiotics

Ana Rita Pereira ^{1,*}, Liam Mark Rooney ², Inês Bezerra Gomes ³, Manuel Vieira Simões ¹ and Gail McConnell ²

¹ LEPABE - Laboratory for Process Engineering, Environment, Biotechnology and Energy, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal ALiCE - Associate Laboratory in Chemical Engineering, Faculty of Engineering

² Strathclyde Institute of Pharmacy and Biomedical Sciences, University of Strathclyde, 161 Cathedral Street, Glasgow G4 0RE, UK

³ LEPABE - Laboratory for Process Engineering, Environment, Biotechnology and Energy, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal ALiCE - Associate Laboratory in Chemical Engineering, Faculty of Engineering

Parabens, as emerging environmental contaminants, raise significant concerns due to their potential to disrupt microbial ecology and dynamics. Their widespread use and continuous discharge result in their widespread distribution and accumulation in aquatic environments due to their incomplete removal by traditional wastewater treatment processes. Bacterial biofilms in these water systems are continually exposed to parabens, resulting in varied bacterial behaviors and characteristics. This study is the first to assess the changes in the biofilm architecture induced by chlorination and the effect of methylparaben (MP) on colony biofilm architecture and conformation using a Mesolens microscope. For this purpose, 2-day-old *Stenotrophomonas maltophilia* colony biofilms were grown in R2A agar with MP at environmentally relevant (15 µg/L) and in-use concentrations (15000 µg/L), both with and without free chlorine at 5 mg/L. MP exposure induced noticeable changes in the biofilm structure, such as a denser center and the formation of distinct structures like channels within the colonies. The MP-exposed colony biofilms exhibited more pronounced internal structures, evidenced by a higher number of peaks in the intensity profile. Chlorine disinfection significantly reduced the bacterial growth in the colony biofilms, decreasing the colony diameter by more than half. Additionally, the circularity of the colonies was significantly affected when chlorine and MP were simultaneously present. Furthermore, MP compromised drinking water's disinfection and increased *S. maltophilia*'s tolerance to TMP-SMX, resulting in a 26% decrease in the inhibition halo compared to that for the non-exposed counterparts. These findings suggest that MP, even at environmentally relevant concentrations, can significantly impact the architecture of *S. maltophilia* colony biofilms, affecting their tolerance to chlorine and antibiotics.



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sciforum-097142: Impact of Urban Green Roofs on Downstream System Design

Ana Mafalda Mendes ^{1,2}, Cristina M. Monteiro ^{3,*} and Cristina Santos ^{4,5}

¹ 1FEUP- Faculdade de Engenharia da Universidade do Porto, Porto, Portugal, Rua Dr. Roberto Frias s/n, 4200-465 Porto, Portugal

² CEiiA – Centro de Engenharia e Desenvolvimento, Av. Dom Afonso Henriques, 1825. 4450-017 Matosinhos, Portugal

³ Escola Superior de Biotecnologia - Universidade Católica Portuguesa

⁴ FEUP- Faculdade de Engenharia da Universidade do Porto, Porto, Portugal, Rua Dr. Roberto Frias s/n, 4200-465 Porto, Portugal

⁵ CIIMAR – Centro Interdisciplinar de Investigação Marinha e Ambiental, Terminal de Cruzeiros de Leixões, Av. General Norton de Matos s/n, 4450-208 Matosinhos, Portugal

In last decades, urban population increase led to the displacement of green spaces and natural infiltration areas, with impermeable surfaces, harming the urban water cycle. Furthermore, and due to the increased frequency and intense extreme precipitation events that are happening more frequently due to global climate change effect, traditional urban drainage systems could not effectively manage precipitation-generated surface water in such intense events, straining the city's water drainage infrastructure. In this regard, Green Roofs (GR) have been considered a sustainable engineering solution that can help to minimize drainage systems stress, due to their retention and detention capacity into their multilayer system structure, and therefore decreasing the amount of drained water that runs-off to the pluvial urban drainage network. The present work developed a simulation procedure, encompassing four roofs of different areas (150 m², 300 m², 500 m² and 1000 m²) to assess the impact of the implementation of an extensive GR with expanded clay in its composition (drainage layer and substrate), on downstream drainage systems sizing process. Characteristic runoff coefficients of different types of roof structures and also a runoff coefficient from an experimental GR tested were selected, to determine the rainwater inflow rate to drainage pipes downstream, Q . Simulation results obtained showed that expanded clay extensive GR allows lowest diameters for the drainage system downstream when compared to other roof types, leading to a potential decrease in the costs associated with the drainage network installation.



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sciforum-095487: Investigation of Diazinon Adsorption from Aqueous Solutions Using Natural Absorbents

Banafsheh Amiri¹, Khaled Ahmadaali², Seyedehssan Torabi³, alireza moghaddamnia³ and Iman Hajirad²

¹ Department of Arid and Mountainous Regions Reclamation, Faculty of natural resources, University of Tehran, Karaj, Iran

² Department of Irrigation and Reclamation Engineering, College of Agriculture and Natural, University of Tehran, Karaj, Iran

³ Department of Plant Protection, Faculty of Agriculture, College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran

Three natural adsorbents were used in this study to determine the absorption rate of diazinon pollution from water environments: date kernel powder, powdered pine cone, and powdered natural biochar from Kuhbanan mining. The tests were conducted using a batch-series test. To model the diazinon pollutant, various concentrations of each adsorbent were investigated as the primary research parameter. The Fourier transform infrared (FTIR), scanning electron microscopy (SEM), and methylene blue test were used to examine the characteristics of the natural absorbent particles employed in this investigation. The findings demonstrate that each adsorbent has a large specific surface area that is ideal for pollutant absorption, a high porosity and roughness, and a multitude of functional groups on its surface.

Analyzing diazinon pollutant absorption by adsorbents quantitatively involves examining Langmuir and Freundlich isotherms. The outcomes of the batch tests demonstrated that 5 grams of natural biochar powder, with an absorption percentage of 1.65%, and 1 gram of natural biochar powder, with an absorption percentage of 0.1, respectively, had the highest and lowest rates of diazinon pollutant absorption. With an RMSE of 0.04 and an R^2 of 0.96, the Freundlich isotherm model fits the date kernel powder absorbent data the best out of all the fitted models. In conclusion, the data obtained indicate that natural biochar powder exhibits the highest absorption rate and the highest effectiveness when it comes to eliminating diazinon from water.



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sciforum-096742: Leveraging Patent Analysis for Innovative Smart Water Grid Solutions

Ahmed Fatimi

Chemical Science and Engineering Research Team (ERSIC), Department of Chemistry, Polydisciplinary Faculty of Beni Mellal (FPBM), Sultan Moulay Slimane University (USMS), P.O. Box 592 Mghila, Beni Mellal 23000, Morocco

Abstract

A "smart water grid" refers to the application of advanced technologies to water distribution systems, aiming to improve their efficiency, sustainability, and resilience. Smart water grids are a combination of the internet of things and information and communications technologies that aim to improve the monitoring, management, and efficiency of water distribution systems. These systems involve the use of sensors, data transmission, and system controls to address various challenges such as water leaks, overuse, quality issues, and responses to droughts and natural disasters. The development of smart water grids faces barriers, but there are solutions being explored to overcome these challenges.

Inventions, through patents, could propose thousands of solutions to such barriers and problems in this area. Patent analysis, as a powerful tool for technology monitoring, can be leveraged for patent inspiration in several ways, such as identifying emerging technologies and trends, studying competitor strategies, leveraging prior innovation, and so on.

In this study, a patent analysis related to smart water grids is proposed. Based on the jurisdictions, classifications, and applicants, an overview is given by answering specific questions, such as those relating to the patterns of patenting for smart water grids: who files patent applications, where, and what is filed?

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sciforum-103267: Local Scale Integrated Approaches for Enhancing Water Reuse: Constructed Wetland Case Study

João Pedro Magalhães ^{1,*}, Cristina Calheiros ¹, Marina Dolbeth ¹, Francisco Arenas ¹, Sofia Pereira ², George Tsiamis ³ and Spyros Ntougias ⁴

¹ Interdisciplinary Centre of Marine and Environmental Research (CIIMAR), University of Porto, Portugal

² Universidade Católica Portuguesa, Escola Superior de Biotecnologia, Portugal

³ Department of Sustainable Agriculture, School of Agricultural Sciences, University of Patras, Greece

⁴ Department of Environmental Engineering, Faculty of Engineering, Democritus University of Thrace, Greece

Constructed wetlands (CWs) are engineered systems, considered a nature-based solution (NBS), that are inspired and mimic many processes (physical, biological, and chemical) and functions that occur in natural wetlands. CIRQUA-Integrated Approaches at Local Scale for Enhancing Water Reuse Efficiency and Sustainable Soil Fertilization from Wastewater's Recovered Nutrients is a project that aims to improve NBS, focusing on CWs for wastewater treatment and water recovery in rural areas. The aim is to upgrade CWs using technological achievements, such as innovative nanostructured filters and photocatalytic modules, sensors and automation in operation, precision irrigation principles, and the integration of advanced artificial intelligence (AI) tools. These innovative technological achievements are being implemented in a case study in Portugal through the upgrading of an existing polyculture horizontal subsurface flow CW, in a rural area for the wastewater treatment of a tourism house. The CW was designed to act as secondary biological treatment, being placed after a previously installed septic tank. Wastewater quality assessment and biodiversity characterization are being carried out in order to evaluate the upgrading of the system. Acknowledgments: This study integrates the project entitled "Integrated Approaches at Local Scale for Enhancing Water Reuse Efficiency and Sustainable Soil Fertilization from Wastewater's Recovered Nutrients", grant agreement No. 2321, Call 2023 Section 1 Management of Water IA, part of the PRIMA programme supported by the European Union. The PRIMA programme is supported under Horizon 2020, the European Union's Framework Programme for Research and Innovation. Authors affiliated with CIIMAR are thankful for the Strategic Funding UIDB/04423/2020, UIDP/04423/2020, and LA/P/0101/2020 through national funds provided by FCT.



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sciforum-102762: Magnetic nanoparticles decorated with synthetic zeolite derived from coal fly ash: Application to removal of heavy metals and organic dyes

Santhana Krishna Kumar Alagarsamy

Department of Chemistry, National Sun Yat-sen University, No. 70, Lien-hai Road, Gushan District, Kaohsiung city-80424, Taiwan

Abstract

Fly ash, a coal combustion by-product, can be converted into zeolites with enhanced adsorption capacity for removing toxic pollutants. This study modified fly ash-derived zeolites with amino propyl imidazole, creating imidazolium-based zeolites for loading Fe_3O_4 NPs. The resulting magnetic film (Fe_3O_4 NPs@zeolite) showed an excellent adsorption of heavy metals and dyes, making it effective for detoxifying industrial wastewater.

Introduction

Chromium and selenium contamination from industrial and geological sources causes severe health and ecological problems. Chromium, found in wastewater, and selenium, emitted from geothermal and volcanic activities, pose risks such as hair loss and kidney damage. Synthetic zeolites, modified with imidazolium-based ionic liquids and magnetic nanoparticles, offer a promising solution for removing these contaminants from water, providing effective and sustainable water treatment options.

Methods

NaX-UP zeolites were synthesized from fly ash by mixing with NaOH and heating, followed by sodium aluminate addition and stirring. The product was washed, dried, and modified with 1-(3-aminopropyl) imidazole to form IL-NaX-UP zeolites. Fe_3O_4 NPs were then synthesized on these zeolites, resulting in a magnetic thin film.

Results

The as-fabricated magnetic films exhibited excellent functionality and durability in the adsorption of Cr(VI), Se(IV), Congo Red, and RhB [1]. The magnetic films are very suitable for practical applications as they can achieve maximum removal performance over a wide pH range. According to the pseudo-second-order kinetic model, the magnetic films have fast adsorption kinetics compared to earlier evidence from the literature.

Conclusions

The resulting magnetic films, incorporating PSS, PVA, and chitosan, demonstrated an excellent adsorption of Cr(VI), Se(IV), Congo Red, and RhB, and were effective in treating water, creating drinkable water by meeting WHO and EPA standards.



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sciforum-097547: Mitigating the Global Potable Water Crisis: A Systematic Review of Emerging Urban Stormwater Conversion Technologies

Kylle Gabriel Cruz Mendoza ^{1,*}, Marc Deo Jeremiah V. Rupin ¹ and Rugi Vicente C. Rubi ²

¹ Chemical Engineering Department, College of Engineering, Pamantasan ng Lungsod ng Maynila, General Luna, corner Muralla St., Intramuros, Manila 1002, Philippines

² Chemical Engineering Department, College of Engineering, Adamson University, 900 San Marcelino St. Ermita, Manila 1002, Philippines

The wide-scale management and treatment of urban stormwater is a promising technological advancement to address the ongoing global potable water crisis. About 26% of the global population have unsafe drinking water and 46% have no safely managed water for sanitation. However, the lack of regulatory framework for urban stormwater usage and uncertainty in water quality poses significant threats to its wide-scale application. Emerging conversion technologies provide a more efficient and cost-efficient means to convert urban stormwater to potable water. Urban Stormwater management such as capture in large cisterns and run-off capture provides the necessary means to properly collect and manage while engineered stormwater treatment systems such as stormwater biofilters provide high reliability and performance while having zero energy consumption for the treatment of collected storm water. By utilizing an efficient urban stormwater management system and appropriate treatment technologies, urban stormwater can be used to alleviate the problems with potable water scarcity. This study delves into utilizing urban stormwater for the generation of potable water, evaluates conversion technologies, and presents its application to mitigate the global potable water crisis. Urban stormwater management systems are examined thoroughly, treatment processes are investigated, highlighting the importance of using appropriate technologies in potable water generation. Through conversion technologies, high volume urban stormwater can be transformed into potable drinking water, addressing water resource management problems and the ongoing global potable water crisis. This systematic review will identify existing conversion technologies and provide research gaps that will pave way to a more efficient and cost-effective conversion technologies that will use high volume urban stormwater for the production of potable water.



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sciforum-092458: Nitrate filtration by deep water culture

Beyza Özdemir and Andrea Ehrmann *

Faculty of Engineering and Mathematics, Bielefeld University of Applied Sciences and Arts, 33619 Bielefeld, Germany

Sustainable water supply is crucial to meet the increasing demand for drinking water and water resources worldwide. A serious challenge in this context is the presence of high nitrate levels in water sources due to agricultural activities and human impacts.

Nitrate is a common anion found in water as a result of agricultural fertilization and other human activities. While nitrate itself is not harmful to health, it can cause health problems at high concentrations in drinking water sources or industrial water reservoirs. The limit value in groundwater is 50 mg/L according to the European Union's Groundwater Directive 2006/118/EC, and countermeasures are to be initiated at a value of 37.5 mg/L. Most methods to reduce the nitrate level, however, are relatively expensive.

One promising method for reducing nitrate levels in water could be the cultivation of plants in deep-water culture systems. In this approach, plant roots are placed in containers filled with water, whereby the plants are able to absorb nitrate from the water and use it for their own growth. In this way, an environmentally friendly alternative for the food supply by cultivating vegetable plants could be achieved in addition to the actual goal of processing groundwater and drinking water. The present experiment aims to test the effectiveness of deep-water culture as a method for reducing high nitrate levels in water. Several series of tests were carried out with different nitrate concentrations and are presented in this poster, giving an overview of possibilities for nitrite reduction and the limits of the measurements.



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sciforum-097050: Optimization of Drinking Water Network Management: Traditional and Innovative Approaches for Leak Detection and Management

Alex Javier Garzón-Orduña ^{1,2,3,*}, Oscar Coronado Hernandez ⁴, Alfonso Arrieta ⁴, Helena Ramos ⁵ and Modesto Pérez-Sánchez ⁶

¹ Researcher

² School of Engineering, Department of Civil and Agricultural Engineering, Universidad Nacional de Colombia, Bogotá 111321, Colombia

³ bUnidad de Gestión de Aguas y Saneamiento, HMV Ingenieros, Bogotá 110231, Colombia

⁴ Instituto de Hidráulica y Saneamiento Ambiental, Universidad de Cartagena, Cartagena 130001, Colombia

⁵ Civil Engineering Research and Innovation for Sustainability (CERIS), Instituto Superior Técnico, Department of Civil Engineering, Architecture and Environment, University of Lisbon, 1049-001 Lisbon, Portugal

⁶ Hydraulic and Environmental Engineering Department, Universitat Politècnica de València, Valencia, 46022 Spain

The study of leaks in potable water networks is crucial due to rates that can exceed 30%, resulting in significant losses and impacting finances, the environment, and water availability. Water management companies grapple with effectively managing these systems, especially in reducing leaks in aging infrastructure. Innovative technologies like mathematical modeling and computational simulation enhance leak detection and management. However, these methods often disregard system inertia, omitting variations in pressure regulating valve (PRV) operations over short periods.

This article compares traditional methodologies with an alternative approach introducing an innovative rigid water column model. This model evaluates losses considering PRV adjustments over short periods, analyzing pressure variations and leakage flow patterns. By factoring in system inertia, it provides a more accurate assessment of leak volumes, improving water management efficiency, and offering a practical tool for engineers assessing leakage volumes in real networks. The importance of considering system inertia to properly simulate PRV operations in water distribution systems is emphasized.

In essence, integrating system inertia into leak management strategies is crucial for optimizing the performance of potable water networks. Leveraging advanced modeling techniques and acknowledging the dynamic nature of water systems enable stakeholders to make informed decisions, minimizing losses, preserving resources, and ensuring water supply sustainability.



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sciforum-097681: Optimizing Energy Use in Water Supply Networks: Minimizing Pump Consumption and Ensuring Water Quality

Gabriella Colajanni ¹, Letizia Paone ¹, Roberto Gueli ^{2*}, Alessio Barbaro Chisari ² and Wladimiro Carlo Patatu ²

¹ University of Catania, Catania, Italy

² EHT S.C.p.A., Catania, Italy

Introduction

Climate change is causing significant shifts in weather patterns and temperatures, leading to environmental degradation, natural disasters, and resource scarcity. Sustainable practices are crucial to mitigate these effects, particularly in the energy and water sectors. This paper presents a mathematical model aimed at optimizing the use of electric energy in water supply networks while ensuring water quality. The focus is on minimizing energy consumption by electric pumps and maintaining the integrity of the pumps through controlled on/off cycles.

Methods

The proposed optimization model considers a hydraulic network with multiple water sources, each with different quality indices. Key assumptions include maintaining minimum pressure throughout the network and ensuring the total volume of water meets demand. The model involves a non-linear formulation, which is later linearized for practical application. Decision variables indicate whether a pump is on or off at given times, and the objective function aims to minimize the total energy consumption of the pumps.

Results

The model's non-linear formulation calculates the energy used by each pump based on its flow rate, head, and efficiency. Constraints ensure that the water volume in each reservoir stays within capacity limits and that the mixed water quality remains within specified bounds. The model also limits the number of pump switches to prevent system wear. Application of the model to a real-world scenario demonstrated its effectiveness in reducing energy consumption while maintaining water quality and operational constraints.

Conclusions

This study addresses the need for energy-efficient water supply systems by optimizing pump operation schedules. The model successfully balances energy use with water quality requirements and system durability. Future work could involve further refining the model to incorporate more dynamic factors and expanding its application to larger and more complex water networks.



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sciforum-091406: Optimizing the dissolved oxygen requirements for effective pollutant removal from coastal aquaculture wastewater aiming at water recycling

Ana T. Oliveira ¹, Paula M.L. Castro ¹ and Catarina L. Amorim ^{2,*}

¹ Universidade Católica Portuguesa, CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia, Porto, Portugal

² Universidade Católica Portuguesa, CBQF – Centro de Biotecnologia e Química Fina – Laboratório Associado, Escola Superior de Biotecnologia

Wastewater treatment presents a pressing global challenge, emphasizing the urgent need for more sustainable solutions. In pursuit of energy and carbon neutrality, microalgal–bacterial granular sludge (MBGS) systems have emerged as a promising alternative, leveraging the symbiotic relationship between the microalgae and bacteria within the granules in terms of gas exchange. MBGS systems offer efficient treatment but also hold promise for substantial energy savings and greenhouse gas emission reductions.

The present study aimed to ascertain the dissolved oxygen threshold required for efficient pollutant removal from coastal aquaculture, aiming at water recycling in industrial settings. To accomplish this, an MBGS system was applied to the treatment of aquaculture wastewater and underwent a gradual reduction in the airflow rate from 3.0 to 1.5 L min^{−1} over 134 days. Regardless of the airflow rate, complete ammonium removal was consistently achieved, while lower airflow rates appeared to enhance nitrite and nitrate removal. The composition of the treated effluents met the toxicity limits for fish, enabling water reuse in aquaculture facilities. However, if the airflow rate was reduced to about 1.5 L min^{−1}, outgrowth of filamentous microorganisms started to occur on the granules' surface, compromising their efficient separation from the treated water.

Aeration typically contributes significantly to the energy consumption in wastewater treatment processes. Utilizing MBGS systems can effectively reduce the aeration needs, up to a certain level, without compromising the treatment performance, thus improving the ecological footprint of the treatment process.

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sciforum-103278: Optimizing Urban Water System Efficiency with Smart Water Grids and IoT Technologies

Muhammad Mubashar Hanif ^{1,*}, Shahbaz Nasir Khan ², Adeen Sajid ³, Ramsha Arif ³, Ameer Umar Kharal ⁴ and Mazhar Hussain ⁴

¹ Agricultural Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad

² Department of Structures and Environmental Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad

³ Environmental Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad

⁴ Agricultural Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad

Urban water systems are under great strain due to population expansion, climate change, and aging infrastructure. Conventional water management practices are falling short of addressing the rising demand for both sustainable and efficient water utilization. Approximately, 30% of urban water is wasted due to leaks and inefficiencies, underscoring the pressing need for innovative solutions. This study explores how smart water grids and advanced technologies can boost the efficiency and resilience of urban water systems. By integrating IoT sensors, real-time data analytics, and automated control systems, smart water grids deliver valuable benefits such as real-time monitoring, leak detection, and improved water distribution efficiency.

A mixed-methods approach is employed in this study, integrating quantitative data analysis from smart water grid installation in various urban areas with qualitative perspectives from stakeholder interviews and detailed case studies. Key components involve the installation of IoT-enabled sensors for the live monitoring of water quality, flow, and pressure. The data gathered from these sensors will be evaluated with advanced statistical models and Geographic Information Systems (GIS) to chart water usage patterns and pinpoint infrastructure weaknesses. Furthermore, machine learning algorithms will be used to predict potential failures and dynamically adjust water supply to match demand.

The anticipated results of this study include notable reductions in non-revenue water, timely leak repairs, and improved water distribution efficiency. Such improvements are more likely to foster more sustainable urban development by guaranteeing a reliable water supply, lowering operational costs, and lessening environmental impacts. By tackling the pressing challenges of urban water management, this study aspires to establish more robust, efficient, and sustainable urban water systems, offering worldwide advantages to societies.



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sciforum-096360: Phosphate-Based Glass: A Promising Material for the Removal of Cationic Dye

Rida El-Bardai

Laboratory of Advanced Materials and Process Engineering (LAMPE), Faculty of Science, Ibn Tofail University, BP 133, 14000, Kenitra, Morocco

This research pioneers the innovative use of glass as a standalone adsorbent for the extraction of crystal violet (CV) dye from aqueous solutions, which is a novel method that has not been previously explored. A unique phosphate-based glass was synthesized using the conventional melt quenching process. The resulting glass was comprehensively characterized using a wide array of analytical techniques, including Fourier transform infrared spectroscopy (FTIR), X-ray energy-dispersive spectroscopy (EDS), scanning electron microscopy (SEM), Brunauer–Emmett–Teller (BET) analysis, Raman spectroscopy, thermal gravimetric analysis (TGA), and X-ray diffraction (XRD). This study marks the first successful application of phosphate-based glass as an adsorbent for CV dye removal, revealing a significant adsorption capacity. The adsorption process was influenced by various physicochemical parameters, which were systematically investigated. Both the Freundlich isotherm and pseudo-second-order models provided excellent fits to the isothermal and kinetic adsorption data, respectively. Detailed kinetic studies showed that the adsorption process followed pseudo-second-order kinetics and conformed to the Freundlich isotherm model. The maximum adsorption capacity observed was 266.745 mg/g. Thermodynamic assessments indicated that the CV dye adsorption process was both spontaneous and exothermic. These findings highlight the exceptional potential of the synthesized phosphate-based glass for effective wastewater treatment applications involving CV dye. This novel approach opens up new avenues for the use of glass materials in environmental remediation and could significantly impact future wastewater treatment technologies.



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sciforum-094996: Photocatalytic Dye Degradation & Antimicrobial Activity of Bi₂WO₆/ZnO Nanocomposite

Sudhan Koirala

Department of Physics , Patan Multiple Campus, Tribhuvan University, 44600, Lalitpur, Nepal

This study delves into the degradation of various dyes using a visible light-driven heterogeneous semiconductor photocatalyst, with a particular focus on a Bi₂WO₆/ZnO binary composite material synthesized via a hydrothermal method. The composite's enhanced photosensitivity to visible light, attributed to a reduced band gap, was revealed through thorough characterization using various analytical techniques. The photocatalytic efficiency of the Bi₂WO₆/ZnO composite was rigorously evaluated by subjecting cationic and anionic dyes to visible light exposure for a duration of 90 minutes.

The kinetic studies conducted demonstrated exceptionally high degradation efficiencies for cationic dyes. Notably, the composite achieved impressive degradation rates, including 99.94% degradation of RhB, 96% degradation of MB, 88% degradation of CV, and a substantial 66% degradation of MG within just 30 minutes. While anionic dyes exhibited slightly lower degradation percentages, the overall efficacy of the Bi₂WO₆/ZnO composite remained commendable.

Beyond its prowess in dye degradation, the Bi₂WO₆/ZnO composite exhibited intriguing antimicrobial activity against a spectrum of microorganisms. This included notable inhibition of *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans*, suggesting its potential application in addressing challenges associated with microbial contamination in addition to its role in environmental remediation.

This research underscores the multifaceted functionality of Bi₂WO₆/ZnO composites and their promising potential for various applications. By harnessing the power of visible light and innovative semiconductor materials, this study not only contributes to the development of sustainable water treatment strategies but also offers insights into broader environmental remediation efforts. The findings pave the way for the advancement of cleaner and safer environments, marking a significant step forward in the quest for effective solutions to contemporary environmental challenges.



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sciforum-098391: Polyoxometalates: Promising Solar-Powered Catalysts for Eliminating Textile Dye Contaminants

Amina Medkour

Department of Engineering Science, Badji-Mokhtar University, Annaba, Sidi Ammar, 23000, Algeria

Textile dye effluents pose a severe threat to environmental and public health in Algeria, necessitating sustainable remediation strategies. This study explores the application of cesium-substituted Dawson heteropoly acid (HPA) photocatalysts for solar-light-driven degradation of dye pollutants like methyl blue in water as an eco-friendly treatment approach. Cesium-substituted Dawson HPAs were synthesized and systematically evaluated for photocatalytic decolorization of methyl blue under direct sunlight irradiation. Critical parameters, including catalyst dosage, dye concentration, H_2O_2 levels, and the influence of inorganic ions (chloride, nitrate, and sulfate), were investigated at neutral pH. The optimal conditions of 1 g/L catalyst, 10 mg/L dye loading, and 3.92 mM H_2O_2 concentration were established to achieve nearly complete decolorization (DE=98%) within 90 minutes. Sulfate ions specifically inhibited dye decomposition, presumably due to scavenging effects. The synthesized cesium-HPA exhibited excellent solar photocatalytic activity for treating dyestuff effluents. Further research should focus on optimizing catalyst design, elucidating mechanisms, and scaling up this technology for practical industrial applications to facilitate the ecological restoration of water bodies impacted by textile effluents. Widespread adoption of such clean catalytic processes can raise awareness about mitigating the dangers textile dyes pose to the environment and ecosystems. Collaborative efforts between academic institutions, industry, and governmental agencies are recommended to develop integrated solutions leveraging this polyoxometalate photocatalysis platform for environmental remediation and to disseminate these research results concerning ecological restoration.



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sciforum-097500: Potential of green roofs to support urban rainwater management: hydraulic experimental assessment

Lineker Max Goulart Coelho *, Solbritt Christiansen and Jesper Molin

Technical University of Denmark - DTU, Dept. of Engineering Technology, Ballerup, 2750, Denmark

Green roofs are one of the nature-based technologies most largely used in the construction sector. Besides their aesthetical benefits, this technology can also be considered a decentralized solution for climate adaptation and flood mitigation, since it can contribute to reducing and delaying the peak flow in rainwater systems. However, even if it can be considered a mature technology, there are no consolidated design standards or guidelines particularly describing how to estimate rainwater volume retention in green roofs at national and international levels. So, the goal of this study is to analyze the hydraulic effect of green roofs on rainwater management based on experimental outflow rate monitoring. The experimental setup was installed at Ballerup in Denmark and consisted of three pitched roofs, each one with 25 m² of surface area and monitored over 1 year. Meteorological data were obtained using a weather station located just on the side of the pilots. The water outflow of the green roofs was monitored by measuring the rainwater flow rate in the pipe that collects water in each green roof. The green roofs presented variations in annual rainwater retention capacity, ranging from 35% to 50%. In terms of peak flow attenuation, it varied from 10% to 90% in both green roofs, depending on rain intensity and the duration of dry periods. The results obtained outline quantitatively the differences between green roof types in terms of water retention. These findings can be used to support future studies addressing green roof design optimization.



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sciforum-097785: Pressure Reduction Forecasting in Urban Water Distribution Systems Using EPANET and Machine Learning Models

Amir Noori ^{1,*}, Ehsan Roshani ² and Hossein Bonakdari ¹

¹ Department of Civil Engineering, University of Ottawa, 161 Louis Pasteur Private, Ottawa, ON K1N 6N5, Canada

² National Research Council, 1200 Montreal Rd., Ottawa, ON, K1A 0R6, Canada

Ageing phenomena are inevitable in urban water distribution systems (WDSs). One of the most popular techniques to reduce the consequences of water losses caused by ageing is the management of hydraulic parameters such as pressure reduction in the water mains. In this study, aiming to investigate the effect of pressure reduction on leakage, EPANET 2.2 software is used to simulate an urban water distribution network. The application of Machine Learning (ML) models such as ANFIS (Adaptive Neuro-Fuzzy Inference System)-Genetic Algorithm (GA), ANFIS-Particle Swarm Algorithm (PSO), and Extreme Learning Machine (ELM) is evaluated to reduce damage due to high operating pressure in a WDS while considering the measured values of head loss and velocity data through hydraulic simulation caused by diurnal demand patterns. In order to investigate the difference between the historical and estimated values, the Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Akaike Information Criterion (AIC), and R are used. A real-world case study is selected to apply the proposed models. After the application of Machine Learning, the obtained results indicate that the ELM technique provides an appropriate tool for predicting pressure in the WDS with minimum error and high desired accuracy. This means that the implementation of the results of the proposed ML model in a real urban WDS is feasible and plays a key role in reducing water losses.



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sciforum-097769: Production of filtration membrane in recycled cellulose acetate to capture wastewater contaminants

Beatriz Martins Silva *, Elina Marinho and Helena Prado Felgueiras

Centre for Textile Science and Technology (2C2T), University of Minho

Sustainability, the word of the moment and a goal that all industries want to achieve, is based on three basic principles: society, environment, and economy. In search of more ecological practices and reduced costs, many companies are currently updating their practices and, consequently, evolving.

The textile and pharmaceutical industries are some of the most influential industries today, contributing to the well-being of humanity and providing socioeconomic benefits, but in them, water resources are affected, with current practices being insufficient to guarantee the treatment of wastewater.

The objective of this research is to develop a cellulose acetate (CA) membrane, originating from pre-consumer cotton waste, modified with an absorbent to capture wastewater contaminants, and to thereby prevent pollution and the deterioration of marine ecosystems. Cork particles will be incorporated into the membrane and tested as potential contaminant absorbers. Membranes with and without additives will be characterized physically, chemically, and mechanically to guarantee optimal performance.

Several stages in this project have already been completed. The first consisted of the extraction of CA from cotton waste via the homogeneous acetylation of cellulose. The extraction was successful, but it is not possible to produce a membrane of 100% recycled CA, though it is viable to create membranes with a combination of commercial CA and recycled CA, using a ratio of 50%. When joining the cork, the membrane does not break and remains in the structure.

Powdered cork was washed, and thanks to the reduced particle size, the stability and homogeneity of cellulose membranes was achieved during production via the phase inversion process. The preliminary results demonstrated the potential of cork to absorb the antibiotic ciprofloxacin and synthetic methylene blue dye (1g of cork to 20 mL of solution). With this formulation, the aim is to find a way of treating textile and pharmaceutical waste based on waste from the industries themselves.



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sciforum-097631: Rainwater harvesting in social housing: an analysis over twelve cities in Brazil

Maria Clara Sampaio Rosa e Silva *, Igor Catão Martins Vaz and Enedir Ghisi

Department of Civil Engineering, Federal University of Santa Catarina, Florianópolis 88040-900, SC, Brazil

Rainwater harvesting (RWH) has emerged as a promising technique to improve water security amid the escalating effects of climate change. However, a comprehensive evaluation of various rainwater harvesting solutions is needed to promote sustainable practices in the building sector. This study aimed to analyse rainwater harvesting in social housing in twelve representative cities in Brazil. Computer simulations were performed for 60 scenarios, comprising five social housing reference models and using rainfall data from twelve representative cities of Brazil's bioclimatic zones. Simulation parameters of the building's characteristics were obtained from the blueprints of the house models, and rainfall data were obtained from Brazilian government databases. Other parameters, such as the runoff coefficient and the non-potable water demand, were retrieved from the existing literature. The results were analysed to understand the influence of the building's characteristics and the different cities' rainfall patterns. Single-family houses have greater potable water savings potential (around 20% to 22% of total water consumption), primarily due to their higher roof-area-to-residents ratio. The multi-family models had a higher average total volume of potable water saved (from 108 to 152 m³/year) due to their higher total volume of water consumed. The city analysis revealed that Canela has the highest water saving potential (up to 35.8%), while Vitória da Conquista has the lowest average potential (0.35%).



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sciforum-103318: Recharging urban water bodies using nanoparticle-treated water: technical feasibility, risk potential and remediation methods

Arijeet Prasad Sabat ^{1,*}, Radhika Sharma ², Divya Vempati ² and Arun Kumar ²

¹ Civil Engineering Department, Indian Institute of Technology Delhi, Delhi, India

² Civil Engineering Department, Indian Institute of Technology Delhi

The availability of freshwater in all forms is declining at a rapid rate. Many major cities are on the verge of experiencing “day zero” due to the risk of running out of drinking water. A huge volume of wastewater is being generated daily from these cities. Therefore, there is scope for a water reuse process in which this wastewater, after treatment, is discharged into natural water bodies or artificially built water bodies for groundwater recharge. The reuse of this water for drinking and household purposes still carries a risk potential. This wastewater carries effluent from industries that might be rich in nanoparticles and other heavy metals. Water containing nanoparticles is dangerous for human consumption. This study investigates the potential effects of nanoparticle release on ecosystems and human health, as well as providing novel strategies for their mitigation and use. The literature was searched to study the removal efficiency of Ag nanoparticles using nature-based units after secondary wastewater treatment. Treated wastewater carrying Ag nanoparticles is discharged into nature-based units (constructed wetlands and soil aquifer treatments) and their removal efficiency was found to be 99.34% in the case of CW only, 99.83% in the case of CW+SAT, and 95.75% in the case of tertiary soil. The initial concentration of Ag NPs in these effluents was in the range of 0-200µg/L. The final concentrations in the water were found to be less than the regulatory permissible guidelines of 100µg/L of silver ions that is seen as being fit for consumption by humans. Limited research data were found that addressed the fact that higher levels of Ag NPs may cause an accumulation of these NPs in the biota and in sediment form on CW. Further studies for the removal of higher concentrations of Ag NPs needs to be done for the risk assessment of NP dosage on humans, the removal efficacy threshold of CW and SAT, and the effects of long-term exposure.



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sciforum-102981: Removal of Pb (II) by Plant-Based MnFe₂O₄/g-C₃N₄ Nanoparticles for Water Treatment: Experimental and Machine Learning Study

Saba Madadgar ^{1,*}, Reza Taherdangkoo ² and Faramarz Doulati Ardejani ¹

¹ School of Mining Engineering, College of Engineering, University of Tehran, Tehran 1439957131, Iran

² Institute of Geotechnics, TU Bergakademie Freiberg, 09599 Freiberg, Germany

This study evaluates the effectiveness of MnFe₂O₄/g-C₃N₄ spinel ferrites nanoparticles, synthesized using *Chrysopogon zizanioides* (*C. zizanioides*) root powder as the base material, in removing Pb (II) from contaminated water through the adsorption process. Firstly, the nanoparticles were synthesized using the co-precipitation method. The MnFe₂O₄/g-C₃N₄ nanoparticles were characterized using various techniques, such as Fourier-transform infrared spectroscopy (FTIR), high-resolution transmission electron microscopy (HR-TEM), field emission scanning electron microscopy (FE-SEM), energy-dispersive X-ray spectroscopy (EDS), Brunauer–Emmett–Teller (BET) surface area analysis, dynamic light scattering (DLS), zeta potential measurement, Raman spectroscopy (RAMAN), and vibrating sample magnetometry (VSM). These analyses confirmed the successful synthesis and revealed the magnetic properties of the nanoadsorbent.

The adsorption capacity of the *C. zizanioides*/MnFe₂O₄/g-C₃N₄ nanoparticles was then tested, demonstrating a high removal efficiency for Pb (II) from contaminated water. The effects of various parameters on the adsorption process, including pH, adsorbent dosage, contact time, initial Pb (II) concentration, and temperature, were investigated. Kinetic studies revealed that the adsorption process followed a pseudo-second-order model with a coefficient of determination of 97.32%, indicating a strong correlation. Additionally, the Freundlich isotherm model best described the adsorption of Pb (II) by the nanoparticles. Thermodynamic studies indicated that the adsorption of Pb (II) was an endothermic and spontaneous process. This study also examined the desorption capability and reusability of the nanoadsorbent over multiple cycles, finding that it could be effectively regenerated and reused, with a high percentage of recovery of adsorbed Pb (II). Additionally, a machine learning algorithm was developed to predict and optimize the adsorption process, providing further insights and improving the efficiency of Pb (II) removal.



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sciforum-094645: Revitalizing Pond Waste: A Novel Approach using Floating Wetlands and Electrolysis for Sustainable Agriculture, Including Wastewater Polishing

Amman Khokhar ^{1,*} and Fraz Nayyar ²

¹ Department of Botany, University of Agriculture Faisalabad , 38000, Pakistan

² Department of Farm Machinery and Power, University of Agriculture Faisalabad , 38000, Pakistan

Sustainable agriculture requires effectively managing environmental challenges, and one such challenge is pond waste. In Pakistan, vast networks of freshwater ponds (approximately 60,470 hectares) are used for fish farming. While this practice produces valuable food, the resulting nutrient-rich wastewater is often discarded, creating a potential environmental burden. However, this very waste holds immense potential for agriculture.

A groundbreaking solution emerges: pond waste can be tackled using a unique combination of floating wetlands and electrolysis. Floating wetlands act as miniature ecosystems within the ponds. These plant-based systems filter and purify the water by absorbing pollutants and fostering the growth of beneficial microorganisms. Electrolysis takes things a step further by using electricity to break down remaining contaminants and potentially even harvest valuable minerals.

This dual approach provides significant benefits. Firstly, it transforms pond waste into nitrogen-rich sludge, a valuable organic fertilizer crucial for plant growth. This reduces dependence on synthetic fertilizers, promotes sustainable agricultural practices, and minimizes chemical usage. Secondly, the method effectively purifies wastewater, enhancing clarity and removing impurities. Originally measured at 1500 ppm TDS, 900 $\mu\text{S/cm}$ EC, and pH 6.5, the treated water improves to 710 ppm TDS, 810 $\mu\text{S/cm}$ EC, and pH 7, making it suitable for reuse in irrigation or replenishing aquaculture systems. This approach conserves water and reduces agriculture's environmental footprint by decreasing reliance on freshwater sources.

By addressing both aspects of pond waste management, this innovative method positions itself as a promising solution for sustainable agriculture in Pakistan. This approach promotes organic practices, reduces dependence on chemical fertilizers, conserves water, and minimizes environmental impact. This paves the way for a more sustainable future for Pakistani agriculture.



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sciforum-087317: Revolutionizing Urban Water Management for Sustainable City

Amna Naeem * and Rana Ammar Aslam

Department of Structures and Environmental Engineering, University of Agriculture, Faisalabad - 38040, Punjab Pakistan

Pakistan, with an estimated population of 241.5 million (2023), ranks as the world's fifth most populous country. Due to an increase in population, Pakistan is facing a serious water shortage, which is affecting people's lives. Pakistan has 143 large and small water storage reservoirs, with major ones like Tarbela, Mangla, and Chashma collectively holding a storage capacity of 18.92 Million Acre Feet (MAF). Pakistan's annual water requirement is approximately 1,000 Billion Cubic Meter (BCM), while the current availability is only around 180 BCM, indicating a substantial water deficit. This deficit is expected to grow with population growth and rising water demand in the future. To address this, authorities need to create strong policies for conserving water. In response to the extending challenges posed by rapid urbanization and population growth in Pakistan, this comprehensive research has delved into the necessary task of transforming urban water management for sustainable cities. The objective was to propose an innovative framework that redefines urban planning and governance, integrating smart technologies to ensure the sustainable use of water resources. The rising demand for fresh water can be linked to the growing population. The internet of things (IoT), a technology that connects devices and systems, can play a crucial role. For the urban water management, we utilized IoT sensors for real-time data collection and AI algorithms for internet decision making. IoT sensors and AI algorithms in urban water management improve real-time data utilization, enhancing decision making for efficient urban water resource management.



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sciforum-093430: Semiconducting single-walled carbon nanotubes filled with silver chloride

Marianna V. Kharlamova

Lomonosov Moscow State University, Leninskie Gory 1, Russia

The foundations of the electronic structures of single-walled carbon nanotubes (SWCNTs) are studied for applications in water treatment. The SWCNTs have metallic and semiconducting physical properties. To improve the functionality of the SWCNTs, they are filled [1-4]. The methods of improving the functionality of the SWCNTs include surface functionalization and filling. In this contribution, the semiconducting SWCNTs were filled with silver chloride (AgCl). Silver chloride is an electron acceptor. The filling of AgCl in the SWCNTs causes strong Fermi level variations. Raman spectroscopy proved the doping-mediated differences in the electronic structures of the pristine and the filled SWCNTs. The physical properties of the different-diameter SWCNTs were modulated in a different manner with the filling. This was demonstrated with the radial breathing band, and the G-band of Raman spectra. The observed differences were the different locations of the peaks, the variations in the intensities, and the disappearance of the peaks. The detected modulations of the electronic structure of the SWCNTs are useful in the water treatment.

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sciforum-087546: Social innovation in water engineering and its effect on providing drinking water services in rural and marginalized urban areas in Pakistan. Batool Fatima; Rana Ammar Aslam Structures and Environmental Engineering, University of Agriculture, Faisalabad.

Ammar Aslam and Batool Fatima *

Department of Structures and Environmental Engineering, University of Agriculture Faisalabad, 83060, Pakistan

The ocean holds about **97%** of the water on the Earth's surface; the remaining **3%** is found in glaciers, ice, and groundwater like rivers and lakes. The total water supply to the world is about **332 million cubic miles** of water, which plays an important role in agricultural fields, as well as industrial and domestic purposes. In Pakistan, as per the International Monetary Fund, the per capita annual water availability has reduced from **1500m³** in **2009** to **1017m³** in **2021**. In Pakistan's different regions like Thar, Sukkur, Hyderabad, and Karachi, mostly in their rural and marginalized urban areas, the water is highly contaminated. Water quality is deteriorating daily due to the rapid increase in population, industrialization, poor agricultural sector management, inefficient infrastructures, and the sewerage system. In Pakistan, **20%** of the population has access to pure water, while the remaining **80%** is forced to use unsafe drinking water. Therefore, the aim of this study is to provide safe drinking water sources to the remaining population. There is a need to install water disinfectants, filters, and treatment plants for the monitoring of water quality parameters in marginalized urban areas and rural areas. Applying different methods for the filtration of water will make water drinkable. The technique of boiling water is also helpful in rural areas. Pipelines could be designed from a nearby water source to a community that lacks a drinking water supply. Due to the implementation of these methods, the **33%** death rate in Pakistan may decrease; this rate is caused by anthropogenic activities, of which the major cause (**80%**) is waterborne disease. We need to spread awareness by starting a **Public Awareness Campaign** among the people of Pakistan to use pure water for health and safety.



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sciforum-097369: Statistical Analysis of 24-Hour Rainfall Patterns in Tehran Metropolitan Area

Sara Ghaznavinia ^{1,*} and Seiyed Mossa Hosseini ²

¹ Faculty of geography , University of Tehran

² Associate Professor, Physical Geography Department, University of Tehran

The determination of rainfall patterns in urban areas influences the availability of water resources, weather systems, and urban planning. In this study, the 24-hour rainfall pattern in 15 rain gauges over the Tehran province was determined and statistically analyzed. In total, 137 storm events with a duration of 20 to 28 hrs each, recorded in a time step of 1 min over a 30 year period, were used. To extract the 24-hour rainfall patterns, Pilgrim and Cordery's methods were adopted. The Chi-square test was used to assess the accuracy and meaningfulness of the obtained patterns. Then, one-way analysis of variance (ANOVA) was adopted to test the difference between the patterns in the stations and also between the four standard patterns in the Soil Conservation Service (SCS) of USA. The results of this study reveal that the higher percentages of the 24-hour rainfall depth occurred in the middle quartiles of rainfall time. ANOVA tests reveal that a significant difference (with a 95% confidence level) was detected between the 15 patterns obtained in the stations in Tehran, and also the between the patterns from Tehran's and the SCS. The topographical and local geographical atmospheric conditions (e.g., heat islands) influence the rainfall pattern in Tehran. Continued research in this field is essential for developing effective strategies to mitigate the impacts of changes in rainfall patterns to ensure the resilience of urban communities and ecosystems.



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sciforum-102699: Sugar Industry Wastewater Treatment Through a Photosynthetic Microbial Desalination Cell: A Sustainable Approach

Syeda Safina Ali * and Zeshan Sheikh

Institute of Environmental Sciences and Engineering (IESE), School of Civil and Environmental Engineering (SCEE), National University of Sciences and Technology (NUST), Islamabad, 44000, Pakistan

The global proliferation of the sugar industry has led to the production of large amounts of untreated effluent being released into the environment, prompting the exploration of energy-saving technologies like microbial desalination cells (MDCs). Despite the proven efficiency of MDCs in wastewater treatment and desalination, their performance is hindered by the high cost and toxicity of the cathode catalysts. MDCs powered by an algal cathode offer an alternative solution by enhancing the effectiveness of the oxidation–reduction reaction and eliminating the need for expensive catalysts and aeration at the cathode. The main aim of this study is to evaluate the efficiency of a *Scenedesmus obliquus*-inoculated photosynthetic MDC (PMDC) in the cathode chamber in comparison to a traditional aerated MDC. It focuses on using sugar industry effluent as an anolyte to enhance the electricity production when treating sugar industry wastewater and achieve simultaneous desalination. This study assesses the performance of MDCs and PMDCs in terms of wastewater treatment, energy generation, and desalination. The results indicate that the PMDC outperformed the MDC throughout the experiment by achieving 21.6% desalination, an average voltage of 275.9 mV, 73.8% anode COD removal, and a maximum power density of 6.8 mW/m², exceeding the performance efficiency of the MDC by 6.43%, 27.5%, 18.5%, and 112.5%, respectively. These results demonstrate that PMDCs are more effective than MDCs in producing electricity, desalinating water, and treating wastewater. Furthermore, PMDCs have the potential to remove nutrients while producing algal biomass, making them a viable alternative for water and wastewater treatment.



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sciforum-095128: The acid and base catalytic oxidation of permanganate towards antibiotic pollutants

Dean Song

The State Agriculture Ministry Laboratory of Quality & Safety Risk Assessment for Tobacco, Tobacco Research Institute, Chinese Academy of Agricultural Sciences, Qingdao 266101, Shandong Province, China

Antibiotics have attracted increasing attention as an emerging class of environmental pollutants in recent years, mainly due to their usage for preventing infection, as well as their inevitable leakage into various environmental media. Although the reported concentration levels are commonly low, the persistence and long-term exposure of these antibiotics may induce the development of antibiotic-resistant bacteria/genes, subsequently threatening the ecological environment and human health.

Chemical oxidation using permanganate has been extensively applied in water and wastewater treatment processes for controlling taste, odor, and algae growth. Recently, permanganate as a powerful oxidant has shown great potential in the degradation of multiple micropollutants including antibiotics. However, the acid/base catalytic mechanism of permanganate remains unclear, although it is very important to effectively control the antibiotic pollutants in aqueous solutions.

From the kinetic and mechanistic points of view, the acid catalysis of permanganate towards sulfamethoxazole could be attributed to the formation of neutral HMnO_4 , which showed a four orders of magnitude higher reactivity than anionic MnO_4^- . The rate-limiting step was determined to be simple N-H bond oxidation, which was also studied computationally using DFT calculations. It is the first time that the Brønsted acid catalysis of permanganate could not only produce the stronger electrophile HMnO_4 , but also change the reaction mode by avoiding bond cleavage in the electron transfer process.

Although base catalysis was also considered to, similarly, add a hydroxyl ion to permanganate, the kinetic salt effect and DFT analysis indicated that the hydroxyl ion could attract the proton of tetracycline toward itself to form a complex-like structure with a highly reactive phenolate-type moiety. The base-catalyzed effect was finally explained by the HOMO orbital and electrostatic potential, whereby the hydroxyl ion could make the phenolic group a more electron-rich moiety for electrophilic attack.



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sciforum-097205: The effect of citric acid on enhancing metal (Cu^{2+} , Ni^{2+} and Pb^{2+}) uptake in duckweed

Lin Guo

Texas A&M University-Commerce

This study evaluated the impact of citric acid (CA) to increase metal uptake Cu^{2+} , Ni^{2+} , and/or Pb^{2+} in duckweed (*Lemna minor*). Duckweed was cultured in single or mixed metal solutions (Ni^{2+} 50 ppm, Cu^{2+} 50 ppm, and /or Pb^{2+} 10 ppm) with different levels of CA added (no CA 0 ppm, low-level 10 ppm, middle-level 50 ppm, or high-level 100 ppm CA) for 4 weeks. Then, the plants were harvested, oven dried, and acid-digested. The amounts of metals in plants were analysed by an inductively coupled plasma optical emission spectrometer. The results indicated that duckweed successfully survived and sequestered metals from all solutions. Different levels of CA had different impacts on different metal sequestration in duckweed. For duckweed cultured in single metal solutions, 10 ppm CA already significantly increased Pb^{2+} accumulation in duckweed; 50 ppm CA and 100 ppm significantly enhanced Cu^{2+} and Ni^{2+} levels in duckweed by more than 80%. For duckweed cultured in mixed metal solutions, middle and high levels of CA significantly increased the amounts of Cu^{2+} and Ni^{2+} in duckweed. However, CA did not have a significant impact on Pb uptake in duckweed from mixed metal solutions. More research is needed to further understand the impact of CA to enhance metal uptake in plants and its application to increase phytoremediation efficiency.



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sciforum-102951: The potential of photocatalysis aided by layered double hydroxides for the removal of 4-chloro-L-phenylalanine from water

Maria Inês Roque ^{1,*}, Matheus M. Pereira ¹, Fethi Ghribi ^{2,3}, João Gomes ¹, Luísa Durães ¹ and Rui C. Martins ¹

¹ University of Coimbra, CERES, Department of Chemical Engineering, University of Coimbra, Rua Sílvio Lima, 3030-790 Coimbra, Portugal

² Centre de Recherche Scientifique et Technique en Analyses Physico-chimiques (CRAPC). Zone Industrielle, BP 384 Bou-Ismaïl, Tipaza, Algeria

³ Unité de Recherche en Analyses Physico-Chimiques des Milieux Fluides et Sols –(URAPC-MFS/ CRAPC), 11, Chemin Doudou Mokhtar, Ben Aknoun – Alger, Algeria

Disinfection By-Products (DBPs) are generated through the interaction of the free chlorine added during the drinking water (DW) disinfection process with natural organic matter (NOM) that may be part of the raw water. The most common DBPs found in DW include trihalomethanes, haloacetic acids, haloacetonitriles and haloketones. The presence of DBPs in DW can lead to several consequences for human health due to their high toxicity; thus, their reduction is crucial to achieve better water quality worldwide. For this purpose, NOM can be removed at the early stages of the treatment process, or the DBPs can be removed at the end of the process.

In this work, photocatalysis was investigated as a potential removal alternative for 4-chloro-L-phenylalanine (Cl-phe), a known precursor of some of the most incident DBPs in DW. For this purpose, several metal layered double hydroxides (LDHs) were synthesized by the co-precipitation method, combining iron with zinc (ZnFe), copper (CuFe), cobalt (CoFe), nickel (NiFe) and manganese (MnFe), and their photocatalytic potential was assessed. Additionally, their performance was compared to commercial titanium dioxide (TiO₂). A 10 mg/L solution of Cl-phe (the highest possible concentration of NOM in DW) was used for the photocatalysis tests, with a load of 200 mg/L, a pH of 7 and UV-A light. TiO₂ was able to completely remove Cl-phe with 2 h of UV-A light exposure. As for the LDH catalysts, CoFe and MnFe did not show an effect on the removal of Cl-phe, whereas CuFe and NiFe showed a greater affinity during the adsorption phase rather than under UV-A light. In contrast, ZnFe was able to remove the Cl-phe by photocatalysis, leading to a removal of 45% with 2 h of UV-A light exposure.

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sciforum-096660: The role of abiotic and biotic aging in the removal of microplastics in the coagulation process

Sabina Ziembowicz *, Małgorzata Kida and Piotr Koszelnik

Rzeszów University of Technology

Although coagulation is a well-known and widely used technique for removing suspended particles, there are no detailed data on its effectiveness in microplastic (MP) elimination. The research available on the removal of MPs by coagulation is at a preliminary stage and there is no research available on the mechanism and effectiveness of removal and the factors that increase the efficiency of elimination. A significant limitation of the research conducted so far on the coagulation process relative to MP elimination is the removal of only one type of MP, while in the environment, there is a mixture of particles differing primarily in composition but also in size and shape. The second limitation is ignoring the fact that microplastic particles present in environmental conditions are transformed/aged under the influence of abiotic and biotic factors. These particles then change not only their appearance, size/mass, or density but also their surface and chemical composition. These changes may have both positive and negative effects on the efficiency of microplastics elimination in the coagulation process.

The main goal of this article is to analyze the impact of biotic and abiotic aging of PE microplastics on the effectiveness of coagulation. The following aging methods are planned to be used: mechanical stress, thermal oxidation, UV aging, chemical treatments, and colonization by microorganisms.



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sciforum-101695: The study and improvement of the performance of a high-rate algal pond treatment plant: from measurement to modelling

Ameni Mokhtar ^{1,*}, Hugues Jupsin ¹, Bernard Tychon ¹, Chema Keffala ² and Fouad Zouhir ¹

¹ Université de Liège, campus d'environnement d'Arlon, 6700, Belgique

² Higher Agricultural Institute of Chott Mariem, Sousse, Tunisia

Today, there are several sustainable wastewater purification techniques that meet the demand for the reuse of treated water and at the same time allow us to provide a new value to the biomass used in the purification. This technique is the high rate algal pond, which is a very advantageous lagoon method. A model station was recently installed in Tunisia at the Superior agronomic institute (SAI) of Chott-Mariam, and the interest of our research is to study its purification performance, to optimize it by using the modeling tool so that we can provide a reusable water for irrigation and agriculture, as well as to valorize the algal biomass produced in a very large quantities by the pond. This research project aims to increase investments in projects including sustainable purification techniques in countries such as Tunisia where the recurring water deficit and the demand for reuse of treated wastewater are particularly present. Our research aims to optimize the treatment process, by applying the modeling tool, which is used as a decision making and sizing tool for the management of this type of treatment system in Tunisia. We are in the process of calibrating a mathematical model of the algal pond by using a series of experimental measurements which are carried out on the experimental station, while allowing the integrated management of effluents and algae produced. Indeed, this technique is based on the symbiotic interaction between heterotrophic bacteria and algae (Oswald, 1978; Santiago 2013) allowing the elimination of the organic load and nutrients (phosphorus and nitrogen), after the step of purification, the algae thus produced in large quantities will undergo a recovery step by bio-flocculation and will be used as bio-fertilizer and as animal feed, where the added value of the project comes from.



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sciforum-097687: Towards Net-Zero Carbon in the Water Sector: The case of Maderia Island's water supply system

Tiago Correia *, Alban Kuriqi and Helena Ramos

CERIS, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais 1, 1049-001, Lisboa, Portugal

The water sector, whether for drinking water supply, water treatment plants, wastewater treatment, stormwater drainage, or plantation drainage, has significant electricity costs and carbon emissions associated with generating the energy needed for these operations. In addition, water utilities have high water losses and generally do not have their sources to generate electricity. According to ERSAR (the regulatory authority for water and waste management), only 43 out of 251 water utilities produced their energy in 2022. Self-generation of energy should be a prerequisite to achieving sustainability and carbon neutrality in the water sector, and there are several prerequisites for this in the sector. In this context, technological innovations in the water sector are also being used to achieve the goal of carbon neutrality. The use of smart water networks and hybrid renewable energy solutions is a methodology for assessing urban water resources, artificial intelligence methods, and smart technologies, improving system efficiency, and replacing pressure reducers with turbines, where possible. A case study of the island of Madeira is discussed. Madeira's water network is one of the least efficient in Portugal and has the highest water losses. The reasons for this are the very different topography, the age of the water networks, and their length and low maintenance. Here, by determining the highest value (while maintaining the flow rates and the minimum pressure required by law) in the EPANET software, the possibility of installing a turbine to generate electricity instead of a pressure-reducing valve is evaluated. The turbine will use the overpressure to generate electricity. The aim is for the system to use this energy in these processes. These high-pressure points are also normally associated with water losses.



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sciforum-102540: Utilizing Remote Sensing and Machine Learning for Efficient Irrigation Management in Semi-Arid Regions

Mannan Aleem ^{1,*}, Shahbaz Nasir Khan ¹, Arfan Arshad ², Muhammad Maaz Tanveer ¹, Saba Abid ¹ and Muqadas Aleem ³

¹ Department of Structures and Environmental Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad, Pakistan

² Department of Biosystems Engineering, Oklahoma State University

³ Department of Plant Breeding and Genetics at the University of Agriculture Faisalabad

Efficient irrigation management is a critical factor for enhancing agricultural productivity and conserving water resources, particularly in semi-arid regions such as the Lower Chenab Canal (LCC) region of Punjab, Pakistan. This study explores the integration of remote sensing technology and machine learning algorithms to develop a sophisticated irrigation management system aimed at optimizing water use and improving crop yields. This research involved collecting high-resolution satellite imagery, climatic data, and field observations to monitor crop health, soil moisture levels, and evapotranspiration rates across different cropping seasons. These data were utilized to train machine learning models capable of predicting crop water requirements with high accuracy. The core of our methodology lies in the application of various machine learning algorithms, including Random Forests, Support Vector Machines, and Neural Networks, to analyze the complex interactions between climatic variables, soil properties, and crop phenology. The predictive model developed was used to generate dynamic irrigation schedules tailored to the specific needs of different crops and growth stages. Field trials were conducted across multiple farms in the LCC region, comparing the performance of our technology-driven irrigation management system with the traditional irrigation practices. The results demonstrated a significant reduction in water usage, with up to 30% savings achieved without compromising crop yields. Additionally, the optimized irrigation schedules contributed to improved soil health and reduced incidences of waterlogging and salinity. This study highlights the potential of remote sensing and machine learning technologies to transform irrigation management, offering a scalable and cost-effective solution for farmers in water-scarce regions. By providing real-time insights and actionable recommendations, our approach empowers farmers to make informed decisions, promoting sustainable agricultural practices and ensuring long-term water resource sustainability.



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sciforum-096280: Water quality and Ecosystem Services degradation in intensively urbanized arid regions versus Wastewater Treatment infrastructure development plans

Dan Dai ^{1,*} and Angelos Alamanos ²

¹ Soil, Water, and Ecosystem Sciences Department, University of Florida, Gainesville, FL 32611, United States

² Independent Researcher, Berlin, 10243, Germany

Recent socioeconomic development with associated rapid population growth, urbanization, and industrialization have significantly affected natural landscapes across the world, with various environmental impacts. Land use changes have direct impacts on water resources and ecosystems, both in terms of quantity and quality and the services provided. Such impacts are particularly evident in developing water-scarce areas, where any land use or infrastructure change can significantly stress water quality and ecosystem services (ES). Understanding the complex interactions between land use changes, infrastructure development, water quality, and ES is essential for strategic environmental planning.

We modelled the impacts of intensified urbanization on water quality and ES, in the context of developing regions facing water scarcity conditions. For that purpose, a large, arid, developing area was selected as the case study: the Yongding River Basin (YRB) in North China. The land use changes were modeled and projected through a Cellular Automata Markov model until 2035. The impacts were assessed by i) a comprehensive water quality model considering the discharge of major pollutants in the river network; ii) their spatiotemporal distribution at fine-resolution grid scale; and iii) the economic spatial valuation of the ES. We also account for the real-world environmental policies of the region by considering future infrastructure development, namely the actual planned expansion and efficiency improvement of wastewater treatment (WWT) plants by 2035.

The major pollutants were COD, NH_4^+ , and Total Phosphorus, resulting primarily from urban sources. The efficiency of domestic WWT was found to be a dominant factor in the spatial distribution of future water pollution, but this cannot be the only solution. ES values decrease in the short-term but can increase in the long-term (2035) with the planned WWT expansion.

Our findings have multiple implications for integrated land--water--economic management toward more sustainable development, with targeted interventions to mitigate the environmental impacts.



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Session 5. Numerical and Experimental Methods, Data Analyses, Digital Twin, IoT Machine Learning and AI in Water Sciences

sciforum-097569: Alleviating Health Risks for Water Safety: A Systematic Review on artificial intelligence-assisted modelling of proximity-dependent Emerging Pollutants in Aquatic Systems

Marc Deo Jeremiah Victorio Rupin ^{1,*}, Kyle Gabriel Cruz Mendoza ¹ and Rugi Vicente C. Rubi ²

¹ Chemical Engineering Department, College of Engineering, Pamantasan ng Lungsod ng Maynila, General Luna, corner Muralla St., Intramuros, Manila 1002, Philippines

² Chemical Engineering Department, College of Engineering, Adamson University, 900 San Marcelino St. Ermita, Manila 1002, Philippines

Emerging pollutants such as pharmaceuticals, industrial chemicals, heavy metals, and microplastics are a growing ecological risk affecting water and soil resources. Another challenge in current wastewater treatments includes tracking and treating these pollutants, which can be costly. As a growing concern, emerging pollutants do not contain lower limit levels and can be detrimental to aquatic resources in minuscule amounts. Thus, the assessment of multiple emerging water pollutants in community-based water sources such as surface water and groundwater is a prioritized area of study for water resource management. It provides a basis for ecological health management of arising diseases such as cancer and dengue caused by unsafe water sources. Accordingly, by utilizing artificial intelligence, wide-range and data-driven insights can be synthesized to assist water resource management and propose solution pathways without the need for exhaustive experimentation. This systematic review examines artificial intelligence-assisted modelling water resource management for emerging water pollutants, notably machine learning and deep learning models, with proximity dependence and correlated synergistic health effects to both humans and aquatic life. This study underscores the increasing accumulation of these emerging pollutants and their toxicological effects on the community, and how data-driven modelling can be utilized to assist in research gaps related to water treatment methods for these pollutants.



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sciforum-096904: Comprehensive analysis of drinking water quality using machine learning techniques

Sania Thomas¹ and Binson V A^{2,*}

¹ Department of Computer Science and Engineering, Saintgits College of Engineering, Kottayam, India

² Department of Electronics Engineering, Saintgits College of Engineering, Kottayam, India.

Ensuring the safety and quality of drinking water is crucial for public health, particularly in regions where water contamination is a significant concern. This study investigates the application of machine learning techniques for water quality analysis in the Indian state of Kerala. A total of 328 water samples were collected and analyzed for various parameters including pH, dissolved oxygen, total coliform, fecal coliform, conductivity, nitrate, and biochemical oxygen demand. These parameters were used to compute the Water Quality Index (WQI), which was subsequently classified into four categories: clean, unclean, polluted, and highly polluted. Five machine learning classifiers were employed to classify the water quality data: Support Vector Machine (SVM), Decision Tree (DT), k-Nearest Neighbors (k-NN), Logistic Regression (LR), and XGBoost. The classifiers were trained and tested on the dataset to determine their accuracy in predicting water quality classes. Among these, XGBoost emerged as the most accurate classifier, achieving a classification accuracy of 91%. The study highlights the effectiveness of machine learning in environmental monitoring and demonstrates the potential of these techniques to aid in water quality management. The high accuracy of XGBoost suggests that it can be a valuable tool for predicting water quality and identifying areas at risk of pollution. By providing reliable classifications, machine learning models can support decision-makers in implementing timely and appropriate interventions to ensure the safety and cleanliness of drinking water.



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sciforum-098781: Experimental and numerical study of the gated and ungated Ogee spillway

Luo Chuyao *, Abdolmajid Mohammadian, Ioan Nistor and Hanifeh Imanian

Department of Civil Engineering, University of Ottawa, Ottawa, ON K1N 6N5, Canada

This study was carried out by combining numerical modeling and experimental measurements to investigate the hydraulic characteristics of ungated and gated ogee spillways with high head ratios. The primary objective was to validate the use of a numerical model as a complementary approach to the experimental model for simulating the hydraulic behavior of these spillways, providing a more comprehensive understanding of their hydraulic properties under varying conditions of head ratios and relative gate openings. An Acoustic Doppler Velocimeter (ADV) was used to measure the vertical flow velocity distributions, and ultrasonic sensor wave gauges were used to obtain the time history of the water level. The results of the measurements were compared with the simulation results using a model fitted with three different turbulence models (realizable $k-\varepsilon$, RNG $k-\varepsilon$, $k-\omega$ SST). The numerical model was developed using OpenFOAM. With respect to the ungated spillway, three different head ratios ranging from 1.4 to 4.6, which correspond to high head ratios, were investigated. Similarly, three different relative gate openings ranging from 0.5 to 2 were investigated for the gated spillway. The results of water surface profiles and velocity profiles suggest that the numerical and experimental models achieve a good agreement for sections located further away from the spillway. For the ungated spillway, the simulation results for the near-spillway sections are enhanced when the head ratio increases. Considering the velocity profiles and error analysis, the realizable $k-\varepsilon$ model was found to best predict the results of the experimental model. A discussion about the discharge equation, velocity fields, pressure fields, and the corner separation zone is also included in this study.



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sciforum-097743: Numerical Investigation For Studying Effects of Slot Location on Reduction Scour Depth Around A Single Circular Pier Using Flow-3D

M. Sobhi Alasta * and Mehmet Ishak Yüce

Department of Civil Engineering, Gaziantep University, 27310 Şehitkamil, Gaziantep, Türkiye

Investigating erosion in the river bed is a necessary component of the design of transportation infrastructure and bridge piers. Many scientists claim that hydraulic river processes cause several bridges to collapse every year due to scouring.

However, there are very few in-depth analyses of numerical simulations of the local scour round a pier using countermeasure methods on bridge piers; therefore, in this study, Flow-3D was used to simulate the CFD model to investigate local scouring around the pier, using a calibrated circular pier from an experimental study that was carried out in the literature. Four cases of slots through the bridge pier with different locations and sizes were investigated.

In order to examine the performance and the reflection of adding an opening through the pier on reduced scour depth round the bridge pier using CFD modelling by comparing with the reference model without slots, the outcomes show up that the larger the slot length, the lower the scour depth.

Moreover, when the slot height expands from the surface water to be balanced with the bed level, the efficacy on reduction scour becomes around 25 % on the lateral side of the pier, 55% in front, and more than 95% in the rear of the pier when compared with the reference pier in the same scour zone.



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sciforum-097367: Remote Sensing-Based Crop Mapping in Tehran Province, Iran: Focus on Wheat and Barley for Efficient Agricultural Management

Parisa Dodangeh ^{1,*} and Reza Shah-Hosseini ²

¹ School of Surveying and Geospatial Eng., College of Eng., University of Tehran, Tehran, Iran

² School of Surveying and Geospatial Engineering, College of Engineering, University of Tehran

This research focused on conducting a crop-type study in Tehran Province, Iran, with a particular emphasis on wheat and barley, essential global agricultural products. Accurate mapping of these crops using remote sensing technologies is crucial for efficient agricultural management and planning. This study covered extensive areas within Tehran Province, including Rey, Varamin, Pakdasht, Pishva, and Qarchak.

A crop type map was created for wheat and barley crops, along with other agricultural products and non-agricultural areas, based on their phenological behavior using the agricultural calendar. Satellite images from Sentinel-1 and Sentinel-2 were used at key stages of crop growth, and features like NDVI, EVI, and VV/VH ratio were extracted to identify plant phenological trends. This study utilized the Google Earth Engine for efficient processing due to the large study area and volume of images.

Different scenarios were tested using a Random Forest classification algorithm with limited training data, resulting in the creation of a crop map. Scenario one, including various spectral bands and indices, achieved an accuracy of 84%, a Kappa coefficient of 69%, and an F1-score of 76%. Scenario two, focusing on spectral indices and the VV/VH ratio, obtained an accuracy of 87%, a Kappa coefficient of 62%, and an F1-score of 64%. The highest accuracy of 94%, Kappa coefficient of 87%, and F1-score of 88% were attained in scenario three by utilizing multispectral bands and VV/VH bands. Scenario four, using only spectral indices, achieved an accuracy of 73%. The superior performance of scenario three was credited to its comprehensive spectral and temporal information, demonstrating the effectiveness of remote sensing in large-scale agricultural mapping.

This research demonstrates the practicality and utility of using remote sensing for agricultural mapping in large areas. The methodologies and results of this research can significantly contribute to efficient monitoring and management of agricultural resources.



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sciforum-099642: A Physico-Chemical Analysis of Groundwater in the Case of the Rural Area Koson in Uzbekistan

Ruzimurod Sattorovich Jurayev¹ and Bekzod Ravshan o'g'li Eshqulov^{2,*}

¹ Department of "Chemical Engineering and Quality Management", Shakhrisabz Branch of Tashkent Institute of Chemical Technology, 20, Shahrizabz str., Shakhrisabz 181306, Uzbekistan

² Shakhrisabz Branch of Tashkent Institute of Chemical Technology, 20, Shahrizabz str., Shakhrisabz 181306, Uzbekistan

In the study of the aquatic environment, determining the chemical makeup and governing elements of groundwater is crucial. This study provides a thorough physico-chemical examination of the groundwater in Uzbekistan's Koson district. A vital resource for the area, the groundwater supports agricultural practices and supplies the locals with drinkable water. Key physico-chemical parameters, such as pH, electrical conductivity, total dissolved solids (TDSs), and hardness, as well as the concentrations of major ions like calcium, magnesium, sodium, potassium, bicarbonates, chlorides, sulfates, and nitrates, were measured in samples taken from various sites throughout the district in order to evaluate the water quality. The results show that both anthropogenic activities and naturally occurring geological formations significantly influence the geographical variability in groundwater quality. Elevated TDS and nitrate levels were found in a number of samples, suggesting that insufficient waste management techniques and agricultural runoff may have contaminated the area. This study also pinpointed regions where problems with water hardness exist, creating difficulties for both industrial and household uses. Through the distribution mapping of various indicators, we offer a comprehensive comprehension of the Koson groundwater quality. The results emphasize the necessity of focused management plans to safeguard and enhance groundwater supplies. Implementing sustainable farming methods, improving the infrastructure for waste treatment, and conducting routine monitoring are among the suggestions made to guarantee the long-term security and supply of groundwater for the district's requirements. This study supports Uzbekistan's efforts to protect its water resources and offers insightful information on regional water quality challenges.



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sciforum-092146: A Spectrophotometric Analysis Method in the Visible (VIS) Range for NO_2^- Nitrites from Different Unknown Water Sources

Cristian-Catalin Gavut

University of Medicine and Pharmacy "Grigore T. Popa", Biomedical Sciences Department, Faculty of Medical Bioengineering, 16 Universitatii Street, Iasi 700115, Romania

The highly toxic carcinogenic potential of nitrites, resulting under certain conditions due to the reduction of nitrate, is well known and continuously studied. The main aim of this study was to exactly establish the amount of pure nitrite NO_2^- expressed in mg/L in eight different unknown groundwater sources by a new visible spectrophotometric method. Nitrate NO_3^- from unknown water samples was quantitatively reduced into NO_2^- nitrite anions using 10%-15% $\text{NH}_2\text{-OH}$ hydroxylamine solution. The obtained nitrite NO_2^- was completely transformed into a diazonium salt by the existing β -naphthol in a 0.2% alcoholic solution, in a strongly acidic medium (HCl, 15%-20%), and in cold storage at $1^\circ -7^\circ \text{C}$ for 25 minutes. Then, the synthesized diazonium salt was quantitatively coupled with free β -naphthol in excess at double concentration in the solution, which led to the formation of an orange-intense orange azo dye that presented an absorption maximum at $\lambda = 478 \text{ nm}$ and was obtained in a quantitative proportion perfectly equivalent to the concentration of pure NO_2^- nitrite in the water samples. Through the spectrophotometric dosing of the orange-intense orange azoic dye formed at $\lambda = 478 \text{ nm}$ in relation to the absolute ethanol as a blank, the pure nitrite NO_2^- in the unknown water samples was directly determined. The eight water samples studied showed high nitrite concentrations (2.2092 mg/L; 3.0669 mg/L; 3.6109 mg/L; 3.6736 mg/L; 3.9038 mg/L; 3.7155 mg/L; 4.2385 mg/L; 5.1589 mg/L), which exceeded the maximum allowed official limit of nitrites in drinking water, at 0.5 mg/L, by approximately four to ten times. All of the water samples studied cannot be intended, as such, for domestic consumption. The method was then subjected to complete statistical validation. The linearity, the limit of detection (LOD), the limit of quantitation (LOQ), the method and system's precision, and the robustness and accuracy of the analysis were calculated.



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sciforum-093472: Analysis of rainfall and temperature simulated from Reanalysis in Timor-Leste

Alcídia de Jesus Carvalho da Costa Henriques and Cláudio Moisés Santos e Silva *

Department of Atmospheric and Climate Sciences, Federal University of Rio Grande Do Norte, Natal, Rio Grande do Norte, 59077-900, Brazil

Timor-Leste is located in Southeast Asia and the South Pacific, about 500 km from the sea border with Australia and the land border with Indonesia. It has an area of approximately 14,954 km² and an estimated population of 1.293 million people. The climate is influenced by the Asian Monsoon regime, in addition to the strong influence of El Niño Southern Oscillation and intra-seasonal variability. Despite its small territory it presents an interesting climatic diversity and until now, studies on the efficiency of large-scale dynamic models on it have not been reported. Thus, the objective is to analyze the skill of two reanalyses in simulating precipitation and temperature over the territory of Timor-Leste. For that, we used the precipitation and temperature data collected in eight (8) cities in the period of 2013 and 2014 with monthly sampling. The models were the ERA-5 and ERA-interim, which are re-analyses of the European Center for Medium-Range Weather Forecasts. The results show that ERA-5 reanalysis performed better compared to ERA-interim, both for precipitation and temperature. However, the result of the model depends on the geographic location of the station. In general, the models were worse in cities located in mountainous regions. We conclude that, in general, the ERA-5 reanalysis managed to reproduce in a more adequate way both the monthly temperature and the rainfall in Timor-Leste.



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sciforum-102764: Assessing stream flows and dynamics of the Athabasca River basin using machine learning

Ali Dewan, Junye Wang and Suhaila Kamal *

Faculty of Science and Technology, Athabasca University, 1 University Drive, Athabasca, Alberta T9S 3A3, Canada

Abstract

Streamflow forecasting is of great importance in water resources management and flood warnings. Machine learning techniques can be utilized to assist with river flow forecasting. By analyzing historical time series data on river flows, weather patterns, and other relevant factors, machine learning models can learn patterns and relationships to present predictions about future river flows. In this study, an Autoregressive Integrated Moving Average (ARIMA) model is constructed to predict the monthly flows of the Athabasca River at three monitoring stations, Hinton, Athabasca, and Fort MacMurray, in Alberta, Canada. The three monitoring stations upstream, midstream, and downstream were selected to represent the different climatological regimes of the Athabasca River. Time series data were used for the model training to identify patterns and correlations using moving averages, exponential smoothing, and Holt-Winters' method. The model's forecasting was compared against the observed data. The results show that the determination coefficients were 0.99 at all three stations, indicating strong correlations. The root mean square errors (RMSEs) were 26.19 at Hinton, 61.1 at Athabasca, and 15.703 at Fort MacMurray, respectively, and the mean absolute percentage errors (MAPEs) were 0.34%, 0.44%, and 0.14%, respectively. Therefore, the ARIMA model captured the seasonality patterns and trends in the stream flows at all three stations and demonstrated a robust performance for hydrological forecasting. This provides insights and predictions for water resources management and flood warnings.



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sciforum-097395: Assessment of Machine Learning Models for Predicting behavior of Laterally Confined Buoyant Jets

Lingkun Meng *, Shuyi Jia, Danial Goodarzi, Abdolmajid Mohammadian and Hossein Bonakdari

Department of Civil Engineering, University of Ottawa, 161 Louis Pasteur Private, Ottawa, ON K1N 6N5, Canada

Buoyant jets are employed to discharge saline or hot wastewater into the ambient environment by various industrial plants which could pose a threat to marine environments and coastal ecosystems. Therefore, understanding the behavior of these jets is crucial for managing their adverse environmental impacts. To characterize the behavior of a confined buoyant jet, a three-dimensional model was employed to solve the transport of mass and momentum using the Computational Fluid Dynamics (CFD) tool OpenFOAM. Various flow conditions were defined by changing the Reynolds number (Re) and densimetric Froude number (Fr) to examine the flow characteristics of vertical buoyant jets subjected to lateral confinement.

The generated datasets were then utilized to train and test different machine-learning algorithms. The machine learning models were developed to predict the flow characteristics based on flow key parameters, including the geometrical parameters. Various machine learning algorithms, including support vector machines (SVM), Extreme Learning Machine (ELM), and Adaptive Neuro-Fuzzy Inference System (ANFIS), were trained and tested using these datasets. The performance of these models was assessed using multiple statistical metrics, and the results were benchmarked against those obtained from a multigene genetic-programming (MGGP) model and an existing regression-based empirical equation.

This study demonstrates the potential of machine learning algorithms to accurately predict the behavior of laterally confined vertical buoyant jets. The findings suggest that machine learning can serve as a reliable and efficient tool in environmental engineering and impact assessments, providing a fast and viable alternative to traditional CFD methods. These models offer a powerful solution for accurately predicting initial dilution properties, supporting the design and assessment of environmental engineering systems.



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sciforum-101594: Assessment of machine learning techniques to estimate reference evapotranspiration at Yauri meteorological station, Peru

Efrain Lujano ¹, Rene Lujano ², Juan Carlos Huamani ^{3,*} and Apolinario Lujano ⁴

¹ Escuela Profesional de Ingeniería Agrícola, Universidad Nacional del Altiplano, Puno 21001, Peru

² Programa de Maestría en Ingeniería de Sistemas, Universidad Nacional del Altiplano, Puno 21001, Peru

³ Servicio Nacional de Meteorología e Hidrología, Lima 15072, Peru

⁴ Programa de Maestría en Riego y Drenaje, Universidad Nacional Agraria La Molina, Lima 15024, Perú

Reference evapotranspiration (ET_o), a key component of the hydrological cycle, is fundamental for agriculture. Traditionally, ET_o is estimated using the Penman-Monteith (PM) method, considered the standard method by the FAO due to its use of multiple climatic variables, providing a solid physical basis. This research aimed to assess machine learning techniques to estimate ET_o at the Yauri meteorological station in Peru. Monthly data on air temperature (maximum, average, and minimum), wind speed, relative humidity, and extraterrestrial solar radiation were used. Two machine learning techniques, K-nearest neighbors (KNN) and artificial neural networks (ANN), were trained and tested. To verify their accuracy, scatter plots, box plots, and various performance metrics were employed. These metrics included mean absolute error (MAE), anomaly correlation coefficient (ACC), Nash--Sutcliffe efficiency (NSE), Kling--Gupta efficiency (KGE), and spectral angle (SA). The results indicate that machine learning techniques provide highly accurate estimates and can serve as viable alternatives for estimating ET_o, especially in situations with limited meteorological data. The implementation of these methods can significantly improve water resource planning and management. This improvement is particularly valuable in agricultural regions with data scarcity, offering a practical tool for farmers and water managers to make informed decisions and enhance resource efficiency. The integration of machine learning in this context demonstrates its potential to address critical challenges in hydrology and agriculture.



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sciforum-103114: Classification of river water quality in Kerala, India, using machine learning methods

Manju G

Department of Computer Science, Government College, Ambalapuzha, Alappuzha, Kerala, 688539, India

Water quality assessment is crucial for environmental management and public health, particularly in regions like Kerala, India, where rivers play a vital role in the ecosystem and human activities. This study investigates the water quality of 44 rivers in Kerala, India, using machine learning techniques to classify water quality based on specific parameters. The data, sourced from the Kerala State Pollution Control Board's Water and Air Quality Directory 2023, include measurements of pH, biochemical oxygen demand (BOD), dissolved oxygen (DO), electrical conductivity (EC), and total coliform concentration. These parameters were used to categorize water into five distinct classes: Class A (drinking water source without conventional treatment but after disinfection), Class B (outdoor bathing), Class C (drinking water source after conventional treatment and disinfection), Class D (propagation of wildlife and fisheries), and Class E (irrigation, industrial cooling, controlled waste disposal). Three machine learning models were employed for classification: support vector machine (SVM), k-nearest neighbors (KNN), and decision tree (DT). The dataset was split into training and testing sets to evaluate the models' performance. Among the models, the SVM achieved the highest accuracy, classifying water quality with an accuracy of 92.83%. The results demonstrate the effectiveness of machine learning in assessing and classifying river water quality, providing a valuable tool for environmental monitoring and management. This study highlights the potential of advanced data analysis techniques to support public health and environmental conservation efforts by accurately identifying water quality categories based on standardized criteria.



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sciforum-097871: Classifying River Basin Flood Risk Using AI: A Case Study of the Rideau River, Eastern Ontario

Victor Joubier ^{1,2}, Isa Ebtehaj ^{3,*} and Hossein Bonakdari ²

¹ Ecole Nationale du Genie de l'Eau et de l'Environnement de Strasbourg, 1 Cour des Cigarières, 67000 Strasbourg, France

² Department of Civil Engineering, University of Ottawa, 161 Louis Pasteur Private, Ottawa, ON K1N 6N5, Canada

³ Department of Soils and Agri-Food Engineering, Université Laval, Québec, QC G1V 0A6, Canada

Flood risk assessment is crucial for effective water resource management and flood mitigation strategies. This study focuses on detecting and classifying flood risk in the Rideau River basin, located in eastern Ontario, Canada, into four distinct classes. The most significant flood occurred in 2019, surpassing a 100-year flood event, and serves as a stark reminder of how climate change impacts our environment. Considering the limitations of machine learning (ML) models, which heavily rely on historical data used during training, they may struggle to accurately predict such “non-experienced” or “unseen” floods that were not encountered during the training process. To tackle this challenge, our study has utilized a combination of numerical modeling and ML to create an integrated methodology. A comprehensive dataset of river flow discharge was generated using a numerical model, encompassing a wide range of potential future floods. This synthetic dataset ensures that the ML model is trained on a diverse array of scenarios, enhancing its ability to predict flood risks accurately, even for events outside the historical record. The AI model classifies flood risk into four categories: low, moderate, high, and very high. These classifications are based on various factors, including river discharge, precipitation, and temperature data. The integration of AI with numerical modeling provides a robust framework for flood risk assessment, enabling more accurate predictions and better-informed decision-making. The findings highlight the importance of using advanced modeling techniques to address the limitations of traditional ML models in flood prediction. By incorporating a wide range of potential future floods into the training dataset, the study improves the model's ability to predict and classify flood risks under changing climatic conditions. The study underscores the need for adaptive measures to mitigate the increasing flood risks posed by climate change, ensuring the resilience and safety of vulnerable communities along the Rideau River.



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sciforum-097363: Enhanced Chlorophyll-a Estimation in the Anzali Wetland Using the Sentinel-2 and -3 Satellites and a Machine Learning Fusion Model

Parisa Dodangeh ^{1,*} and Reza Shah-Hosseini ²

¹ School of Surveying and Geospatial Eng., College of Eng., University of Tehran, Tehran, Iran

² School of Surveying and Geospatial Engineering, College of Engineering, University of Tehran

Quantifying chlorophyll-a (Chl-a) concentrations is paramount in wetland ecosystems as a key indicator of phytoplankton biomass and overall water quality. In this study, we applied three distinct models—Gilerson, Gulin, and Mishra—to derive the Chl-a concentrations from Sentinel-3 satellite data in the Anzali wetland, Iran, in 2023. The Anzali wetland, located on the southwestern coast of the Caspian Sea in Gilan Province, is one of northern Iran's most significant and biodiverse wetlands.

The Gilerson and Gulin models were based on band ratios, specifically the red-edge band ratio. In contrast, the Mishra model utilized an empirical model based on the Normalized Difference Chlorophyll Index (NDCI). These models initially generated Chl-a maps with a lower spatial resolution, which was subsequently enhanced to a 20-meter spatial resolution using features extracted from Sentinel-2 data. Machine learning played a crucial role in this enhancement process, where a Random Forest classifier was trained with the extracted features to refine the Chl-a maps from the Sentinel-3 data. This approach improved the spatial resolution of the chlorophyll concentration estimations across the Anzali wetland.

Sentinel-3 data were resampled to 20 meters for accuracy assessment and utilized as ground-truth data. Field data were collected using in situ measurements of the Chl-a concentrations, ensuring robust ground-truthing. Evaluation of the accuracy metrics revealed the following outcomes for the Gilerson, Gulin, and Mishra models, respectively: RMSE values of 3.71, 10.12, and 11.63; bias values of 0.65, 1.46, and 2.64; and MAE values of 2.85, 7.74, and 8.83. These results indicate that the Gilerson model had the highest accuracy, followed by the Gulin and Mishra models. The synergistic fusion of the Sentinel-2 (S2) and Sentinel-3 (S3) data enhanced the spatiotemporal resolution, providing valuable insights into the Chl-a dynamics at varying scales, thus aiding in refining management strategies and preserving wetland ecosystems.



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sciforum-102745: Enhanced Photoelectrochemical Degradation of Dyes in Water Using Pulsed Electrodeposited CeO₂-TiO₂ Nanorod Photoanodes

Alberto Enrique Molina Lozano * and María Teresa Cortés Montañez

Departamento de Química, Facultad de Ciencias, Universidad de los Andes, Bogotá D.C, 111711, Columbia

This study investigates the enhancement of photoelectrochemical degradation of dyes in aqueous solutions using TiO₂ nanorod photoanodes modified with cerium oxide (CeO₂) via electrodeposition techniques. Two different electrodeposition methods, constant potential and pulsed potential, were employed to deposit CeO₂ on the TiO₂ nanorods. The pulsed potential method significantly outperformed the constant potential method, demonstrating superior photocurrent generation. The modified photoanodes were tested for their ability to degrade methylene blue and methyl orange dyes under visible light irradiation. The TiO₂ nanorod photoanodes with CeO₂ deposited using the pulsed potential method exhibited the highest efficiency in dye degradation, attributed to the optimized cerium oxide deposition and enhanced charge transfer properties achieved through the pulsed electrodeposition technique. The improved performance of the pulsed potential-modified photoanodes highlights their potential for application in environmental remediation, particularly for the treatment of dye-contaminated water. This study not only demonstrates the effectiveness of pulsed electrodeposition in enhancing the photocatalytic performance of TiO₂ nanorod photoanodes but also provides valuable insights into the development of advanced photocatalytic materials for water purification. The findings underscore the benefits of using pulsed deposition techniques to achieve high-performance photoanodes for efficient photoelectrochemical degradation of organic pollutants, offering a promising approach to address environmental challenges associated with dye pollution in water.



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sciforum-098613: Enhancing Solar Still Efficiency: An Open-Source Python Algorithm for Accurate Performance Prediction and Data Generation

Fatima Belmehdi ^{1,2,*}, Samira Othmani ³ and Mourad Taha Janane ¹

¹ Mohammed V University in Rabat, Ecole Nationale Supérieure d'Arts et Métiers (ENSAM), Rabat, Morocco

² CNRST, Centre National Pour La Recherche Scientifique et Technique, Rabat, Morocco

³ Mohammed V University in Rabat, Ecole Normale Supérieure de Rabat (ENS), Rabat, Morocco

The present work focuses on optimizing solar stills to address global water scarcity, impacting 2.2 billion people, aligning with UN Sustainable Development Goal 6 for sustainable water management. Solar still desalination is particularly suited to off-grid applications due to its integration with renewable energy sources.

In the scientific literature, efforts to employ AI for predicting solar still performance are hindered by the scarcity of experimental data. To overcome this, we introduce an innovative open-source Python algorithm designed to optimize solar still designs. Validated with a precise 4% error margin, this model accurately forecasts performance and addresses data scarcity by generating a comprehensive dataset for enhanced machine learning training.

The algorithm employs the 4th-order Runge–Kutta (RK4) method to solve differential equations, calculating temperatures (water, cover, absorber, and insulation), cumulative condensed water flow, efficiency, and cost. It adjusts computations based on ambient temperature and solar irradiation data, utilizing interpolation techniques for increased precision. Additionally, the algorithm provides a visualization of device configurations and includes detailed technical descriptions. This encompasses geometric features, meteorological conditions, environmental factors, and materials data stored in an adjustable dataframe. It calculates thermodynamic properties using equations of state from the IAPWS association for each iteration. Moreover, hydraulic considerations such as the Colebrook–White equation approximation via Newton's method for turbulent regimes are integrated to estimate the Darcy friction factor for inclined, cascade, and stepped solar still configurations.

By optimizing parameters and materials, the algorithm enhances solar still efficiency while balancing cost-effectiveness. It minimizes resource expenditures and enriches machine learning training data, demonstrating potential for innovative, economically viable solar desalination solutions.



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sciforum-103274: Enhancing Urban Water Resilience: Integrating Smart Technologies, Holistic Management, and Green Engineering Solutions

Rabia Abid ^{1,*}, Muhammad Azhar Ali ¹, Saba Abid ², Usman Ali ³ and Muhammad Touseef Qamar ¹

¹ Department of Food Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad, Pakistan

² Department of Structures and Environmental Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad, Pakistan

³ Department of Textile Engineering and Technology, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad, Pakistan

As urban areas confront the escalating challenges posed by climate change, population growth, and environmental degradation, developing resilient and sustainable water management systems has become crucial. This study examines a comprehensive approach to enhancing urban water resilience through the integration of smart technologies, holistic management frameworks, and green engineering solutions. Smart technologies, including advanced sensor networks and real-time data analytics, are revolutionizing urban water management by facilitating dynamic monitoring, predictive maintenance, and optimized resource allocation. These innovations improve flood forecasting, reduce water losses, and enhance distribution efficiency. Complementing these technologies, a holistic management approach that merges storm water management, wastewater recycling, and potable water systems within a unified framework is demonstrating significant improvements in resource efficiency and environmental sustainability. This integrated strategy supports the development of adaptable water infrastructure capable of addressing diverse urban stresses. Additionally, green engineering solutions, such as green roofs, permeable pavements, and constructed wetlands, offer effective storm water management while also reducing urban heat islands and enhancing biodiversity. By synthesizing recent research and practical applications across these domains, this paper provides a forward-looking perspective on building robust, adaptive urban water systems. The integration of smart technologies, comprehensive management practices, and green engineering solutions contributes to advancing urban water resilience and sustainability in the face of ongoing and future challenges.



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sciforum-097600: Evaluating Trends in Groundwater Discharges Functioning through Machine Learning Tools Applied to Springs in Karstic Aquifers: Results Obtained in Las Loras Unesco Global Geopark (Spain)

Africa De La Hera-Portillo ^{1,*}, Elvira Ester Musakka ², Manuela Chamizo-Borreguero ¹, Pedro Martínez-Santos ^{3,4}, Karmah Salman ⁵, Jose Ángel Sánchez ⁵, Marwan Ghanem ⁶, Alsharifa Hind Mohammad ⁷, Nour-Eddine Laftouhi ⁸, Larry Stevens ⁹ and Rod Fensham ^{10,11}

¹ Centro Nacional Instituto Geológico y Minero de España, Consejo Superior de Investigaciones Científicas, (IGME-CSIC). Ríos Rosas 23, 28003 Madrid, Spain

² Department of Geodynamics, Stratigraphy and Paleontology. Faculty of Geological Sciences. Jose Antonio Novais s/n, 28040 Madrid, Spain

³ Department of Geodynamics, Stratigraphy and Paleontology, Faculty of Geological Sciences

⁴ Jose Antonio Novais s/n, 28040 Madrid, Spain

⁵ Geoparque Mundial UNESCO Las Loras. 34800 Aguilar de Campoo, Palencia

⁶ Birzeit University – Ramallah / Palestine

⁷ Water, Energy and Environment center, The University of Jordan. Jordan

⁸ Cadi Ayyad University, Faculty of Sciences Semlalia of Marrakech, Earth Sciences Dept. Morocco

⁹ Springs Stewardship Institute 414 N Humphreys St. Flagstaff, AZ 86001

¹⁰ Queensland Herbarium (DES), Mt Coot-tha Road, Toowong, QLD 4066, Australia

¹¹ Department of Biological Sciences, University of Queensland, St Lucia, QLD 4072, Australia

The UNESCO Global Geopark Las Loras (Palencia-Burgos, 960 km², Spain) constitutes a significantly sensitive area to changes caused by the impact of climate change, as it is located at the transition between the Atlantic and Mediterranean sides of the biogeographical regions in Spain and is a notably depopulated area.

The analysis of the impact of climate change on groundwater resources has been carried out by applying global climate models to the precipitation and temperature data series available at the Aguilar de Campoo weather station. The obtained projections for future potential climate scenarios (time intervals 2021-2040 and 2051-2070) in Las Loras UGGp at a monthly scale have been based on AEMET Free and open data, Representative Concentration Pathway (RCP), and Global Circulation Models (GCM).

The prevalence of karstic aquifers identified in the Las Loras UGGp renders this area particularly vulnerable to potential declines in water resources. The conservation of springs is an essential indicator of the efficiency in groundwater management. Using the springs as an indicator of water management, ML tools have been applied to estimate the number of active springs versus inactive springs as a first theoretical approach, which is expected to be checked in the near future using field campaigns and other complementary methodologies. The number of known springs amounts to more than 200 according to information obtained from IGN maps. However, the number of active springs compared to those that have disappeared is not well known. This work presents the results obtained as a first approach. The correlation level is higher than 90%, and this methodology could be extrapolated to other areas.



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sciforum-089763: Evapotranspiration Modeling for Efficient Water Resource Management: A Comparative Study of Takagi-Sugeno Fuzzy Systems and Generalized Regression Neural Network Models in Semiarid Algerian Regions

Assia Meziani ^{1,2,*}, Abdelmonem Miloudi ^{1,2} and Mohammed Sayah Lambarek ¹

¹ Faculty of Technology, Department of Hydraulic and Civil Engineering, University of El-Oued, El-Oued, Algeria.

² New Technology and Local Development Laboratory, University of El-Oued, El-Oued, Algeria.

The objective of this study is to compare two modeling approaches, the Takagi-Sugeno Fuzzy System (TSFS) and Generalized Regression Neural Network (GRNN) models, with evapotranspiration calculated by FAO-56. The selected sites are situated in Constantine, Guelma, Mascara, Saida, Setif, Souk Ahras, Tiaret, and Tlemcen, known for their semiarid climates. The daily data registered from 2000 to 2022 include air temperature at 2m (°C), relative humidity at 2m (%), dew point at 2m (°C), precipitation (mm), surface pressure (hPa), ETO FAO evapotranspiration (mm), vapor pressure deficit (kPa), wind speed at 10m (km/h), soil temperature from 0 to 7cm (°C), soil moisture from 0 to 7cm (m³/m³), sunshine duration (s), and terrestrial radiation (W/m²). The data were split into training (70%), validation (15%), and testing (15%) sets. To evaluate the two models, several indices were calculated, including Nash–Sutcliffe efficiency, coefficient of determination, root mean square error, mean absolute error, ratio sum ratio, and Willmott index.

The statistical results indicate that the GRNN model provides more accurate estimations of evapotranspiration compared to the TSFS model in semiarid regions. This is evidenced by a root mean square error (RMSE) of ≤ 0.285 , a mean absolute error (MAE) of ≤ 0.212 , a minimum coefficient of determination (R^2) of 0.976, a Nash–Sutcliffe efficiency (NSE) of ≥ 0.976 , a ratio sum ratio (RSR) of ≤ 0.156 , and a Willmott index (WI) of > 0.882 for training, validation, and testing. In contrast, the TSFS model shows an RMSE of ≤ 0.513 , an MAE of ≤ 0.405 , an R^2 of > 0.923 , an NSE of ≥ 0.965 , an RSR of ≤ 0.277 , and a WI of > 0.799 .

The findings of this study confirm that the GRNN model is more suitable for accurately estimating evapotranspiration in semiarid regions, contributing to efficient water resource management in these areas. Future research should focus on expanding the dataset to include diverse climatic regions to enhance the models' applicability.



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sciforum-097593: Exploring bacterial coaggregation in aquatic systems using advanced physicochemical and imaging techniques

Ana C. Afonso ^{1,*}, Jack Botting ^{2,3}, Inês B. Gomes ¹, Maria José Saavedra ⁴, Lúcia C. Simões ⁵, Jun Liu ^{2,3} and Manuel Simões ¹

¹ ALICE-LEPABE, Faculty of Engineering, University of Porto, Porto, Portugal

² Department of Microbial Pathogenesis, Yale School of Medicine, New Haven, CT 06536, United States

³ New Haven Microbial Sciences Institute, Yale University, West Haven, CT 06516, United States

⁴ CITAB, University of Trás-os-Montes e Alto Douro, Vila Real, Portugal

⁵ CEB-LABBELS, School of Engineering, University of Minho, Braga, Portugal

Coaggregation is a specific interaction mechanism where genetically distinct bacteria recognize and adhere to each other via complementary protein adhesins and polysaccharide receptors. Despite its critical role in biofilm formation and extensive studies in oral environments, coaggregation remains poorly understood in aquatic systems. Understanding coaggregation is crucial due to its significant implications, including its role in multispecies biofilm formation, water quality effects, impacts on engineered systems' performance, and potential biotechnological applications. This study offers an in-depth characterization of the cell surface properties of *Delftia acidovorans* isolated from drinking water (DW). Two strains showing different coaggregation abilities were selected (005P—coaggregating and 009P—non-coaggregating). The coaggregating 005P strain demonstrated higher surface hydrophobicity and more negative surface charge compared to the non-coaggregating 009P strain. Additionally, 005P showed higher cell surface and co-adhesion energies. Chemical analysis using Fourier-transform infrared spectroscopy revealed subtle differences in the bacterial surfaces, particularly in spectral regions associated with carbohydrates and proteins (860-930 cm⁻¹ and 1212-1240 cm⁻¹). Cryo-electron tomography highlighted distinct differences in pili structures between the strains. The pili in 005P were identified as pili-like adhesins. This research represents the first comprehensive characterization of a coaggregating strain from DW, employing a combination of advanced analytical techniques to provide new insights into the mechanisms driving bacterial coaggregation in aquatic systems.



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sciforum-098198: Field-Based Measurements of Soil Infiltration: Implications for Water Resource Management in Gaya District, India

Vikram Kumar ^{1,*} and Atul Kumar Rahul ²

¹ Government of Bihar, India

² Assistant Professor, Civil Engineering Department, MIT Muzaffarpur, Bihar - India

The accurate quantification of soil infiltration rates is paramount for effective water resource management. However, obtaining precise field-based measurements remains a challenge due to the lack of comprehensive datasets. Understanding soil infiltration is crucial for optimizing water use, enhancing groundwater recharge, and mitigating water-related issues such as runoff and soil erosion.

This study addresses the critical need for field-based measurements of soil infiltration rates in Gaya district, Bihar. Utilizing a mini disc infiltrometer, infiltration characteristics were assessed across all 24 blocks, encompassing diverse soil types and land uses. The mini disc infiltrometer measures the rate at which water enters the soil through a small disc placed on the surface, providing insights into soil permeability and water absorption dynamics.

The results revealed significant variability in infiltration rates, with average cumulative rates ranging from 0.38 to 2.20 cm/min. Notably, the initial infiltration rates were uniformly high across all blocks, gradually decreasing with successive readings. Moreover, forested areas exhibited higher cumulative infiltration rates compared to urban and grassland regions. Approximately one-third of the blocks demonstrated infiltration rates exceeding the area average, indicating favorable conditions for groundwater recharge and emphasizing the importance of implementing recharge structures.

Further analysis identified reduced infiltration rates in inundated areas, attributed to elevated soil water table levels. To address the lack of comprehensive datasets, a district-wide infiltration rate map was developed, serving as a valuable resource for decision-making in water resource management. These findings underscore the critical role of field-based infiltration measurements in informing sustainable water management practices. By bridging the gap in data availability and offering insights into soil-water dynamics, this study contributes to the enhancement of water resource management and resilience in the face of changing environmental conditions.



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sciforum-097737: Flow-3D Analysis of Hydrodynamic Forces on Oblong Bridge Piers

Abubaker Sami Dheyab ¹, Ana Margarida Bento ² and M.Sobhi Alasta ^{1,*}

¹ Department of Civil Engineering, Gaziantep University, 27310 Şehitkamil, Gaziantep, Türkiye

² Hydraulics, Water Resources, and Environmental Division, Department of Civil Engineering, Faculty of Engineering of the University of Porto, 4200-465 Porto, Portugal

The accurate prediction of scour development at bridge foundations is essential in order to ensure the safety and integrity of engineering structures. The complexity of the scouring process arises from the separation and generation of multiple vortices and the dynamic interaction between the flow and the movable bed during scour hole development. Traditional experimental approaches to scour characterization have primarily focused on the evolution of the movable bed, often with less emphasis on detailed flow field characterization. This study addresses this gap using FLOW-3D software to develop a computational model that simulates the turbulent flow field around bridge pier models in a controlled environment.

The primary objective is to compare the simulation results with experimental data to improve the understanding of the mechanisms driving flow-induced scour. The study involves velocity measurements of the flow around a bridge pier model carried out in a large-scale tilting flume. Detailed measurements of stream-wise, cross-wise, and vertical velocity distributions and Reynolds shear stresses were taken during both the flat and eroded bed stages of scouring.

Preliminary results from the computational model show a strong correlation with the experimental data, capturing the complex flow patterns and vortex formations that contribute to scour. The model successfully reproduces the observed velocity distributions and Reynolds shear stresses, providing valuable insights into the dynamic interactions between the flow and the bed material. These findings demonstrate the potential of advanced computational modelling to complement experimental studies and provide a more comprehensive understanding of scour processes at bridge foundations. This research contributes to the development of more accurate prediction tools, ultimately enhancing the design and safety of bridge structures.



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sciforum-097243: Generative AI-Aided Digital Twin for Urban Flood Risk Assessment: Challenges and Opportunities

Hooman Razavi ^{1,*}, Ali Asgari ², Hossein Bonakdari ³, Amirhossein Mostofi ⁴ and Omid Titidezh ⁵

¹ Tecnologico de Monterrey

² School of Administrative Studies, Faculty of Liberal Arts & Professional Studies, York University, Toronto, Canada

³ Department of Civil Engineering, University of Ottawa, Ottawa, Canada

⁴ Business School - Management, Technology & Organisation, Auckland University of Technology

⁵ School of Architecture, Building and Civil Engineering, Loughborough University, Loughborough, United Kingdom

Floods are the most frequent and destructive disasters, causing widespread destruction, A significant loss of life, and substantial economic impacts globally. Climate change exacerbates urban flood risks by altering precipitation patterns, increasing the frequency of extreme weather events, and raising sea levels. These escalating risks necessitate innovative solutions for effective urban flood management. Digital Twin (DT) technology offers a promising solution by providing virtual models and data-driven simulations that enhance urban landscape management, enabling timely flood warnings, evacuation planning, and property protection. Integrating Generative Artificial Intelligence (GenAI) further elevates digital twins by enhancing predictive capabilities and creating more realistic and interactive scenarios. Utilizing generative algorithms, digital twins can generate synthetic data to simulate a wide range of potential outcomes, improving the accuracy of modeling complex systems and forecasting variations and challenges. Moreover, GenAI improves the precision and reliability of digital twins in representing real-world environments through high-fidelity simulations. This study synthesizes findings from the literature review to develop a conceptual framework for elucidating the synergies between generative AI and digital twins in the context of urban flood risk assessment. It begins with an introduction to the integration of generative AI and digital twins for simulating flood scenarios. The paper then delves into the fundamentals of generative AI, discussing its principles, applications, and successful implementations across various domains, particularly in urban flood risk assessment. Subsequent sections examine the evolution of digital twins and their critical role in assessing, predicting, and mitigating flood risks. The study further investigates the intersection of generative AI and digital twins, highlighting the enhanced simulation capabilities provided by GenAI. Concluding with an in-depth analysis of specific applications of GenAI-enhanced digital twins in flood risk assessment, the study anticipates future challenges and advancements, emphasizing emerging trends and potential development opportunities.



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sciforum-097586: Green Synthesis of Silver Nanoparticles Using *Phyllanthus emblica* and *Adhatoda vasica* Leaf Extract and comparative study on microbes

Divya Acharya

Research scholar Biotechnology kalinga university Raipur Chhattisgarh India

Introduction

In ancient times, silver played an important role in curing many diseases and fighting against many infections. Currently, silver is used in AgNPs for targeting many biomedical and physio-chemical reactions to fulfill research goals. But many drawbacks are also reported in AgNP reactions, like allergy and environmental risks, so to avoid all these side-effects, plant-based AgNPs are synthesized by researchers. In our research, we have used silver nano-particles of *Phyllanthus emblica* and *Adhatoda vasica* Leaf Extract and conducted a comparative study on microbes.

Methods

Leaf samples were first collected, then crushed into a powder. Next, we made a water-based extract solution by heating the mixture to 80 degrees Celsius for three to four hours using a magnetic stirrer. Finally, the leaf extract was combined with 1M silver nitrate solution, which was made by dissolving 1.7 grams of silver nitrate in 100 milliliters of water. Finally, the mixture of amla and adusa silver nitrate was centrifuged at 12000 rpm for 30 minutes, discarding the supernatant and collecting the dark pellet to form AgNPs of leaf extract. Finally, the leaf extract was collected in the form of a powder and dried for two to three days in a dark place. Using the disc diffusion and well diffusion methods, we investigated the effects of these AgNP powders at varying concentrations against disease-causing bacteria, such as *E. Coli*, *S. Aureus*, *Mucor*, and *Aspergillus* strains. Additionally, we utilized the commercial antibiotic streptomycin to complete the comparative study.

Conclusions

The presence of secondary metabolites in plant leaves makes plant-based drug systems and AgNP molecules more effective and eco-friendly as compared to chemical-based AgNPs. In our research, AgNPs of amla and adusa leaf extracts were investigated in a comparative study on microbes with positive results compared to the commercial antibiotic streptomycin in terms of killing microbes, as was clearly shown by the formation of a zone of inhibition on Petri plates .



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sciforum-103056: Groundwater Resource Availability Index as a Management Tool for Assessing Groundwater Resource Sustainability

Luis Moreno-Merino ¹, Olga García-Menéndez ¹, Héctor Aguilera-Alonso ² and Africa De La Hera Portillo ^{3,*}

¹ Centro Nacional Instituto Geológico y Minero de España, Consejo Superior de Investigaciones Científicas, (IGME-CSIC). Ríos Rosas 23, 28003 Madrid, Spain

² Centro Nacional Instituto Geológico y Minero de España, Consejo Superior de Investigaciones Científicas (IGME-CSIC). Ríos Rosas 23, 28003 Madrid, Spain

³ Geological Survey of Spain (Instituto Geológico y Minero de España-IGME)

Excessive groundwater extraction for agriculture, combined with climate change, is depleting groundwater reserves and degrading their quality. This threatens both groundwater-dependent economies and ecosystems. In the Duero River basin in Spain, four groundwater bodies are in poor quantitative condition, and eighteen have a poor chemical status.

Within the European project STARS4Water (Supporting Stakeholders for Adaptive, Resilient, and Sustainable Water Management), a management system has been developed using the Groundwater Resource Availability Index (GWAi), reference levels, and management guidelines. This system aims to be universally applicable and flexible enough to adapt to various hydrological, climatic, and management contexts. The GWAi is designed to be calculated easily using data from standard monitoring programs, and its results should be easily interpretable by various stakeholders.

The GWAi calculation involves defining a 'calculation period' and determining the normalized slope of piezometric-level changes during that period. This is carried out iteratively, starting from the beginning of the historical piezometric data series, with the calculation window moving forward by one year in each iteration. This process reveals both the evolution of the index and its individual values. Management recommendations are based on the index's evolution over time, where negative GWAi values indicate resource depletion and positive values indicate increasing resource availability. These calculations were automated in a user-friendly spreadsheet program. The GWAi was applied across the Duero River basin and in more detail to the Los Arenales-Tierra de Medina-La Moraña groundwater body, these areas being severely affected by resource quantity and chemical status issues.



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sciforum-097515: Impeller 3D Printing and Optimization Techniques in Turbomachinery: Review

Abel Remache ^{1,*}, Victor Hugo Hidalgo ^{2,3}, Helena M. Ramos ⁴ and Modesto Pérez-Sánchez ⁵

¹ Faculty of Engineering and Applied Sciences, Universidad Central del Ecuador, 170902 Quito, Ecuador

² Carrera de Pedagogía Técnica de la Mecatrónica, Facultad de Filosofía, Letras y Ciencias de la Educación, Universidad Central del Ecuador, 170902 Quito, Ecuador

³ Laboratorio de Mecánica – Informática, Departamento de Ingeniería Mecánica, Escuela Politécnica Nacional, Quito 170517, Ecuador

⁴ Civil Engineering Research and Innovation for Sustainability (CERIS), Instituto Superior Técnico, Department of Civil Engineering, Architecture and Environment, University of Lisbon, 1049-001 Lisbon, Portugal

⁵ Hydraulic and Environmental Engineering Department, Universitat Politècnica de València, Valencia, 46022 Spain

Impellers within turbomachinery face critical challenges related to material wear, maintenance costs, performance, and efficiency. The optimization of impellers has been extensively studied to address these issues across components such as turbines, pumps, compressors, fans, and mixers. The objective of this comprehensive review is to explore current state-of-the-art techniques for resolving these problems in the field of additive manufacturing (AM) and optimization methods. We conducted an exhaustive search of scientific articles in major databases, meticulously filtering relevant information from high-quartile sources. The study reveals various AM techniques applied to impellers and adjacent elements, along with diverse materials used in functional system components. Additionally, we describe the positive effects of optimization methods, including Multi-objective Optimization (MO), Artificial Neural Networks (ANN), Response Surface Method (RSM), and Genetic Algorithm (GA), on turbomachinery part design. Recent trends indicate increased variability in optimization approaches, often combining multiple techniques or optimization models for optimal results. Regarding AM, evidence suggests that Fused Deposition Modeling (FDM) and powder bed fusion technology are the most widely used methods in this field. The materials used in AM processes are very varied and depend on their applications and can be metals (Ti-6Al-4V, Inconel 718, AISI316L, 17-4 PH), polymers (ABS, nylon, PLA, PU), resins and ceramics.



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sciforum-097879: Integrating HEC-RAS and AI for Enhanced Flood Prediction and Management in the Rideau River, Eastern Ontario

Victor Joubier ^{1,2,*}, Isa Ebtehaj ³ and Hossein Bonakdari ²

¹ Ecole Nationale du Genie de l'Eau et de l'Environnement de Strasbourg, 1 Cour des Cigarières, 67000 Strasbourg, France

² Department of Civil Engineering, University of Ottawa, 161 Louis Pasteur Private, Ottawa, ON K1N 6N5, Canada

³ Department of Soils and Agri-Food Engineering, Université Laval, Québec, QC G1V 0A6, Canada

This study focuses on the application of Hydrologic Engineering Center's River Analysis System (HEC-RAS) to simulate the dynamic behavior of the Rideau River, located in eastern Ontario, Canada. The study area spans between 25 and 30 km of the river, including a bifurcation at Hogs Back Falls in Ottawa, where the river splits into the Rideau Canal and the Rideau River before merging with the Ottawa River. HEC-RAS is utilized to simulate river discharge, leveraging a substantial database of flow measurements from various gauging stations. These measurements allow for the determination of discharge rates for return periods ranging from 2 to 1000 years, calculated using the Gaussian method. The table below outlines the discharge values to be input into the HEC-RAS model. In addition to hydraulic simulations of the Rideau River, this study employs artificial intelligence (AI) to predict river discharge based on meteorological variables such as maximum temperature (Tmax), minimum temperature (Tmin), mean temperature (Tmean), and precipitation. By integrating AI with traditional hydrological modeling, the study aims to enhance the accuracy and reliability of flood predictions. By gaining a deeper understanding of the influence of temperature on the occurrence of spring floods, researchers and practitioners can improve the effectiveness and applicability of machine learning techniques in flood prediction and management. This study's findings underscore the importance of considering temperature fluctuations, precipitation levels, and historical discharge data in flood modeling. These insights, coupled with the reliable predictions provided by the AI model, empower decision-makers to make more accurate and effective decisions in flood management strategies. This leads to improved mitigation and adaptation measures in response to increasing flood risks. This integrated approach enhances flood prediction capabilities and supports the development of robust and adaptive flood management strategies for the Rideau River and similar watersheds.



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sciforum-102541: Integrating IoT and AI for Smart Water Management: Enhancing Urban Water Networks with Real-Time Monitoring and Digital Twin Technology

Saba Abid ^{1,*}, Shahbaz Nasir Khan ¹, Mannan Aleem ¹, Abdul Nasir ¹ and Rabia Abid ²

¹ Department of Structures and Environmental Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad, Pakistan

² Department of Food Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad, Pakistan

As global water resources face unprecedented challenges from population growth, climate change, and urbanization, innovative technologies are essential for sustainable water management. This study explores the application of Internet of Things (IoT) and Artificial Intelligence (AI) within Smart Water Management Systems (SWMS), highlighting their transformative potential in urban water networks. IoT-enabled devices offer continuous real-time monitoring of water parameters, providing a wealth of data that AI algorithms can analyse to optimize water distribution, detect leaks, and manage water quality. The implementation of Digital Twin technology allows for the simulation and analysis of various water management scenarios, enhancing decision-making processes and operational efficiency. This research presents case studies demonstrating the effectiveness of IoT and AI in predicting water demand patterns, identifying system failures, and improving overall water management resilience and sustainability. The integration of these technologies not only reduces operational costs but also enhances environmental protection, aligning with the goals of sustainable development and risk mitigation in water resource management. Our findings contribute to the ongoing discourse on smart water grids, showcasing how IoT and AI can be effectively integrated into traditional water management infrastructures. This study provides a comprehensive roadmap for future advancements in water technology, emphasizing the importance of innovative approaches in addressing the complexities of modern water management.



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sciforum-097200: Integrating Machine Learning and Computational Fluid Dynamics for Predicting the Trajectory of a Rosette Jet in Crossflow

Shuyi Jia *, Lingkun Meng, Danial Goodarzi, Hossein Bonakdari and Abdolmajid Mohammadian

Department of Civil Engineering, University of Ottawa, 161 Louis Pasteur Private, Ottawa, ON K1N 6N5, Canada

The study of rosette jets in crossflow is essential for understanding the transport and mixing of hot and saline discharges in crossflow ambient. Conventional approaches utilize physical experiments and Computational Fluid Dynamics (CFD) for study, which are both costly and time-consuming. This highlights the necessity for more time- and cost-efficient models, such as machine learning techniques, which offer a promising alternative for achieving accurate and efficient predictions. This study aims to evaluate the performance of machine learning algorithms using datasets generated by the CFD tool OpenFOAM, validated by experimental results. The datasets included key parameters influencing the jet trajectory, such as jet-to-ambient velocity ratios, Reynolds number, jet angle, and jet trajectory. Various machine learning algorithms, including support vector machines (SVM), Extreme Learning Machine (ELM), and Adaptive Neuro-Fuzzy Inference System (ANFIS), were trained and tested using these datasets. The models' performance was evaluated based on their predictive accuracy and computational efficiency. The machine learning models were developed to predict the jet trajectory based on the jet-to-ambient velocity ratios, Reynolds number, dimensionless jet angle. The performance of these models was assessed using multiple statistical metrics, and the results were benchmarked against the previous study's findings. The machine learning models demonstrated varying degrees of success in predicting the jet trajectory. The results were compared against the previous study, showing that some machine learning models effectively captured the complex dynamics of rosette jet trajectories, validating the models' robust generalization capabilities. These models provide a rapid and feasible alternative to traditional CFD methods for accurately predicting the trajectories of rosette jets, which support the design and environmental assessment of coastal outfall systems.



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sciforum-103302: Interpretation of variables in a machine learning model for short-term streamflow prediction

Sergio Ricardo López-Chacón ^{1,*}, Fernando Salazar ^{1,2} and Ernest Bladé ²

¹ International Centre for Numerical Methods in Engineering (CIMNE), 08034 Barcelona, Spain

² Flumen Institute, Universitat Politècnica de Catalunya (UPC BarcelonaTech)—International Centre for Numerical Methods in Engineering (CIMNE), 08034 Barcelona, Spain

Machine learning models have shown promising results for streamflow prediction. However, they are commonly difficult to interpret because they are not based on physical principles but on the relationship between inputs and outputs. Consequently, this work proposes to evaluate two main aspects: First, the advantages and drawbacks of the methods for assessing the influence of the variables inside a machine learning model for short-term streamflow prediction. Second, whether the influence of variables has an acceptable physical interpretation. In this sense, a Random Forest model was trained with the Upper Ter Catchment (Spain) data. The model employs different accumulated precipitation and streamflow variables. The methodology evaluates the influence of the variables globally, by intervals, and in specific predictions. The results show that the mean decrease in accuracy, the mean decrease in node impurity and the mean SHAP (Shapley Additive Explanations) confer the main influence to a similar group of variables. Nonetheless, the Tornado method shows discrepancies. The partial dependence analysis results suggest that this method cannot accurately portray the influence of the variables in poorly represented ranges. In contrast, the ALE (Accumulated Local Effects) results acceptably capture the influence of the variables for the whole data spectrum. The Shapley and SHAP values indicate that the accumulated precipitation in less than six hours acquires the highest importance during the rising limb of the hydrograph, which is consistent with the catchment system. During the falling limb, the streamflow values closer to the output horizon are the most influential, suggesting that the shape of the limb is guided by them. Machine learning models for streamflow prediction can obtain physically acceptable relations between variables and outputs, which may lead to a further description of the catchment system. However, the methods used to represent the influence of the variables must be selected carefully to avoid misleading interpretations.



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sciforum-097790: Investigating the Effectiveness of Countermeasures in Reducing Local Scour at Bridge Piers Using FLOW-3D

Mehmet Ishak Yüce¹ and M. Sobhi Alasta^{2,*}

¹ Department of Civil Engineering, Hydraulics, Gaziantep University, Gaziantep, Gaziantep, 27310, Turkey

² Department of Civil Engineering, Gaziantep University, 27310 Şehitkamil, Gaziantep, Türkiye

Scour is a primary cause of bridge failures worldwide, posing significant risks to infrastructure stability and safety. Understanding the mechanisms of scouring is crucial for developing effective mitigation strategies. This study employs FLOW-3D software to create a detailed three-dimensional model of local scour around a bridge pier, providing an advanced simulation framework. The model is meticulously calibrated using experimental data obtained from tests conducted on a circular pier, ensuring high accuracy and reliability in the simulation results.

The primary objective of this research is to assess the efficacy of circular collars as countermeasures in reducing scour depth around bridge piers. Circular collars are designed to deflect the flow of water and disrupt the vortices that contribute to sediment erosion at the pier base. By incorporating these countermeasures into the model, we aim to quantify their impact on reducing local scour.

The simulation results reveal that the addition of circular collars significantly diminishes local scour around the pier. The collars effectively alter the flow patterns, reducing the intensity of vortices and the resulting sediment displacement. This study provides valuable insights into the practical application of FLOW-3D in hydraulic engineering and underscores the potential of circular collars as a cost-effective solution for mitigating scour-related bridge failures.



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sciforum-103079: Leveraging Machine Learning and Ultrasonic Technology for Autonomous Detection and Mitigation of Harmful Algal Blooms in Oceanic Environments

Sajeev Magesh ^{1,*} and Varun Rao ²

¹ Dublin High School, 8151 Village Pkwy, Dublin, CA, United States

² Mission San Jose High School, 41717 Palm Ave, Fremont, CA, United States

Harmful algal blooms (HABs) pose significant threats to aquatic ecosystems, public health, and local economies by degrading water quality, causing fish kills, and producing harmful toxins. Traditional methods of detecting and mitigating HABs are often labor-intensive and expensive, targeting only smaller water bodies. This project leverages machine learning and satellite imagery to locate and classify oceanic HABs, utilizing ultrasonic sound emissions at specific frequencies to eliminate each targeted HAB. The system analyzes satellite images with convolutional neural networks to identify and categorize different types of harmful algae, allowing for rapid, large-scale monitoring of water bodies and providing timely data for environmental management. Existing research indicates that ultrasonic waves at specific frequencies can effectively disrupt and destroy algal cells without harming other aquatic organisms. To mitigate detected HABs, we utilize an existing database to identify the appropriate ultrasonic wave frequency for the targeted HAB and emit it through a transducer. Our technique prioritizes ensuring that other marine life is not affected by accounting for the hearing frequency ranges of various ocean-dwelling organisms. We develop a prototype drone to integrate these technologies, enabling autonomous scanning and treatment across the open ocean. The drone successfully combines satellite-based detection with ultrasonic mitigation, demonstrating the practical application of this dual approach. Preliminary field tests indicate the prototype's effectiveness in identifying and reducing oceanic HABs. This scalable and eco-friendly solution represents a significant advancement in HAB management, contributing to the protection of aquatic environments and public health.



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sciforum-093603: Meteorological Drought Management in the Mediterranean: Integrating Satellite and Reanalysis Data for Enhanced Early Warning Systems in the Tensift River Basin (Morocco)

Mohamed Naim ^{1,2,*} and Brunella Bonaccorso ²

¹ Department of Science, Technology and Society , University School of Advanced Studies of Pavia, Pavia, 27100, Italy

² Department of Engineering, University of Messina, Messina, 98166, Italy

Drought is a major climatic hazard in the Mediterranean region, particularly in the Tensift river basin in Morocco. It has severe implications for water availability, agriculture, and local economies. However, traditional monitoring systems often fail to provide timely drought warnings. This study explores the integration of satellite and reanalysis data to enhance early warning systems, aiming to improve drought detection and monitoring across the Mediterranean. The effectiveness of the Standardized Precipitation Index (SPI) and the Standardized Precipitation Evapotranspiration Index (SPEI) based on satellite data from the Climate Hazards Group Infrared Precipitation (CHIRPS) and reanalysis data (ERA5-Land) was assessed using Receiver Operating Characteristic (ROC) curve analysis, comparing them to ground observations from 1981 to 2021. This study focused on optimizing thresholds and timescales for these indices to improve drought detection. The integration of CHIRPS and ERA5-Land significantly enhanced the detection of drought events compared to conventional methods. The ROC analysis identified optimal threshold levels for SPI and SPEI, which improved their detection performance. The Pearson Type III distribution was found to be the most suitable for SPI calculations, while the Log-logistic distribution was best for calculating SPEI. Integrating satellite and reanalysis data significantly advances drought characterization in the Tensift basin, facilitating more proactive drought management. This method proves crucial for mitigating impacts and supporting decision-makers in sustainable water resource management. Future research should aim to integrate these indices with socio-economic impacts to develop a comprehensive drought risk management strategy.



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sciforum-091985: New Quantitative Spectrophotometric Analysis in the Visible (VIS) Range of Nitrates, NO_3^- , from Fresh Groundwater Sources Intended for Domestic Consumption

Cristian-Catalin Gavut

University of Medicine and Pharmacy "Grigore T. Popa", Biomedical Sciences Department, Faculty of Medical Bioengineering, 16 Universitatii Street, Iasi 700115, Romania

The aim of this study was to conduct a precise analysis through a new spectrophotometric method that uses nitrate anions, NO_3^- , as species with significant toxic potential covertly existing in the composition of several samples of water intended for domestic consumption. Nitrates, NO_3^- , from the studied groundwater samples quantitatively reacted with phenol disulfonic acid, which led to the synthesis of an intense bright yellow nitro-phenol disulfonic acid compound in the presence of a solution of NaOH, 2 M, and ammonia, 10-12%, 2:1. Nitro-phenol disulfonic acid showed an absorption maximum at a wavelength of $\lambda = 402 \text{ nm}$ and was obtained in a quantitative proportion perfectly equivalent to the concentration of pure NO_3^- nitrate anions obtained from the water samples. Through spectrophotometrically dosing the bright-yellow intense nitro-derivative formed at $\lambda = 402 \text{ nm}$ in relation to double-distilled H_2O as a control, the concentrations expressed in mg/L of pure nitrate NO_3^- ions in the unknown water samples were directly determined. Following this method, the NO_3^- nitrate concentrations from all eight unknown groundwater sources were found to be below the maximum allowed reference limit of **50 mg/L**. The method proposed was linear over the entire concentration range of the chosen standard solutions (4,00 $\mu\text{g/mL}$ - 40 $\mu\text{g/mL}$). The linear regression coefficient was $R^2 = 0.9995198$, $R^2 \geq 0.9990$, and the correlation coefficient was $R = 0.9997599$, $R > 0.9990$. The standard error of the regression line was $\text{SE} = 0,0059577$, $\text{SE} 1$. The detection limit was $\text{LOD} = 0,8456 \mu\text{g/ mL}$, $\text{LOD} 1$, and the quantitation limit was $\text{LOQ} = 2,8093 \mu\text{g/ mL}$, $\text{LOQ} 3$. The method used for the visible spectrophotometric analysis of nitrates was subsequently subjected to complete statistical validation.



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sciforum-103245: Numerical Analysis of Flow around Spur Dikes Using Flow-3D

Muhammad Faizan Khatri *, Abdul Lateef Qureshi and Babar Naeem

US-Pakistan Center for Advanced Studies in Water, Mehran University of Engineering & Technology, Jamshoro, Pakistan

Spur dikes are hydraulic structures widely used to divert the flow from riverbanks to the centerline. The reason for deviating the flow is to protect the bed and prevent erosion around banks. But the spur stability becomes at risk due to the flow vortex around it. Hence, it is vital to investigate the flow patterns around these spurs, either by physical means or numerical analysis. Since Physical Modeling requires a lot of effort, it is essential to conduct further study with a new approach and a technique with less hassle using Computational Fluid Dynamics software named FLOW-3D to simulate complex hydrodynamics problems. In this paper, a Renormalized Group (RNG) $k-\varepsilon$ turbulence model was employed to address the flow pattern around spur dikes. The model was validated using the experimental data results present in the open literature. Grid sensitivity analysis was also conducted, which provided evidence that a finer mesh using the nested mesh technique produced better results than a coarse mesh. Statistical tests, the coefficient of regression (R^2), root mean square deviation (RMSD), and mean absolute error (MAE) are utilized to compare the data on the transverse velocities in different sections to check the accuracy of the model with the observed data. For a 4 cm spur in a laboratory flume, the R^2 , RMSD, and MAE were obtained as 0.97, 0.011, and 0.004, respectively, which shows the good agreement of the model results with the observed data, with minimal discrepancies. Therefore, it is recommended to be utilized for similar studies in the future and is applicable to field conditions.



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sciforum-103066: Numerical Modeling of Groundwater Impact on Slope Stability and Dewatering System Design in the Western Pit of Sangan Iron Ore Mine

Mohsen Safari ^{1,*}, Faramarz Doulati Ardejani ², Reza Taherdangkoo ³ and Christoph Butscher ⁴

¹ Department of Mining Engineering, Birjand University of Technology, Birjand, Iran

² School of Mining, College of Engineering, University of Tehran, Tehran, Iran

³ TU Bergakademie Freiberg, Institute of Geotechnics

⁴ Institute of Geotechnics, TU Bergakademie Freiberg, Gustav-Zeuner-Str. 1, 09599, Freiberg, Germany

Groundwater in open-pit mines can significantly influence mining operations, affecting both safety and productivity. A thorough understanding of groundwater conditions and their impact on slope stability is essential for optimizing mine design and ensuring operational efficiency. This study investigates the effects of groundwater on the slope stability of the western pit in the Sangan iron ore mine through detailed numerical modeling. The graphical model revealed that in the tenth year of mining operations, the safety factors in the lower benches fell below 1.3, indicating potential instability based on the Mohr–Coulomb failure criterion. This instability poses a significant risk to the structural integrity of the mine. Further analysis demonstrated that reducing pore pressure could substantially increase the factor of safety, thereby mitigating the risk of slope failure. To address this critical issue, a comprehensive dewatering program was meticulously designed, modeled, and implemented to effectively reduce or eliminate pore pressure, ultimately enhancing pit slope stability. The validity of the numerical model was rigorously confirmed through subsequent analysis, demonstrating its reliability as a predictive tool for groundwater flow and slope stability assessment in similar mining environments. This study underscores the crucial importance of incorporating groundwater management into the design and operational planning of open-pit mines to ensure long-term stability and safety.



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sciforum-103313: Numerical Modeling of Metal Pollutant Dispersion from the Khatunabad Smelting Chimney Using Satellite Images and the ERA Database

Fatemeh Amiresmaeili ^{1*}, Faramarz Doulati Ardejani ¹, Amirreza Heydarzade ²,
Mohammad Yavarzadeh ³, Reza Taherdangkoo ⁴ and Christoph Butscher ⁵

¹ School of Mining Engineering, College of Engineering, University of Tehran, Tehran 15614, Iran

² Shahid Bahonar University of Kerman, Kerman, Iran

³ Research & Development Branch, National Iranian Copper Industries Company, Sharebabak, Iran

⁴ TU Bergakademie Freiberg, Institute of Geotechnics

⁵ Institute of Geotechnics, TU Bergakademie Freiberg, Gustav-Zeuner-Str. 1, 09599, Freiberg, Germany

The chemical pollutants and particulate matter resulting from the copper smelting process have severe impacts on air quality and human health. In this context, modeling air pollution from copper smelting plants has been recognized as a powerful tool for analyzing and predicting the dispersion of pollutants and assessing their effects on the environment and public health. This study aims to present optimization and control methods for mitigating air pollution from copper smelting plants and to examine the impacts of the Khatunabad smelting plant on the climatic parameters of the Khatunabad plain. The climatic parameters such as temperature, precipitation, soil moisture, and wind, derived from the ERA5-Land database, along with vegetation data from MODIS sensors, were analyzed in the Khatunabad plain. Subsequently, the dispersion of pollutants emitted from the Khatunabad smelting plant's chimney was modeled using climatic data and the AERMOD software. The results indicated that the concentration and behavior of pollutants were strongly correlated with wind components. Therefore, modeling the behavior of pollutants while accounting for wind patterns at different hours, months, and seasons can serve as an effective tool for analyzing and predicting the dispersion of pollutants from the copper smelting plant in the Khatunabad plain. The maximum concentration of total suspended particulate matter in this modeling was estimated at $0.48 \mu\text{g}/\text{m}^3$, while the maximum concentration of SO_2 was estimated at $0.95 \mu\text{g}/\text{m}^3$. Additionally, based on the modeling results, the highest accumulation of pollution was observed in the northeastern and southwestern sections of the plant.



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sciforum-103424: Numerical modeling used to create a digital twin for mollusk farming: exploratory studies with MOHID BIVALVES in the bays of Santa Catarina Island, Brazil

Katt Regina Lapa ^{1,*}, Luis Hamilton Pospissil Garbossa ², Sofia Saraiva ³, Sunshine de Avila Simas ¹, Eliziane Silva ¹, Carlos Henrique Araujo de Miranda Gomes ¹, Claudio Manoel Rodrigues de Melo ¹ and Ramiro Neves ⁴

¹ Department of Aquaculture - AQI, Center for Agricultural Sciences - CCA, Federal University of Santa Catarina - UFSC, Brazil.

² Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina - Epagri

³ Maretec, IST, University of Lisbon, Portugal

⁴ Maretec, Instituto Superior Técnico, Portugal

The prediction of the dynamics of mollusk farming in Santa Catarina, Southern Brazil, in response to environmental changes is essential for ecosystem management and the implementation of public policies. Climate changes or the carrying capacity of the environment can affect commercial exploitation and quantify the environmental impacts of farming. Computational mathematical models, such as MOHID Bivalves, have been used to analyze these issues, combining descriptions of ecological and physical processes to solve complex problems. MOHID, based on a computational grid to solve mass transport equations, was coupled with a biogeochemical module based on DEB theory, which describes the physiological response of an organism to environmental changes. The objective of this research was to evaluate the hydrodynamic numerical tool MOHID Bivalves applied to aquaculture, focusing on predicting the growth of *Crassostrea gigas* in the bays of Santa Catarina Island, Southern Brazil. Parameterizations and numerous simulations were performed to adjust the model to field data between 2013, 2015, and 2019 in the southern and northern locations of the bays. Preliminary results showed that the model satisfactorily reproduced the growth dynamics in shell length of *C. gigas* at both study sites, even without site-specific calibration. Mathematical models with hydrodynamic numerical simulation are the best option to accurately predict the dynamics of mollusk farming in response to natural or anthropogenic changes, whether for optimizing commercial exploitation or quantifying environmental impacts. It was concluded that the model is suitable for the cultivation configurations of *C. gigas* in the bays of Santa Catarina Island, Southern Brazil, providing a powerful tool to sustainably optimize aquaculture practices. The next stages of the study include applying this parameterization associated with the water quality model to predict the carrying capacity of the bays and predictive studies of better farming scenarios.



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sciforum-097738: Numerical Models for Groundwater Flows: Key in Construction

David Beltrán-Vargas ^{1,*}, Fernando García-Páez ¹, Manuel Martínez-Morales ² and Sergio Arturo Rentería-Guevara ¹

¹ Department of Civil Engineering, Autonomous University of Sinaloa, 80013, Culiacán, Sinaloa, México

² Groundwater Hydrology Division, Mexican Institute of Water Technology, 62550, Jiutepec Morelos, Mexico

The presence of groundwater flow in a construction project affects the construction process, resulting in issues ranging from excavation stability to the redesign of foundations and infrastructure, leading to project delays and major revisions. Groundwater level drawdown, a controlled technique in Civil Engineering, mitigates this effect. Understanding the aquifer is important to ensure accurate representation in the model and to plan the appropriate dewatering technique. In Mexico, the regulation of these procedures related to laws, norms, and regulations lacks a specific bibliography. Additionally, the availability of databases with piezometric information is insufficient and limited. Methodologies for analysis have evolved worldwide to capture the system's complexity, employing numerical models to assess its behaviour. First, it was necessary to characterize the area, considering the water-table level. Subsequently, a numerical model was developed using ModFlow and its ModelMuse interface, both developed by the United States Geological Survey (USGS). This allowed the evaluation of different scenarios in response to proposed dewatering techniques and the anticipation of potential impacts, thereby avoiding the trial and error practice. Analyses of “Torre Tres Ríos”, a building in Sinaloa, Mexico, were conducted to assess water-table behaviour in the area. In July, the water-table was at 33 meters above sea level (masl). By October, it had risen to 35.74 masl, attributed to the recharge due to the rainy season and the influence of the Tamazula River. By November, it had dropped to 35.20 masl, indicating a discharge process. The steady-state model initially represented with piezometric levels close to 33 masl in July. Subsequent transient-state model outputs for October and November reported water-table elevations at 35.676 and 35.438 masl, respectively. Calibration results revealed a mean absolute error of 0.15 meters and a standard deviation of 0.174 meters, approving the model results. This information is important for informed decision-making in dewatering processes, enabling precise adjustments in pumping.



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sciforum-093006: Predicting Per- and Polyfluoro-Alkyl Substance Uptake by Agricultural Crops Using Machine Learning Tools

Shalini Kandlamadugu Madanmohan and Veera Gnaneswar Gude *

¹ Purdue University Northwest Water Institute, 2540 169th St. Schneider Avenue Building, Hammond, Indiana 46323

² Environmental & Ecological Engineering, Purdue University, West Lafayette, IN

Scientific advances in recent years have tremendously improved the predictive capabilities of domain-specific problems with the use of machine learning and artificial intelligence. An innovative exploration is performed to understand the root uptake of per- and polyfluoroalkyl substances (PFASs) by plants, focusing on the intricate interactions between PFAS compounds, crops and soil. We established a machine learning model which performs a regression task to accurately predict the root concentration factors (RCFs) values of the PFAs. Various machine learning models are trained and evaluated on various evaluation metrics, and the best model has an R^2 value of 0.9379. These models significantly outperformed the other existing models in predicting the logRCF values, indicating their robustness in capturing the complex dynamics of PFAS uptake by plants. For model development, around 300 instances (or data points) of root concentration factors (RCFs) that measure the amount of PFASs absorbed by the plant roots from the soil are used. The data also included 11 features, related to PFAS chemical structures, organic carbon content, crop and soil characteristics and cultivation conditions. The developed model is evaluated and interpreted to obtain the most important features, which highly contribute to predicting RCF values. Feature importance analysis was utilized to gain a greater understanding of the decision-making processes of the models and the significance of individual features. This study shed light on a detailed approach to predict and understand how plants absorb PFASs and also captured the essential variables that affect the uptake of PFAS, and offered insightful information about the various components that contribute to their occurrence.



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sciforum-093579: Prediction of Blue-Green Algae Cells in a City Water Source Based on the LSTM Model

Liangzhi Sun ^{1,*}, Yangyang Chu ¹, Hui Li ¹, Shihu Shu ² and Xiaomeng Han ²

¹ DongHua University, Shanghai 201620, China

² Shanghai Institute of Pollution Control and Ecological Safety, Shanghai 200092, China

China ranks sixth in the world in terms of freshwater resources, yet its per capita freshwater resources are only one-fourth of the global average. Additionally, freshwater resources exhibit spatial unevenness. Given the rapid pace of urbanization, the safety of China's freshwater resources in terms of water quality is at risk due to contamination. Consequently, the utilization of water quality models for predicting changes in water quality has emerged as a prominent research focus. The data-driven water quality prediction model provides a scientific basis for water resource management departments to provide early warning of algal blooms and formulate effective control measures in advance. In this study, we predicted the dominant algae (blue-green algae) population in a water source based on the Long Short-Term Memory (LSTM) network model. Additionally, we explored the effects of the type of feature combination and the step size of the time window on the prediction performance of the LSTM by establishing different feature combinations and different time windows as input methods. The experimental results show that the performance of multi-feature prediction is consistently superior to single-feature prediction. Simultaneously, increasing the number of features in the input model tends to diminish the model's predictive performance. The time window impacts the performance of LSTM predictions. As the step size increases, the model prediction performance gradually enhances, eventually stabilizing while concurrently incurring significant time overhead. Lastly, this study offers insights into future research directions from three key dimensions: the input indicator, optimization algorithm, and model combination.



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sciforum-097627: Prediction of Crop Yield using Deep learning CNN-LSTM model for an agriculture-intensive basin of India: A Hindon Basin Case Study

Sai Bargav Reddy^{1,*}, Vanshika Singhal² and Urva Chiragbhai Prajapati²

¹ Research Scholar, Hydraulics Engineering Division, Department of Civil Engineering, Indian Institute of Technology Roorkee, Roorkee, Haridwar, Uttarakhand, 247667, India

² B.Tech 3rd Year student, Department of Civil Engineering, Indian Institute of Technology Roorkee, Roorkee, Haridwar, Uttarakhand, 247667, India

Predicting crop yield, which plays a pivotal role in crop market planning, insurance strategies, and efficient harvest management, presents a significant challenge attributable to the intricate interplay between various environmental and agricultural management factors. This study capitalizes on recent advancements in satellite technology and machine learning techniques to construct a robust prediction model tailored explicitly for the agriculture-intensive Hindon basin located in India. The method used in this study capitalises on the strengths of the Convolutional Neural Network (CNN) and Long-Short-Term Memory (LSTM) models, renowned for their expertise in capturing intricate spatial features and uncovering a variety of phenological traits crucial for accurate crop yield prediction. The model development phase involved training on a diverse set of variables encompassing crop growth indicators, environmental parameters such as MODIS Land Surface Temperature (LST) data and MODIS Surface Reflectance (SR) data, and historical crop yield records sourced from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). An analysis of the outcomes derived from the model indicates that the integrated CNN-LSTM framework exhibits superior performance compared to utilizing either the CNN or LSTM models in isolation. This advanced method holds great promise in enhancing the accuracy of crop yield forecasts, thereby empowering farmers to make informed decisions about the selection and optimal timing for growing specific crops.



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sciforum-102790: Solving the Zero-Inertia/Diffusive-Wave Hydrodynamic Model as a Nonlinear Advection Problem with the Finite Element Method: Preliminary Results

Ilia Popstoyanov Dimitrov

Department of Marine Physics, Institute of Oceanology "Prof. Fridtjof Nansen" at the Bulgarian Academy of Science (IO-BAS), Varna, 9000, Bulgaria

The zero-inertia/diffusive-wave hydrodynamic model is often numerically solved as a nonlinear parabolic/diffusion differential problem, similar to the heat equation. In this approach, the function of the sought solution usually represents the elevation of the water surface of the flow. Such numerical solutions have been implemented using the finite difference, finite volume, or finite element method and are applied in the estimation of river flow, watershed runoff, or flood inundation, for example.

In this study, the two-dimensional zero-inertia/diffusive-wave hydrodynamic model was solved as a nonlinear advection differential problem. The function of the sought solution is the thickness (sometimes called flow height) of the water flow. An implicit finite difference scheme was applied for the time domain. In order to handle irregular geometries, the Galerkin finite element method was employed. To enhance the stability of the numerical solution, stabilization terms were added to the numerical scheme, namely, the streamline-upwind Petrov-Galerkin (SUPG) term and the spurious-oscillations-at-layers diminishing (SOLD) term. Different types of boundary conditions at the outflow boundaries were imposed.

When simple tests were carried out, the results were in good agreement with the analytical or some existing numerical solutions. While more complicated tests were conducted, the results were still realistic, although with defects.

The presented approach can be used for numerical solutions with longer time domains. Further investigations are needed to improve the numerical solution in the frame of this approach. Future studies can help in choosing better numerical schemes for the time domain and other stabilization terms in the finite element method.



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sciforum-096548: Synthetic Year Generation for Irrigation Systems: Optimizing Networks using a Distribution-based Methodology in MATLAB

Melvin Alfonso Garcia-Espinal ^{1,*}, Modesto Pérez-Sánchez ¹, Francisco-Javier Sánchez-Romero ² and P. Amparo López-Jiménez ¹

¹ Hydraulic and Environmental Engineering Department, Universitat Politècnica de València, Valencia, 46022 Spain

² Rural and Agrifood Engineering Department. Universitat Politècnica de València. Valencia, 46022 Spain

The efficient management of irrigation networks is a pressing need, and it requires huge datasets to calibrate and simulate varying annual conditions. However, acquiring such datasets with the desired statistical properties might be challenging. This study presents a detailed methodology to generate synthetic years of flow rate data in irrigation networks. This approach is centred on the parameters of the best-adjusted distribution function, target volume, minimum and maximum constraints, and the number of values to generate, which is a crucial step towards more precise modelling and management of water resources.

The methodology was developed and implemented in MATLAB using the Statistics and Machine Learning Toolbox. First, the ideal distribution function was determined for each month of the dataset (e.g., Normal, Gamma, Lognormal). The input parameters were the parameters of the best-adjusting distribution, the total volume for each month, the maximum and minimum flow values, and the total number of entries to generate. The function generates an initial set of random numbers following the specified distribution, then normalises and transforms the data. An iterative optimization process is carried out to adjust the values to match the desired monthly volume, ensuring the convergence criteria are met. Thus, the synthetic data represent the variations in the demands.

The methodology was tested with various distribution functions and target values to validate its performance. The generated synthetic years closely followed the input best-fitting distribution patterns and matched the target volume with minimal deviation. This study introduces a MATLAB-based methodology that effectively generates synthetic years of data tailored for irrigation networks. The approach facilitates realistic and reliable simulations of water usage patterns by ensuring adherence to the best-fitting distribution and the input constraints. This tool is valuable for planning, optimizing, and managing irrigation networks.



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sciforum-102850: Temperature and Precipitation Projections in Sindh Province Using CMIP6 Data

Bakhtawar Samo ^{1,*}, Ghulam Hussain Dars ² and Kamran Ansari ²

¹ USPCAS-W Mehran UET, Jamshoro

² USPCAS-W Mehran University of Engineering and Technology Jamshoro, Sindh, Pakistan

Sindh Province has experienced significant alterations in temperature and precipitation, resulting in heightened occurrences of extreme weather like heatwaves, droughts, and floods, exacerbating environmental challenges in frequency and intensity. This study utilized the multi-model ensemble of the climate models from the Coupled Model Intercomparison Project Phase 6 (CMIP6) to analyze historical and future climatic projections in Sindh Province, Pakistan. This study aim to develop high-resolution, region-specific estimates that capture the subtle implications of various climatic scenarios and Shared Socioeconomic Pathways (SSPs) using modern climate models and downscaling approaches. These changes in climate have amplified the occurrence and intensity of various environmental challenges. The findings are categorized into two time periods: the near future (2030-2060) and the far future (2060-2100) under the Shared Socioeconomic Pathways (SSPs). This study aims to increase scientific knowledge of how Sindh Province is being affected and will be affected by climate change. The results show that the temperature will continue to increase in the future in Sindh. However, models project uncertain precipitation patterns, including an increased frequency of extreme events (floods, heatwaves, and droughts) in this region. The insights will help policymakers and water managers in preparing sustainable and climate-resilient water management strategies in this region.



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sciforum-094015: The Arctic sea ice variability in a transient coupled CGCM simulation during the past 21,000 years.

Gagan Mandal ^{1,*}, Shail V. Ekka ² and Amali I. Hettiarachchi ²

¹ Irreversible Climate Change Research Center, Yonsei University, South Korea

² Department of Earth Sciences, National Central University, Taoyuan, Taiwan

Given the recent increased attention towards **"tipping points"** in understanding the effects of climate change, it is vital to comprehend Arctic sea ice variability over the past twenty-one thousand years before the present (ka). Here, we have analyzed a quasi-continuous coupled general circulation model (CGCM) simulation to gain further insight into how the Arctic sea ice coverage (SIC) (ocean surface covered with more than 5% sea ice concentration) spatially responds to changes in orbital, greenhouse gas, meltwater, and continental ice sheet forcings over the past 21 ka. We found that the annual mean Arctic SIC predominantly varied in the Atlantic Ocean sector, particularly during the Heinrich 1 (H1; ~19–17 ka) and Younger Dryas (YD; ~12.9–11.3 ka) cold events and Bølling–Allerød (BA; 17–14.35 ka) warm periods. By altering the poleward oceanic heat transport into the Arctic, a weakened (strengthened) AMOC resulted in the expansion (reduction) of Arctic SIC. Meanwhile, we observed a two-way relationship between the AMOC and Arctic SIC with an out-of-phase (in-phase) relationship when AMOC leads (lags) Arctic SIC by 20 years (4 ka). Subsequently, we observed a sea ice-capping mechanism wherein an increase (decrease) in Atlantic SIC during H1/YD (BA) reduces (increases) net ocean surface heat flux and deep convection, thereby influencing the AMOC strength. Furthermore, it was found that the SPG and AMOC strengths have been in-phase throughout the past 21 ka, except during the abrupt termination and input of freshwater flux during the BA and Meltwater Pulse 1A (~14.4–13.9 ka) events, respectively. Recent studies have observed increased Greenland ice sheet melting and precipitation in the Arctic, which would increase the influx of freshwater into the Arctic Ocean. Meanwhile, our paleoclimate study suggests that a sudden change in freshwater discharge into the subpolar North Atlantic may alter the polar ocean dynamics, which may help in understanding near-future Arctic conditions.



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sciforum-088420: The Emergence of Drone Technology in Hydrological Studies

Bartosz Nycz¹ and Katarzyna Pietrucha Urbanik^{2,*}

¹ Department of Heat Engineering and Air Conditioning, Rzeszow University of Technology, Al. Powstancow Warszawy 6, 35-959 Rzeszow, Poland

² Department of Water Supply and Sewerage Systems, Faculty of Civil, Environmental Engineering and Architecture, Rzeszow University of Technology, Al. Powstancow Warszawy 6, 35-959 Rzeszow, Poland

Introduction

This paper examines the transformative role of drone technology in water sciences, focusing on its applications in hydrology, water quality assessment, and aquatic ecosystem monitoring. With the growing need for high-resolution, spatially comprehensive data in water sciences, drones offer an unprecedented opportunity to enhance data collection and analysis.

Methods

We review current methodologies, including drone-based remote sensing, water sampling, and thermal imaging techniques, to assess water bodies and their surrounding environments.

Results

Findings highlight the efficiency of drones in capturing detailed, real-time data on water quality parameters, surface water movements, and vegetation health, contributing to more accurate hydrological models and environmental assessments.

Conclusions

The incorporation of drone technology in water sciences significantly advances the field, offering more agile, precise, and cost-effective methods for water monitoring and management. This shift not only supports better-informed decision-making but also paves the way for innovative research avenues in understanding and protecting aquatic ecosystems. Future research should focus on developing standardized protocols for drone operations in water sciences and exploring the integration of drone data with traditional monitoring systems for comprehensive watershed management. Moreover, as drone technology continues to evolve, its integration into water sciences promises further enhancements in spatial and temporal data resolution. This progression is crucial for addressing the complex challenges of water management in the face of climate change and increasing human impact on natural water systems.



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sciforum-095489: The Quantitative Modeling of Check Dam Volumes by Environmental Factors: A Study of Iranian Sub-Basins

Omid Kavooosi¹, Khaled Ahmadaali^{2,*} and Aliakbar Nazari Samani¹

¹ Department of Arid and Mountainous Regions Reclamation, Faculty of natural resources University of Tehran, Karaj, Iran

² Department of Irrigation and Reclamation Engineering, College of Agriculture and Natural, University of Tehran, Karaj, Iran

Check dams generally consist of a vertical barrier constructed on ditches, small streams, channels and gullies that have often been formed by the erosive activity of water. A check dam serves many purposes, such as reducing runoff velocity, reducing erosive activities, reducing the original channel gradient, improving bed sediment moisture in adjoining areas, sediment retention and allowing for percolation to recharge aquifers. A check dam interferes with flows in the upstream and downstream channels and dissipates the energy of flowing water. Therefore, identifying the quantitative variables that influence the volume of these structures is crucial for accurately estimating construction costs and their effectiveness. This study aimed to model check dam volumes across 100 sub-basins in eight provinces of Iran (Alborz, East Azerbaijan, Ilam, Bushehr, Qazvin, Fars, Mazandaran, and Hamadan). The database for modeling included 27 environmental features from each of the 100 sub-basins, and Gene Expression Programming (GEP) was used for the modeling process. The results indicated that the key features for estimating check dam volume among the 27 variables studied are precipitation, slope, drainage density, TWI index, shape factor, elevation difference, concentration time and NDVI index. The evaluation of the modeling, based on R^2 , RRMSE, RAE and NSE values, revealed that the most accurate model for Qazvin province had values of 0.97, 0.18, 0.17 and 0.96, respectively. In contrast, the least accurate model for Mazandaran province had values of 0.80, 0.38, 0.35 and 0.80. Additionally, the results demonstrated that environmental characteristics could be used with high accuracy to estimate check dam volumes quickly. This allows for the relevant costs to be estimated before implementing check dams, facilitating the prioritization of areas effectively.



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sciforum-092870: Thermodynamic Analysis and Prediction of Chemical Synergy in Complex Aqueous Chemical Processes

Igor Povar * and Oxana Spinu

Institute of Chemistry, Moldova State University, Chisinau, MD2028, Republic of Moldova

Through rigorous thermodynamic analysis, the phenomenon of chemical synergy in complex chemical processes has been elucidated. Experimental methods in water sciences often involve studying the effects of various chemical combinations and concentrations on water quality and behavior. Understanding chemical synergy helps researchers design experiments that account for the combined effects of different chemical components, leading to more accurate and insightful results. Overall, chemical synergy informs and enhances numerical and experimental methods, as well as data analyses, in water sciences by providing a more comprehensive understanding of the complex interactions between chemical components in water systems. Chemical synergy manifests in various ways, depending on factors such as reactant structures and process energies. Essentially, any chemical interaction depends on the chemical composition of the reaction mixture, temperature, and pressure. Chemical synergy is governed by the intensity of these parameters, particularly temperature, pressure, and concentration ratios of chemical agents, that is the chemical composition. It is established that in complex processes, synergy leads to the formation of mixed compounds, enabling the exploration or prediction of necessary effects. The absence of synergy in some cases may result from the lack of measuring certain properties. Moving forward, software programs should account for mixed compound formation in seeking synergistic effects. Additionally, discovering synergy necessitates considering mixed compound or complex formation. These findings are pivotal for exploring and designing new synergistic processes. The deduced relationships will be extremely useful for the search and directed design of new synergistic processes with required properties. Future research will focus on isolating and characterizing mixed compounds, along with providing detailed thermodynamic and kinetic insights through theoretical calculations, complementing empirical observations.



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sciforum-102617: Understanding land use land cover change dynamics using machine learning algorithms in the Abelti watershed, Omo-Gibe Basin, Ethiopia.

Mulatu Abayicho Sulamo ^{1,*}, Asfaw Kebede Kassa ² and Gebremedhin Gebremeskel Hailec ³

¹ Department of hydrology, College of Agriculture, Jinka University, Jinka, Southern Ethiopia Region, 0000, Ethiopia

² Hydraulic and Water Resources Engineering Department, Haramaya Institute of Technology, Haramaya University, P.O. Box 138, Dire Dawa, Ethiopia

³ Department of Earth and Environmental Sciences, Wesleyan University, Middletown, Connecticut, United States

Abstract

Data on land cover are essential for many facets of life, including politics, economics, and science. Since timely and precise land cover information is essential to the correctness of all subsequent applications, it is highly sought after. The purpose of this work is to select the better LULC classifier and investigate change detection using a more accurate classifier. Support vector machine (SVM) and random forest (RF) algorithms were applied to categorize LULC satellite data in the watershed. Six LULC classifications comprised the research area: bare lands, forests, shrublands, waterbodies, settlements and agricultural lands. SVM and RF have overall classification accuracies of 87.46% and 91.19%, respectively, and RF was selected for change detection analysis. According to the results, there was a growth in agricultural land of 6.44% between 2002 and 2012 and 14.94% between 2012 and 2022. Between 2002 and 2012, the settlement area grew by 72.17%, and between 2012 and 2022, it expanded by 21.44%. The forest saw a 48.27% decrease from 2002 to 2012 and a 14.94% gain from 2012 to 2022. Shrub land decreased by 8.16% between 2002 and 2012 and by 26.30% between 2012 and 2022. Additionally, there was a change in bare land between 2002 and 2012, when it increased by 74.05%, and between 2012 and 2022, when it decreased by 41.42. Consequently, utilizing an RF algorithm to detect changes in LULC is a crucial method for classifying multispectral satellite data to comprehend the best way to exploit natural resources, implement conservation measures, and make decisions regarding sustainable development. The study results provide useful information for policymakers and planners in the implementation of sustainable land resource planning and management in the context of environmental change.



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sciforum-097729: Unified Water Pollution Database: A Comprehensive Repository for Monitoring Chemical Agents and Their Effects on Health and Ecosystems

Chalaris Michail *, Nikolaos Stasinopoulos and Anastasia Tezari

Hephaestus Laboratory, School of Chemistry, Faculty of Sciences, Democritus University of Thrace, 65404 Kavala, Greece

Water pollution poses a significant threat to both human health and ecological systems worldwide. This abstract proposes the development of a comprehensive database that catalogues chemical agents (natural and man-made) found in various water bodies such as lakes, rivers, lagoons, and coastlines. The database will systematically document these pollutants alongside their associated harmful effects on human health and ecosystems. The impetus for creating this database stems from the growing need for a centralized, accessible repository of information that can facilitate research, policy-making, and public awareness. Water quality monitoring often yields fragmented data, which hinders the comprehensive understanding of the impact of pollutants. By aggregating data from various studies, reports, and monitoring programs, this database aims to bridge this gap, providing a holistic view of water contamination. Existing databases focus on specific aspects, such as certain types of pollutants or particular water bodies and may not always link the pollutants to their health and ecological impacts comprehensively. The proposed database would differ by aiming to be more comprehensive and integrative, covering not only a broader range of pollutants but also associating each chemical with its specific harmful effects. By aggregating this information into a single, accessible repository, the proposed database would provide a holistic view of water contamination, filling the gaps left by existing databases, offering a detailed and actionable resource for addressing water quality issues. It will serve multiple stakeholders, such as researchers, environmental agencies and policy makers, to study the prevalence and impact of specific pollutants, to identify priority areas for intervention, draft evidence-based regulations, monitor the effectiveness of implemented policies, identify and mitigate of public health risks. Additionally, the database will empower the general public and advocacy groups with the knowledge necessary to engage in informed dialogue about water quality issues and advocate for safer environmental practices.



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sciforum-097144: Using Artificial intelligence in sustainable agriculture and irrigation management

Sanaz Mohammadi ^{1,*} and Iman Hajirad ²

¹ Water Management and Engineering Department, Collage of Agriculture, Tarbiat Modares University, Tehran, Iran; sanaz.mohammadi@modares.ac.ir

² Ph.D. Student, Department of Irrigation and Reclamation Engineering, College of Agriculture and Natural Resources, University of Tehran, Karaj, Iran.

Background and Aims

This study explores the application of artificial intelligence (AI) in irrigation management to optimize soil, water, and fertilizer consumption in agriculture. The growing world population and the subsequent increase in demand for agricultural products, coupled with climate change, have put increasing pressure on water resources. Therefore, efficient soil and water management practices are necessary. AI techniques such as machine learning, neural networks, and the Internet of Things (IoT) are being utilized to analyze various data sources including weather patterns, soil conditions, crop types, and water levels.

Methods

The working method in this research includes collecting information from the articles listed in the References Section and examining them in detail in order to identify the types of sub-branches of artificial intelligence used in studies related to climate change in different sectors of agriculture. More than 41,000 full titles in 130 reference databases were simultaneously reviewed. A total of 26 primary studies were selected to form the basis of this review.

Results

This study emphasizes how studies on water and soil management heavily rely on artificial intelligence (AI) techniques based on artificial neural networks (ANNs) and fuzzy logic. ANNs have shown great performance and are primarily utilized for machine learning-based solutions. Compared to other AI techniques or even well-known regression methods, these networks are frequently more effective. In the assessment of soil and water issues, ANN-based solutions have also been shown to be more effective than traditional equations, particularly in situations when limited data are available.

Conclusions

This enables farmers to make informed decisions in agricultural operations to safeguard and manage water and soil resources effectively. In conclusion, this study underscores the potential benefits of integrating AI technologies in irrigation management for sustainable agricultural practices in an increasingly water-scarce world.

Keywords: water and soil management, fuzzy logic, artificial neural networks, climate change, irrigation



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sciforum-100723: Water Quality Classification in terms of WQI using Machine Learning Algorithms in Keenjhar Lake, Pakistan

Muhammad Imran ^{1,*}, Danrong Zhang ¹, Muhammad Zaman ², Shazia Parveen ³ and Nur E Jannat Mishu ⁴

¹ College of Hydrology and Water Resources | Hohai University, Nanjing, 210098 | China

² Department of Irrigation & Drainage | Faculty of Agricultural Engineering & Technology | University of Agriculture, Faisalabad, 38000 | Pakistan

³ Department of Biochemistry | Bahauddin Zakariya University, Multan, 60000 | Pakistan

⁴ College of Information Science and Engineering | Hohai University, Nanjing, 210098 | China

Water is a valuable natural resource and national asset, and the primary component of ecosystems. Water sources include rivers, lakes, glaciers, rainwater, and groundwater. Water resources are essential for many economic sectors, including agriculture, animal production, forestry, industrial operations, hydropower generation, fisheries, and more. Water availability and quality are deteriorating due to factors such as population growth, industry, and urbanization. The Water Quality Index (WQI) is a useful and exclusive classification system that summarizes all aspects of water quality in a single phrase. This rating system aids in selecting the most suitable treatment method to address the challenges. The models were evaluated using key statistical factors, a dataset with six relevant parameters, and water use records. The database included electrical conductivity, pH, dissolved oxygen, nitrates, phosphates, suspended particles, and water temperature. We used three machine learning models for the classification of water namely, Support Vector Machine (SVM), K-Nearest Neighbor (KNN), and Random Forest (RF). This study was conducted on Keenjhar Lake, Karachi, Pakistan, and this work employed a dataset of 360 instances and six defining features from 1993 to 2022 on the monthly dataset. The classification algorithms were evaluated using five metrics: accuracy, recall, precision, Pearson's correlation, and F1 score. In terms of classification, the testing results indicate that the SVM model performed the best, predicting Water Quality Classification (WQC) values with an accuracy of 99.50%. It is important to note that precise water quantity and quality predictions are vital for sustainable resource management, public health protection, and environmental preservation.



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sciforum-090888: Well Placement Strategy on Carbon Dioxide Storage in Saline Aquifer at Mae Moh Basin

Romal Ramadhan ^{1,2,*} and Min Thura Mon ^{2,3}

¹ Department of Mining and Petroleum Engineering, Chiang Mai University, Chiang Mai, Thailand

² Encovy Research Group, Jakarta, Indonesia

³ Faculty of Economic, Chiang Mai University, Chiang Mai, Thailand

The need for urgent climate action and achieving net-zero emissions drives the development of CCS technologies, including CO₂ injection and storage in saline aquifers. This aligns perfectly with Thailand's ambitious commitment to combat climate change and achieve net-zero emissions, reflecting the global imperative for efficient CCS initiatives. Geologically unique formations like the Mae Moh basin in Thailand offer significant potential for carbon storage because it's a coal-fired power plant is located nearby which releases about 10 Mtpa, making them pivotal players in supporting Thailand's net-zero target. The current study focuses on an examination of well placement strategies, a crucial element in optimizing CO₂ storage efficiency within saline aquifers. By targeting the geological context of Mae Moh basin, we investigated and compared the performance of four distinct well-pattern scenarios: Single Vertical Injection (SVI), Single Horizontal Injection (SHI), Two Vertical Injection (TVI), and Two Vertical Injection and Brine Production (TVIP) wells. Each of these scenarios serves as an indicator of well-placement efficiency tailored to the specific geological intricacies of Mae Moh basin. Over a 30-year period of injection, the TVI is remarkably the most effective configuration, injecting as much as 1.70 MtCO₂, which is attributed to the presence of two vertical injection wells that facilitating efficient and rapid CO₂ co-injection. The TVIP introduces an innovative approach by combining CO₂ injection with brine production, resulting in a cumulative injection of approximately 0.86 MtCO₂. Additionally, the analysis of CO₂ trapping mechanisms reveals a dynamic interplay, of which structural and residual gas trapping mechanisms dominate the early stage of injection before transitions to solubility trapping over time. The current investigation emphasizes the adaptability required for CCS project operating in challenging geological conditions.



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Session 6. Water Resources Management, Floods and Risk Mitigation

sciforum-096596: Assessing the vulnerability of water resources to drought by applying the Standardized Drought Vulnerability Index (SDVI) to the Lake Karla basin

Stylianos Voudouris ^{1*}, Athanasios Loukas ¹, Pantelis Sidiropoulos ¹ and Lampros Lambros Vasiliades ²

¹ School of rural and surveying engineering, Dept. of transportation and hydraulic engineering, Aristotle University of Thessaloniki, Greece

² Dept. of Civil Engineering, University of Thessaly, Greece

The aim of the current research is to identify the impact of droughts on the vulnerability of water resources in the hydrological basin of Lake Karla in Thessaly, Central Greece, using the Standardized Drought Vulnerability Index (SDVI). The Lake Karla basin covers a total area of 1170 km² and has a semi-arid climate. It is an agricultural basin in which water-demanding crops (such as cotton, maize and alfa-alfa) are cultivated. Drought is an extreme weather phenomenon, occurring more frequently recently with significant impacts, such as reduced infiltration and surface runoff. To assess water resources' vulnerability against the drought phenomenon, the SDVI was applied, which is a composite index that integrates all types of droughts (meteorological, hydrological, agricultural, social and economic). The SDVI, with its holistic approach, can be used as a monitoring tool to provide knowledge for the identification of vulnerable areas. The SDVI incorporates Water Supply, Water Demand, Infrastructure, Impact and drought indices, such as cSPI-6 and cSPI-12, as sub-indices. The SPI (Standardized Precipitation Index), based on precipitation data for the years 1960-2018 from nearby stations, was used to identify drought. The conceptual hydrological model UTHBAL was applied for water balance estimation to calculate the Water Supply sub-index. The Water Demand sub-index was estimated mainly based on the demand for irrigation water. For the calculation of the Impact sub-index, the reduction in agricultural production was used with corresponding data for each hydrological year obtained from the Hellenic Statistical Authority. The Infrastructure sub-index was assessed in terms of the actual capacity of the reservoirs (dams) in the Lake Karla basin related to the total water demand. The sub-indices were standardized on a scale of 0-3. When applying the SDVI index to the Karla basin for 30 hydrological years (from 1978/88 to 2017/18), it was found that the index has a value larger than 1.5 for about 15 years, indicating the high vulnerability of the basin.



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sciforum-097071: Agricultural drought assessment in Slovakia's lowlands: Insights from a Soil Water Deficit Index (SWDI) analysis

Evangelos Leivadiotis * and Silvia Kohnová

Department of Land and Water Resources Management, Faculty of Civil Engineering, Slovak University of Technology in Bratislava, (Radlinskeho 11), Bratislava 81005, Slovakia

The increasing frequency and severity of drought episodes in Central Europe due to climate change pose a significant threat. Slovakia is particularly vulnerable to these changes due to its complex geography and vital agricultural lowlands. This study focuses on agricultural droughts, which harm the economy and the delicate ecosystem. Monitoring soil moisture, a key indicator of drought is challenging due to the need for in situ data. However, remote sensing data provide valuable insights from the Advanced SCATterometer (ASCAT) on the Meteorological Operational (Metop) satellites. ASCAT offers soil moisture data with daily revisit times and spatial resolutions of 12.5 and 25 km². This research calculated the Soil Water Deficit Index (SWDI) using ASCAT soil moisture data for the growing season (March–November) from 2007 to 2019 in the Danubian and Eastern Slovakian lowlands. SWDI, calculated monthly, employs the 5th percentile as the wilting point and the 95th percentile and minimum of the maximum value during the growing season as estimators of field capacity. According to the research findings, the average duration of drought events is six months in the Eastern lowlands and 5.5 months in the Danubian lowlands, occurring with a frequency of 66.7% and 65.8%, respectively. The average drought magnitude is 6.93 in the Eastern lowlands and 7.2 in the Danubian lowlands. The shortest drought duration recorded is three months (2008), and the longest is eight months (2019). Peak drought magnitude (8.16) occurred in 2011, with the lowest (5.5) in 2010. Drought intensity averaged 1.23, peaking at 2.04 in 2008 and dropping to 0.80 in 2012. The Danubian lowlands recorded the highest intensity (2.6) in 2011 and 2014, and the lowest (0.99) in 2009. These findings underscore the urgent need for adaptive strategies to protect agriculture and ecosystems from climate-change-induced drought impacts.



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sciforum-103298: Agricultural Drought Impacts on Production of Major Crops in Pakistan under Climate Change.

Muhammad Safdar ^{1,*}, Uzair Abbas ², Nalain E Muhammad ³, Aamir Raza ³,
Hafiz Muhammad Bilawal Akram ⁴ and Rehan Mehmood Sabir ¹

¹ Agricultural Remote Sensing Lab (ARSL), Department of Irrigation & Drainage, University of Agriculture, Faisalabad, 38000, Punjab, Pakistan

² Agricultural Remote Sensing Lab (ARSL), University of Agriculture, Faisalabad, 38000, Punjab, Pakistan

³ Department of Irrigation & Drainage, University of Agriculture, Faisalabad, 38000, Punjab, Pakistan

⁴ Department of Agronomy, University of Agriculture, Faisalabad, 38000, Punjab, Pakistan

Climate change is causing substantial damage to major crops in Pakistan's agricultural sector. The increasing frequency and intensity of droughts have raised adverse impacts on crop production and food security. The study analyzes historical data on rainfall patterns, temperature variations, and crop yields over the past few decades, revealing a clear trend of increasing agricultural drought incidents across various regions of Pakistan. This has led to crop production suffering due to water scarcity, inadequate irrigation facilities, and declining groundwater levels. Major staple crops like wheat, rice, and cotton have been adversely affected, leading to yield losses and diminished farmers' incomes. Climatic data, and crops yield data were collected from 1990 to 2021 Pakistan Metrological Department and Crop reporting service Punjab. Statistical correlation analysis were performed on rainfall patterns, temperature variations, and crop yields of wheat, rice, and cotton. The results reveled that due to shifting patterns of rainfall and increasing in temperature from decade to decade; wheat yield increased from 20 to 30 maunds per acre, rice yield increased 12 to 23 maunds per acre, cotton yield decreased 22 to 20 maunds per acre. Drought years 1998,1999,2000,2001,2002, 2015,2018 and 2019 significantly decreased the crop yields for all crops. The growing threat of agricultural drought poses a significant threat to Pakistan's crop production and food security. Smallholder farmers are particularly vulnerable due to lack of access to credit, technology, and insurance. Climate change has prompted farmers to adopt drought-resistant crop varieties and water conservation practices. A comprehensive approach involving policymakers, researchers, and communities is needed, including improved water management strategies and early drought monitoring systems.



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sciforum-092881: Importance of cryospheric reserves in sustaining streamflow of Himalayan mountainous catchments

Suhail Lone * and Gh Jeelani

Department of Earth Sciences, University of Kashmir, Srinagar-190006 Union territory of Jammu and Kashmir, India

Himalayan high-altitude catchments are crucial sources of freshwater, supporting essential activities both upstream and downstream. However, the warming climate is causing the cryospheric cover to diminish, affecting freshwater availability throughout the Himalayan catchments. Therefore, understanding the hydrological processes shaping the regional water cycle is vital for effective water resource management policies. The dataset reveals significant spatial and temporal variability in meltwater without clear isotopic signatures of different river flow sources. Nevertheless, distinctive signatures of river/stream flow sources emerge at the sub-basin or catchment scale due to changing physiographical, meteorological, and local climatic conditions. Microclimatic factors like altitude variation and aspect slope further influence the spatio-temporal variability in water sources and streamflow, resulting in different lapse rates at the sub-basin/catchment level. This study highlights that the contribution of snowmelt and glacier melt to river flow varies across space and time, with snowmelt dominating in the Indus while glacier melt dominates in the Suru catchment. The rugged topography and microclimate of the Upper Indus River Basin (UIRB) primarily govern the diverse contributions from various river flow sources. With a warming climate leading to reduced solid precipitation, continuous glacier mass loss, and early snow cover melting, the perennial flow of rivers is expected to be impacted inconsistently. This has the potential to disrupt the economic and political stability of the region.



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sciforum-103456: Performance evaluation of ERA5, MERRA 2 and PERSIANN-CDR reanalysis grids in the Tambo basin

Cristhian Apaza-Vilca *, Maria Liz Mamani-Yupanqui and Efrain Lujano

Escuela Profesional de Ingeniería Agrícola, Universidad Nacional del Altiplano, Puno 21001, Peru

Grid-based meteorological data products, such as reanalysis data, are essential for overcoming data scarcity in sparse and uneven hydrometeorological networks, especially in developing countries. However, these products require detailed validation to ensure their accuracy and reliability. This research evaluates the performance of ERA5, MERRA-2, and PERSIANN-CDR products in the Tambo basin, using monthly precipitation data from meteorological stations for the period 1985-2019 and applying two approaches: point values from stations and areal averages. The performance metrics considered are the Pearson correlation coefficient (CC) and percentage bias (PBIAS). In the station-based evaluation, ERA5 demonstrated excellent temporal correlation (with a CC between 0.83 and 0.91), but there was significant overestimation of precipitation (PBIAS between 72.0% and 217.5%). PERSIANN-CDR also overestimated precipitation (with a PBIAS between 8.0% and 86.9%) and showed low temporal correlation (with a CC between -0.14 and 0.15). In contrast, MERRA-2, despite underestimating precipitation (with a PBIAS between -30.8% and -77.9%), showed good temporal correlation (CC between 0.72 and 0.82). In the areal average evaluation, ERA5 had the best correlation (with a CC of 0.94) and a high bias (106.8%). MERRA-2 exhibited a low bias (a PBIAS of -53.5%) and a slightly lower correlation (0.88). PERSIANN-CDR had moderate bias (24.5%) and an intermediate correlation (0.70). These findings highlight the need to improve accuracy and reduce bias in products like ERA5 to optimize their use in hydrological applications and water resource management, thereby contributing to better forecasting and planning in water-scarce regions and helping to mitigate the impacts of climate change, especially in vulnerable areas.



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sciforum-097740: Traditional Water Systems: Way Forward to Revive Natural Ponds in Gurgaon, Haryana

Neha Korde¹, Shalini Sheoran^{2,*}, Prachi Patel³ and Amit Kumar Jaglan⁴

¹ Assistant Professot at School of Planning and Architecture, New Delhi

² Lecturer at Department of Planning & Architecture, DLCSUPVA Rohtak

³ Assistant Professor at Institute of Architecture & Planning, Nirma University, Ahmedabad

⁴ Assistant Professor at School of Planning and Architecture, New Delhi - India

Water appeared to be fundamental to the human settlement. Traditional water systems can be understood as a complex, diverse, and intricate regime of water structures designed to support the population as it grew. These structures are also termed as water architecture in India constituting a broad category of natural as well as manmade infrastructure. With the passage of time in a fast-forward mode & rapid urbanisation, the ponds; natural catchment areas which helped mitigate the seasonal flooding due to heavy rains in the past have become either defunct or non-existent today in the urban areas which is a matter of concern today. The paper attempts to revisit to the traditional water systems and knowledge to bring out solutions to these problems by means of the traditional wisdom, is ever more relevant today, as we face the climate crisis. Solutions which are basic, simple and logical and which can be implemented without extensive use of technology may pave the way forward to revive the ponds in water-scarce yet flood-prone areas of Gurugram in Haryana. Historical and interpretative research techniques, such as literature analysis, comparative analysis, case investigations, reasonable significance, qualitative analysis, and location-specific building study are used related to traditional water systems especially in the case of Haryana. Relevant field study is undertaken for identifying the issues and challenges faced in context to the non-existence of the natural ponds and their Conditions in specific areas are analysed using secondary sources and primary observations wherever deemed significant.



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sciforum-103359: A Fuzzified Multicriteria Approach for Water Resource Management Based on the French School of Multicriteria

Mike Spiliotis

Department of Civil Engineering, Democritus University of Thrace, Kimmeria Campus, 67100 Xanthi, Greece

Instead of the simplified “optimization procedure,” multicriteria analysis, which also incorporates optimization theory, is an integrated tool that encompasses all aspects of decision-making. The field of water resources management is particularly well suited for applying multicriteria problems due to the various dimensions of water systems. This work emphasizes comparing alternatives and aggregating several criteria with different natures and metrics. Furthermore, the lack of knowledge or ill-defined information and the qualitative responses of experts necessitate the use of fuzziness. Hence, this article examines the use of hybrid multicriteria methods for the final ranking of alternatives. Fuzziness is employed to express data uncertainty, uncertainty during binary comparisons, and the final aggregation of criteria. It is worth noting that fuzziness is used not only to quantify uncertain information but also to justify the decision-making scheme. Even if the best multicriteria method “is a very elusive goal and this quest may never be answered,” the “French school” of multicriteria could incorporate many concepts of fuzziness due to its sophisticated background. Therefore, two hybrid fuzzy outranking methods oriented towards water resource management are proposed, based on the ELECTRE and PROMETHEE methods, and useful comparisons are made. A challenge is to ensure a commensurate solution in the final decision and to avoid full compensation among the criteria by using the non-discordance principle. Additionally, ideas on how this principle can be transferred to the modified PROMETHEE method are presented.



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sciforum-097462: Advanced Flood Classification Using Rapid Machine Learning Techniques: Insights from Saint-Charles Station, Quebec

Isa Ebtehaj ^{1*}, Mohamed Khelifi ² and Hossein Bonakdari ³

¹ Laval University

² Department of Soils and Agri-Food Engineering, Faculty of Agriculture and Food Sciences, Université Laval

³ Department of Civil Engineering, University of Ottawa

Flood forecasting is critical for effective water resource management, particularly in regions prone to flooding. This study presents an innovative approach to flood-type forecasting at the Saint-Charles station, located in Quebec, Canada, using an Extreme Learning Machine (ELM) methodology. Our objective was to develop a robust classification model to predict flood types, enhancing preparedness and mitigation efforts accurately. The dataset used spans from 2008 to the end of 2023, encompassing various hydrological parameters, meteorological data, and historical flood records. The ELM, known for its rapid learning speed and minimal computational burden, is applied to classify flood types based on the input features extracted from the dataset. The data preprocessing involves the normalization and handling of missing values to ensure model accuracy. Feature selection is performed to identify the most influential variables contributing to flood occurrences, including precipitation, river discharge, and soil moisture levels. The ELM model is trained and validated using a cross-validation technique to avoid overfitting and ensure generalization. The results indicate that the ELM model demonstrates high classification accuracy and efficiency in predicting flood types at the Saint-Charles station. The model's performance is evaluated using standard metrics such as accuracy, precision, recall, and F1-score. A comparative analysis with other machine learning models highlights the superiority of ELM in terms of speed and predictive capability. This study highlights the potential of ELM as a valuable tool for flood forecasting, providing actionable insights for water resource managers and policymakers. The findings contribute to the body of knowledge in flood management and AI applications in hydrology, paving the way for further research and the implementation of advanced machine learning techniques in environmental monitoring.



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sciforum-097730: Advanced Water Availability Analysis in the Amu Darya River Basin through Integrated Remote Sensing and Modeling Techniques

Sayed Ishaq Deliry ^{1,*} and Uğur Avdan ²

¹ Department of Remote Sensing and Geographical Information Systems, Institute of Graduate Programs, Eskisehir Technical University, Eskisehir, Türkiye

² Institute of Earth and Space Sciences, Eskisehir Technical University, Eskisehir, Türkiye

Effective management of water resources is crucial for sustainable development, particularly in regions like the Amu Darya River Basin, where water availability directly influences ecological and human systems. This study leverages integrated remote sensing data and model outputs to enhance water budget and availability analyses within the basin. Utilizing the GLDAS CLSM 2.1 model alongside satellite-derived precipitation and evapotranspiration data, this research provides a comprehensive assessment of water budget components, including precipitation, evapotranspiration, terrestrial water storage changes, and runoff, during the period 2001-2023. Moreover, by utilizing the NASA GLDAS model, a novel global dataset of the water budget components measured in millimeters per month was developed, streamlining the estimation process across different scales. Our results reveal significant variations in the precipitation estimates between the satellite observations and model predictions, with the satellite data generally indicating lower precipitation rates. The evapotranspiration analysis showed that remote sensing data tend to underestimate the values compared to model outputs, emphasizing the necessity of multi-source data integration for accurate water budget estimations. Furthermore, this study highlights discrepancies in the runoff estimation between the modeled outcomes and the gauge observations, illustrating the challenges in capturing the actual streamflow dynamics without streamflow routing in the models. This analysis underscores the importance of using advanced remote sensing and modeling techniques to improve water availability assessments, facilitating better management and conservation practices in the basin. These findings contribute to a deeper understanding of the hydrological processes in the Amu Darya River Basin, supporting efforts towards more resilient water resource management.



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sciforum-103321: An Assessment of produced water from oil and gas operations in Kuwait as a resource for alternate water and commercial salts

Feras Al Salem ^{1,2,*}, Fawaz Alsalem ³, Khaled Aldeyain ⁴, Dalal Alohal ⁵ and Thies Thiemann ⁶

¹ Kuwait Gulf Oil Company, Ahmadi City, Kuwait

² Department of Biology, United Arab Emirates University, P.O. Box 15551, Al Ain, United Arab Emirates

³ Kuwait Oil Company, Ahmadi City, Kuwait

⁴ Technical affairs sector, Ministry of Oil, Shuwaikh, 74 Arabian Gulf street. P.O.Box : 5077 Postal Code 13051, Kuwait

⁵ Drilling and production department, Ministry of Oil, Shuwaikh, 74 Arabian Gulf street. P.O.Box: 5077 Postal Code 13051, Kuwait

⁶ Department of Chemistry, United Arab Emirates University, P.O. Box 15551, Al Ain, United Arab Emirates

Produced water (PW) is seen as one of the largest waste streams emanating from the oil and gas industry. Often, PW is highly saline and exhibits high oil contents. Therefore, it cannot be discharged into the environment directly. Rather, very often, PW is treated rudimentarily and subsequently injected into disposal wells in the sub-surface. An initial water-oil separation is achieved with a three-way separator, frequently followed by gravity-based separations, such as with hydrocyclones. Further treatment, which adds to the cost of the operation, depends on the potential utilization of PW as a fresh-water substitute for drilling and workover operations, or enhanced oil recovery methods within the oil and gas industry itself, as a source for recoverable commercial salts such as calcium carbonate and sodium chloride, or as a source of water for cooling or for irrigation, the latter especially in regions that are water-scarce, where the utilization of treated PW as an alternate water source can contribute significantly to the water production of a country.

In the current paper, the treatment of PW from a South Kuwaiti oilfield is examined to explore whether the generated PW can, upon such treatment, be disposed of in an environmentally safe way, and whether the generated PW can deliver commercial products such as salts and usable water of adequate purity to make the treatment economically sustainable. Different treatment methods, such as ceramic membrane filtration and sorption filtration on biomass, both for the separation of residual oil from water, the precipitation of calcium as calcium carbonate, and solar evaporation/distillation for the recovery of salts and purified water, have been examined experimentally, where products of adequate purity could be obtained to make them commercially viable.

Finally, different combinations of treatment methods for the purification of PW have been assessed for their economic feasibility in the state of Kuwait.



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sciforum-103190: An Assessment OF THE Soil Fertility and Physicochemical Properties IN THE Command Area of Darawat Dam

Osama Shaikh *, Arjumand Zehra Zaidi and Asmat Ullah

Integrated Water Resource & Management, U.S. Pakistan Center for Advanced Studies in Water, Mehran University of Engineering and Technology, Jamshoro, Sindh, 76086, Pakistan

Due to the growing demand of food and fibers, natural resources are under significant pressure. To increase production and improve yield, new agricultural areas are being developed. These developments can disrupt ecosystems by altering land cover and use patterns, diverting streams for irrigation, and extracting groundwater. In some cases, the conversion of land into irrigated area leads to land degradation and ultimately reduces the agricultural productivity over time. In this context, effective water management plays a crucial role in maintaining soil's quality and fertility. The Darawat Dam, situated on the Nai Baran River near Janghri village, approximately 70 km from Hyderabad, Sindh, Pakistan, is a critical infrastructure project, designed to develop a new command area and to increase the agricultural productivity through the development of irrigation systems. The dam plays a pivotal role in sustainable land use and water management in the region, as it improves groundwater recharge and aids in flood control. Considering this context, this study explores the existing fertility status and physico-chemical characteristics of soil within the command area of Darawat Dam, aiming to contribute towards sustainable water and water management. Soil samples were collected from two depths (0-15 cm and 15-30 cm) using an auger, with a total of fifty samples analyzed. The findings indicate that the soils in this area range from sandy loam to clay loam and are non-saline (EC 0.065-0.744 dS m⁻¹) and slightly alkaline (pH 7.0-8.0). No salinity hazard was observed based on the soluble cations and SAR values. However, the organic matter levels are low (0.227-1.557%), as are available phosphorus (2.66-16.44 mg kg⁻¹) and potassium (80-290 mg kg⁻¹) levels, suggesting potential nutrient deficiencies for high-input agriculture. Additionally, water availability and management within the catchment area are vital factors influencing soil fertility and agricultural productivity, as they impact the nutrient transport and soil moisture levels



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sciforum-097236: An Important Combination for Improving the Determination of Flood Zones: Remote Sensing Techniques and Hydraulic Models

Jamilton Echeverri-Díaz ^{1,*}, Oscar Coronado-Hernández ², Modesto Pérez-Sánchez ¹, Alfonso Arrieta-Pastrana ² and Helena M. Ramos ³

¹ Universidad Politécnica de Valencia

² Instituto de Hidráulica y Saneamiento Ambiental, Universidad de Cartagena

³ University of Lisbon

The computation of flood-affected zones plays a pivotal role in risk management and land use planning. These zones can be identified by applying remote sensing techniques, digital elevation models, and implementing hydrological and hydraulic models. Remote sensing can detect changes in water surface levels over time using optical and SAR images. Digital elevation models are essential for defining the topography and morphometry of water bodies. Often, these techniques are employed to determine water levels associated with recorded events, representing a need for estimating water levels associated with different return periods. Subsequently, hydraulic models must be integrated with remote sensing techniques to create reliable models for sizing engineering projects related to return periods, which can vary from 5 to 5 years depending on the cost-benefit relation of a selected hydraulic structure. This research presents a framework for utilizing technological tools to combine remote sensing techniques with hydraulic models to correlate recorded flooding events and estimate flooding for different return periods. A case study in Santa Cruz de Lorica, Colombia, is assessed to demonstrate the advantages of the combined techniques discussed in this study. The flooding in the case study is delineated using optical and SAR images from different sources. A detailed discussion about using images applied to flooding zones is presented.



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sciforum-102820: Analysing Temporal and Seasonal Climate Trends in the Doon Valley, Uttarakhand

Ashish Mani ^{1,2,*}, Maya Kumari ¹ and Ruchi Badola ²

¹ Amity School of Natural Resources and Sustainable Development, Amity University, Sector-125, Noida-201303, Uttar Pradesh, India

² Ganga Aqualife Conservation Monitoring Centre, Wildlife Institute of India, Chandrabani, Dehradun-248001, Uttarakhand, India

This study investigates the temporal and seasonal trends of key climatic parameters within the Doon Valley, including maximum temperature (°C), minimum temperature (°C), precipitation (mm), and relative humidity (%). Utilizing data from the National Aeronautics and Space Administration (NASA) Prediction of Worldwide Energy Resources (POWER) Modern Era Retrospective-analysis for Research and Applications (MERRA-2), we analysed daily, monthly, and annual datasets spanning from 1981 to 2023 using R software version 4.4.1. The analysis covers four distinct seasons: Pre-Monsoon (March to May), Monsoon (June to September), Post-Monsoon (October to November), and Winter (December to February). Significant temporal variations ($P < 0.05$) were detected for all assessed parameters. Notably, maximum temperatures during the Monsoon season, particularly in June, exhibited a significant decline of -1.99°C (6.30%) from 1981 to 2023. In contrast, minimum temperatures increased significantly during the Post-Monsoon season, rising by 2.85°C (24.57%). Precipitation rates and occurrences saw a substantial increase during the Monsoon season, with a notable rise of 384.48 mm (42.65%) in July and August. Additionally, relative humidity showed a significant increase across all seasons, rising by 24.50%. These findings highlight the major climatic alterations in the Doon Valley during the last four decades. These findings provide insights into changes in temperature and precipitation trends, which could affect water resources and aggravate environmental hazards. This underscores the need for effective water resource management and climate adaptation strategies to mitigate these effects on the ecosystem and local communities.



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sciforum-102451: Analyzing Flash Floods and their Consequences in Dera Ismail Khan using Remote Sensing and Geographic Information System techniques

Asif Sajjad ^{1,*}, Muhammad Ahmad ², Rana Waqar Aslam ³ and Anwaar Tabassum ⁴

¹ Department of Environmental Sciences, Quaid-i-Azam University, Islamabad

² Department of Environmental Sciences, Faculty of Biological Sciences, Quaid-i-Azam University, 45320 Islamabad, Pakistan

³ State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan University, Wuhan 430079, China

⁴ Department of Environmental Sciences, Faculty of Biological Sciences, Quaid-i-Azam University, Islamabad 45320, Pakistan

Introduction

Flash floods are among the most devastating natural disasters, impacting both rural and urban areas by causing extensive damage to communities, infrastructure, and livelihoods. Effective flash flood mapping is essential for assessing risks in flood-prone regions, involving a comprehensive decision-making framework that considers multiple criteria. Globally, flash floods result in significant casualties and damage, underscoring the need for enhanced mapping and damage assessment to mitigate their impacts. In Pakistan, the Dera Ismail Khan (DI Khan) district is particularly vulnerable to flash floods, with the 2022 event marking the most severe flood in the district's history.

Materials and Methods

To address this, we employed Remote Sensing (RS) and Geographic Information System (GIS) techniques to map the spatiotemporal dynamics of the flood and assess the resulting damage. Landsat 9 data were utilized for flood mapping and damage assessment. We developed flood maps for pre-flood, during-flood, and post-flood scenarios using the Modified Normalized Difference Water Index (MNDWI). Land use and land cover were classified using the Supervised Maximum Likelihood technique, with spatial training and validation samples sourced from Google Earth Pro.

Results

Our results indicate that the flood inundated an area of approximately 2,876 km², lasting around one and a half months, and caused substantial damage to agricultural lands and built-up areas.

Conclusions

This study provides valuable insights into flood management in DI Khan, offering strategies to improve flood management practices. Furthermore, this approach can be applied to analyze flash floods in other regions globally, enhancing our ability to manage and mitigate the impacts of such events.



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sciforum-097437: Assessing Morphological Changes in Ghoramara Island, Sagar Block, South 24 Parganas, Sundarban

Adeeba Mumtaz * and Dr.Dharmaveer Singh

Symbiosis Institute of Geoinformatics, Symbiosis International Deemed University

Abstract: This study aims to draw attention to the problem of Ghoramara Island's ongoing submergence and reshaping in relation to the island's natural ecosystem. Remote sensing and GIS will be the primary tools to examine the situation and provide controls. The morphological alteration of the island between 2010 and 2022 has been studied in great detail. The island's size has decreased to 3.49 square kilometers for several reasons, including anthropogenic and natural processes occurring in this area. An NDVI, or a Normalized Difference Vegetation Index, has also been developed to monitor changes in the vegetation cover between 2016 and 2022. The island has shrunk as a result of storm surges, and pictures clearly show where the tropical cyclones Amphan and Yaas struck the land mass and inflicted significant damage. To halt erosion, earthen embankments were constructed. A bioengineering approach to solving the problem was tried but was ineffective. If the government can offer effective management of the Ghoramara Island coast protection program, which incorporates bioengineering methods and is already in operation, this could greatly help the locals. Ghoramara is eroding due to a variety of circumstances, but if the locals want to halt this, they must take the appropriate measures. For instance, they should crop scientifically, plant trees on the island's side, and have the local government maintain the earthen ridges. Erosion and channel sedimentation will stop if the channel's depth can be maintained.



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sciforum-103347: Assessing the Influence of the El Niño--Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) on Precipitation in Iran Using Kendall and Pearson Correlations

Negin Zarei ¹, Farhad Behzadi ², Ehsan Vasheghani Farahani ^{2,*} and Alireza Massah Bavani ²

¹ Department of Water Engineering, Faculty of Agriculture, Razi University, Kermanshah, Iran

² Department of Water Engineering, Faculty of Agricultural Technology, College of Agriculture & Natural Resources, University of Tehran, Tehran, Iran

This study examines the relationship between the El Niño--Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD) with Iran's precipitation patterns. Correlation analyses were conducted between ENSO indices (Nino1+2, Nino3, Nino3.4, and Nino4) and IOD phases, specifically the negative (NIOD) and positive phase (PIOD), using monthly and seasonal precipitation data from 91 synoptic stations across Iran from 1990 to 2018. On a monthly scale, the Kendall Tau correlation showed significant correlations at a 95% confidence level across most regions of Iran for all indices, except for the Nino3.4 index. Direct correlations up to 0.5 were noted with the Nino1+2 index and up to 0.3 with the Nino3 index, excluding the Caspian Sea coast. Inverse correlations of -0.3 with Nino4 and up to -0.5 with PIOD were found in all basins except the Caspian Sea. The results also indicated correlations up to 0.5 in many regions of Iran with the PIOD index. Seasonally, no significant correlations were observed between precipitation and the indices in winter, summer, and autumn. However, in spring, only the Nino1+2 and Nino4 indices showed significant correlations, with Nino1+2 ranging from 0.5 in the west to 0.3 in central and eastern Iran and Nino4 showing an inverse correlation up to -0.3. The Pearson correlation also demonstrated significant relationships between monthly precipitation and the indices, particularly for Nino1+2 and PIOD. Correlations up to 0.5 were observed across Iran, increasing to 0.7 in the Ghareh Ghowm basin. The PIOD index showed an inverse correlation, reaching -0.5 in the eastern and northeastern regions (Ghareh Ghowm basin). These findings highlight that the Nino1+2, Nino3, and NIOD indices positively correlate with Iran's precipitation, while the Nino4 and PIOD indices show a negative correlation. Nino3.4 does not exhibit a significant relationship with precipitation in Iran. These insights are valuable for improving forecasting and water resource management.



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sciforum-089743: Assessment of Climate Change Impacts on Water Resources of Semi-arid Catchments, and the Possibility of Climate-induced Migration

Sayed Amir Alawi

Civil Engineering, Dokuz Eylul University, Izmir, 35390, Türkiye

This study was performed to investigate the effects of climate change on a semi-arid catchment. The Soil & Water Assessment Tool (SWAT) was used for hydrological modeling. Two Representative Concentration Pathway scenarios (RCP4.5 and RCP8.5) were utilized for assessment in the periods 2050-2069 and 2080-2099. Calibration and validation were performed using the SWAT Calibration and Uncertainty Program (SWAT-CUP). Future climate data were prepared using the Model for Interdisciplinary Research on Climate (MIROC5) from Coupled Model Intercomparison Project Phase 5 (CMIP5). Under the impacts of the RCP4.5 scenario, the temperature in the Shakardara district indicated a +3.4°C and +3.8°C rise during 2050-2069 and 2080-2099, respectively. However, considering RCP8.5, it will continue to rise by +4.4°C and +6.54°C in the same periods. Runoff will decrease by 71.47% and 67.88% considering the RCP4.5 scenario. It is going to change to 63.03% and 65.2% under the RCP8.5 scenario. The Shah wa Arus dam in the catchment will fail due to severe drought. Therefore, we argue that climate change will exacerbate water problems and cause drought in the Shakardara district and inhabitants in this district will be forced to migrate because the main source of income for people in the Shakardara is agriculture and the water shortage will cause economic problems. It is therefore recommended to take action about future climate-related migration by developing a viable plan for water management considering climate change in the Shakardara district.



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sciforum-097453: Assessment of groundwater contamination around municipal landfills—water resource management

Aleksandra Wdowczyk * and Agata Szymańska-Pulikowska

Wrocław University of Environmental and Life Sciences

A particular threat to surface water and groundwater is the migration of leachate, both from uncontrolled and organised landfills. Leachate is generated by infiltration of rainwater, groundwater and leaching of water from waste. It can contain a wide range of pollutants, including soluble organic compounds, inorganic pollutants, suspended solids, heavy metals and hazardous substances. The use of appropriately selected tools can be helpful in assessing the impact of landfills on environmental elements. It is critical to assess groundwater contamination in the areas around landfills, given that groundwater is the most important source of drinking water and is essential to meet the needs of communities. The aim of this study was to assess the variability in groundwater quality using the Landfill Water Pollution Index (LWPI). The properties of groundwater in the vicinity of two municipal landfills in a Central European country (Poland) were analyzed for a period 11 and 15 years of their operation. The results confirmed that LWPI is an effective method for assessing the quality of groundwater in the vicinity of municipal waste landfills. The obtained results confirm the negative impact of landfills, despite the insulation used. LWPI showed poor quality of groundwater, a visible impact of the landfill (landfill W, average LWPI - 2.34) and moderately polluted waters and a minor impact of the landfill (landfill S, average LWPI - 1.37). In most cases, it was observed that two parameters, EC and TOC, are the main factors contributing to the deterioration in groundwater quality. Analysis conducted on multi-year groundwater data using specific indicators can help managers better understand the impact of municipal solid waste on surrounding areas and help avoid potential operational problems in the future.



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sciforum-096111: Assessment of Groundwater Storage Depletion using GRACE and Land Surface Models in Mzimba District, North Malawi

John Sichone

Department of Geography and Environmental Studies, The Catholic University of Malawi, Blantyre, 5452, Malawi

Climate change and over-exploitation are imposing unprecedented threats to groundwater resources. Globally, groundwater reserves have depleted to the extent that well yield has decreased, pumping costs have risen, and land has irreversibly subsided. In Malawi, groundwater quantity is a national problem, specifically in Mzimba district due to severe droughts. In this study, the spatial and temporal trends of groundwater depletion were assessed using Gravity Recovery and Climate Experiment (GRACE) data and Land Surface Models (LSMs) from Global Land Data Assimilation System (GLDAS) and Global Surface Water Explorer (GSWE). The results show the following: 1. Groundwater storage is depleting at an average rate of $-1.0 \pm 0.06 \text{ cm yr}^{-1}$ ($0.1043 \text{ km}^3 \text{ yr}^{-1}$) in the study area with high rate of up to -1.2 cm yr^{-1} ($0.12516 \text{ km}^3 \text{ yr}^{-1}$) in the western side and as low as -0.4 cm yr^{-1} ($0.04172 \text{ km}^3 \text{ yr}^{-1}$) in the eastern part. 2. Groundwater storage increases from -13 cm in November up to 15 cm between May and April. 3. Drought is the primary cause of such depletion trends with correlation between active evapotranspiration and groundwater depletion and between downward surface shortwave radiation and groundwater depletion, at -0.577 and -0.678 , respectively. The results from this study reveal the need for the scientific community and the general public to consider groundwater recharge strategies specifically by mitigating climate change to reduce prolonged droughts. This study suggests the need to establish a stand-alone groundwater assessment and monitoring authority for enhanced conservation efforts for the water resources in the country.



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sciforum-097653: Combined Fluvial and Pluvial Flooding in an Urban Catchment: A Hydrodynamic Modeling Approach of Davao River, Philippines

Roumel Salvador Alvarez ^{1,2,*} and Fibor J Tan ³

¹ University of Mindanao, College of Engineering Education/Center of Green Nanotechnology Innovations for Environmental Solutions - Bolton St, Poblacion District, Davao City, 8000 Davao del Sur

² Mapua University, School of Graduate Studies - 658 Muralla St., Intramuros, Manila 1002, Philippines

³ Mapua University, School of Civil, Environmental, and Geological Engineering - 658 Muralla St., Intramuros, Manila 1002, Philippines

Flooding is a significant natural hazard affecting millions of people worldwide, with both fluvial (accumulated rainfall as river runoff) and pluvial (accumulated rainfall directly ponding in the floodplain) sources contributing to the inundation risk of an area. Recently, Davao City, a city with a vast land area spanning Mt Apo in the Philippines, experienced severe flooding on January 16–19, 2024, and January 31, 2024. It not only caused aggravated flooding in low-lying areas but also triggered other related hazards in the city, affecting 214,100 families in the entire area. Traditional flood modeling approaches often focus on fluvial and sometimes on pluvial flooding being modeled separately, neglecting the interactions between these two or more flood drivers, often leading to less accurate flood representations. Hence, this study suggests an integrated methodology for fluvial and pluvial compound flooding, aiming to enhance a better comprehension of the dynamics of flood risk within mixed forested and urban settings. This includes the analysis of the flood morphology employed by using (QGIS) in isolated cases of fluvial and pluvial and its combined scenarios in varying return periods (5, 10, 25, 50, and 100) to assess its impact on the flood inundation of an area. The research utilizes a hydrologic-hydraulic modeling framework to simulate fluvial, pluvial, and combined flooding processes through (HEC-RAS) to estimate the depth and extent of flood waters over an area and verify its results with historical flood events. The results concluded a very pronounced flood-impact zones in combined scenarios due to the effect on water volume and flood depth. Hence, the proposed methodology highlights the urgency of understanding flood behavior as experienced by recent flood events to be better prepared for the potential of future multi-hazard risks exacerbated by the changing environment we have nowadays.



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sciforum-102204: Combined sewer overflow issues in Terre Haute

Namita Shrestha * and Audrey Hankins

Department Civil and Environmental Engineering, Rose Hulman Institute of Technology, Terre Haute, Indianan, 47803, USA

The city of Terre Haute, Indiana, faces significant challenges with its combined sewer system (CSS), which frequently results in combined sewer overflows (CSOs) during heavy rainfall events. These overflows lead to the discharge of untreated wastewater into local water bodies, posing environmental and public health risks. This study focuses on the application of the Storm Water Management Model (SWMM) to analyze and propose solutions for the CSO problem in Terre Haute. The SWMM was employed to simulate various hydrologic and hydraulic conditions within the CSS, assessing the impact of different storm events and potential mitigation strategies. Key parameters such as rainfall intensity, sewer capacity, and land use were incorporated into the model to ensure accurate representation of the system's performance. Over the course of the study, we created a model in SWMM consisting of 9 subcatchments, 42 conduits, 33 junctions, and 11 outfalls for the city of Terre Haute. The simulation results identified critical areas prone to overflow and evaluated the effectiveness of various control measures, including green infrastructure, storage tanks, and sewer separation. The findings suggest that a combination of these measures can significantly reduce CSO occurrences, improving water quality and compliance with environmental regulations. Future work will focus on optimizing the model and aligning the model with the new plans based on city of Terre Haute's CSO Long-Term Control Plan.



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sciforum-103261: Comparative Analysis of Satellite-Based Evapotranspiration (ET) Products

Asad Abid *, Arjumand Zehra Zaidi and Asmat Ullah

U.S-Pakistan Center For Advanced Studies in Water (USPCAS-W), Mehran University of Engineering and Technology (MUET) Jamshoro Sindh, Pakistan

Understanding the spatio-temporal variations in actual evapotranspiration (ETa) over irrigated agricultural areas is essential for effective water resource management. Remote sensing methods have been developed to estimate ETa, but selecting a suitable method remains challenging. Satellite-based (ETa) products offer a promising solution, but identifying an adequate product is difficult due to limited validation data. This study aims to evaluate the performance of different satellite-based (ETa) products, addressing the challenge of product selection and contributing to the prudent use of freshwater resources. This study conducts an evaluation and comparison of freely available satellite-based ET products. It presents a case study focused on a selected site in Sindh Pakistan, analyzing these products' spatial and temporal patterns, resolution, and accuracy. The goal was to identify the most suitable ET product for the study area. We have observed significant differences in ET values among the satellite-based products, highlighting the need for a comprehensive evaluation to select the most suitable product for the study area. This research highlights the importance of an in-depth validation of available satellite-derived (ETa) products. Such validation is crucial for making informed decisions in water resource management and assessing crop water productivity effectively within the region. Moreover, understanding these variations can significantly enhance irrigation practices and contribute to the sustainable management of water resources in agriculture.



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sciforum-086798: Comparison of different models for sediment yield estimation in two basins with different hydrological regimes

Nader Tavassoli ¹, Khaled Ahmadaali ², Iman Hajirad ³ and Aliakbar Nazari Samani ²

¹ Department of Watershed Engineering, College of Agriculture and Natural, University of Tehran, Karaj, Iran

² Department of Arid and Mountainous Regions Reclamation, Faculty of natural resources University of Tehran, Karaj, Iran

³ Department of Irrigation and Reclamation Engineering, College of Agriculture and Natural, University of Tehran, Karaj, Iran

We employ regional analytic techniques to estimate suspended sediment load in watersheds that lack statistics due to their size and the absence of sediment measuring stations. In order to model the suspended sediment load for the Poonel watershed in Gilan and the Kowter watershed in West Azerbaijan province, this research used gene expression planning (GEP) methods, an adaptive network-based fuzzy inference system (ANFIS), support vector regression (SVR), and autoregressive integrated moving average (ARIMA). Finally, a comparison was made between these methods. For this purpose, information was gathered from 1979 to 2016 from the hydrological stations at Poonel and Kowter, as well as data on the flow rate, sediment discharge, precipitation height, minimum, maximum, and average temperatures of two synoptic stations at Bandar Anzali and Mahabad. Any precipitation that occurred on a day with a mean temperature below zero was classified as snowy precipitation in order to identify the kind of regime. We took into consideration the rainfall regime of the Poonel watershed (0.02% snowfall) and the snow regime of the Mahabad watershed (10% snowfall). The objective was to simulate the flow rate of sediment through five inputs: precipitation height, minimum temperature, maximum temperature, average temperature, and flow rate. The findings indicated that the SVR with polynomial kernel was the best model for the Kowter basin (snow regime), with a root mean square error of 0.49 and a coefficient of explanation of 0.74; similarly, the Poonel basin (rain regime) exhibited an optimal model for the SVR with polynomial kernel, with a root mean square error of 0.42 and a coefficient of explanation of 0.75. After all 14 models were ranked, it was discovered that the models associated with the Poonel basin performed better; these models had ranks ranging from 1 to 5. This indicates that model performance is affected by a weighted precipitation regime.



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sciforum-103222: Correlation between hydraulic analysis and spatially distributed topographic index modelling for flood risk mapping

Eleni A. Tzanou ^{1*}, Anastasia I. Triantafyllou ², Dimitrios A. Natsiopoulos ³, Dimitrios Ramnalis ⁴ and Georgios S. Vergos ²

¹ School of Surveying and Geoinformatics Engineering, Faculty of Engineering, International Hellenic University, Greece, GR-62124

² Laboratory of Gravity Field Research and Applications – GravLab, Department of Geodesy and Surveying, Aristotle University of Thessaloniki, Greece, GR-54124

³ School of Surveying and Geoinformatics Engineering, Faculty of Engineering, International Hellenic University, Greece, GR-62124

⁴ GeoSense PCo, Thessaloniki, Greece-GR57013

Flood risk mapping is a key instrument for integrated flood risk management. The scope of this study was to create a methodology to assist in identifying flooding risk hotspots and potential flood-prone areas, thus providing a much quicker but reliable method for identifying areas with a high flooding risk. The methodology developed aimed to correlate the hydraulic simulation results obtained from a hydraulic analysis with topographic indexes that allowed the production of risk maps at the regional scale and for larger areas. Flooding susceptibility was assessed through the correlation of the hydraulic modelling results obtained from Hec-RAS with the Topographic Wetness Index (TWI), among other remote sensing indices (NDVI, NDWI, MNDWI, and fCover). The study area was set in northern Greece, in the region of Western Macedonia. The hydrological sub-basin has an area of 50.90 km² and is located in the catchment of Aiani. The first part of the study focused on integrating DTMs, remote sensing indexes, and geospatial data into a Geographic Information System (GIS) to generate high-quality cartographic information for flood risk analysis. The next phase was the implementation of the hydraulic analysis and modelling. Different flooding scenarios concerning different return periods were applied. The topographic indexes' results were then calibrated, based on the hydraulic analysis outputs, in terms of i) thresholding and adjusting the acceptable value range, calibrating them based on the calculated inundation profiles for various return periods for a selected area, and ii) their correlation with other indices. The interpretation of the correlation between the TWI and the hydrological analysis as the flood risk potential offered a group of flood risk maps with distinct categorisations and classifications of risk areas (low to high), providing different flood zoning for different inundation areas according to different discharge flows.



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sciforum-096654: Decarbonization Strategies for Wastewater Treatment Plants: Enhancing Energy Efficiency and Reducing Emissions

Zuhoor Al Rashdi *, Hind Barghash, Al Rayan Al Zakwani, Zainab Al Belushi and Aisha ALHasni

German University of Technology

Water scarcity is one of the main risks that the MENA region's nations are dealing with. Climate change, rising temperatures, etc. are the key contributors to this problem. Because of this, treating wastewater and reusing it in some fields like agriculture, industry, and groundwater augmentation is one way to lessen the demand for fresh water. However, wastewater treatment facilities are regarded as a source of GHG emissions. Generating energy with electricity will produce GHG emissions. For this reason, alternative solutions are suggested, such as generating energy utilizing solar power or gravity rather than electrical pumps.

The decarbonization of WWTPs has emerged as a crucial goal for achieving sustainable resource recovery as global efforts to combat climate change step up. All things considered, the decarbonization of WWTPs offers a tremendous potential to turn these historically energy-intensive buildings into sustainable and resource-efficient centres. WWTPs may promote the shift to a more sustainable and resilient water infrastructure while also helping to mitigate the effects of global climate change from conventional treatment to decarbonized treatment.

Implementing a range of strategies can be employed to lower carbon emissions, including reducing pump usage, utilizing solar energy, selecting alternative chemicals, and incorporating recyclable materials. The application of carbon management scenarios is expected to lead to a decrease of 7.56×10^3 CO₂ equivalent emissions for the MBR plant, a reduction of -1.27×10^4 CO₂ equivalent emissions for the SBR plants (indicating a decrease), and a decrease of -9.49 CO₂ equivalent emissions for the CW (constructed wetland).



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sciforum-101543: Design and Development of a Carbon Filter System for Enhancing Groundwater Recharge through Rainwater Harvesting

Adeen Sajid * and Ramsha Arif

Department of Structures and Environmental Engineering, University of Agriculture Faisalabad.

With the growing concerns over water scarcity and depleting groundwater levels in Pakistan due to population growth, climate change, and inefficient use of water resources, the water demand has also increased. The worst figures are provided by the sixth Sustainable Development Goal (SDG) of the UN Agenda 2030 "Clean Water and Sanitation," with over 733 million people residing in countries under severe water stress. Rainwater harvesting can help solve the domestic water problem that we have just tagged as a local issue. It is the most sustainable approach, in which the rainwater from rooftops, land surfaces, or rock catchments is collected and stored via scientific techniques. Rainwater harvesting has great potential for groundwater recharge and to combat problems of water crisis, urban flooding, and insecurity in local sources. This system stores rainwater trapped in these catchment areas, which is then passed through activated carbon filters to remove all impurities within. The clean rainwater is further conveyed to recharge wells and infiltrated safely into the groundwater table. The initial results suggest that using the rainwater harvesting system to increase groundwater recharge rates is an efficient way to improve water sustainability in different communities. This project combines rainwater harvesting with state-of-the-art filtration methods to help save water and take a step toward the sustainable management of groundwater resources.



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sciforum-101919: Designing Sustainable Drainage Systems to Mitigate Flood Risks in Urban Areas of the Lower Chenab Canal Region

Mannan Aleem ^{1*}, Shahbaz Nasir Khan Nasir Khan ¹, Naeem Siddique ², Muhammad Hassan Ali ³ and Saba Abid ¹

¹ Department of Structures and Environmental Engineering, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad, Pakistan

² Department of Irrigation Drainage, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad, Pakistan

³ Department of Irrigation Drainage, Faculty of Agricultural Engineering and Technology, University of Agriculture Faisalabad, Pakistan

The Lower Chenab Canal (LCC) region in Punjab, Pakistan, serves as an essential agricultural area that significantly contributes to the country's food production. However, the intensive use of agrochemicals and water resources has raised considerable concerns regarding the sustainability of groundwater quality in this region. This study aims to comprehensively analyze the impact of prevalent agricultural practices on groundwater quality in the LCC region. To achieve this, we conducted extensive field sampling across various agricultural zones within the region, collecting groundwater samples during different cropping seasons. These samples were analyzed for a range of chemical parameters, including nitrates, phosphates, pesticides, heavy metals, and other pollutants. The results were then correlated with agricultural practices, such as fertilizer and pesticide application rates, irrigation methods, and crop rotation patterns. Our findings reveal a strong association between intensive agricultural activities and elevated levels of nitrates and pesticides in groundwater, posing significant health risks to local communities. Notably, regions practicing monoculture and heavy agrochemical use showed higher contamination levels compared to areas with diversified cropping and organic farming practices. Additionally, geospatial analysis using Geographic Information System (GIS) and remote sensing data provided insights into the spatial distribution of groundwater contaminants and identified critical hotspots requiring immediate intervention. This research underscores the necessity for adopting sustainable agricultural practices, such as integrated pest management, precision agriculture, and organic farming, to mitigate groundwater pollution. Furthermore, this study advocates for the implementation of stringent regulatory frameworks and continuous monitoring programs to ensure the protection of groundwater resources. By integrating advanced geospatial tools and data analytics, this research contributes to developing effective strategies for sustainable groundwater management in the LCC region and similar agricultural landscapes globally.



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sciforum-097390: Developing a Comprehensive Water Management Plan for the Niger Basin

Mohammad Uzair Anwar Qureshi *, Ousmane Seidou, Hitenkumar Harish Motiyani and Hossein Bonakdari

Department of Civil Engineering. University of Ottawa. 800 King Edward Ave, Ottawa, ON K1N 6N5, Canada.

Introduction

The Niger basin, located south of the Sahel in West Africa, is prone to frequent flooding, particularly in the city of Niamey. Climate change has exacerbated these issues, making effective water management critical. This project aims to develop a comprehensive water management plan for the Niger basin, focusing on flood mitigation, hydropower optimization, irrigation efficiency, and ecological sustainability.

Methods

Our approach integrated multiple tools and models, including QGIS for watershed delineation, the Australian Water Balance Model (AWBM) for converting precipitation data into streamflow, and Goldsim for optimization based on real-world data. We ran climate change scenarios using the SSP585 model to predict future conditions. The Water Evaluation and Planning (WEAP) software was employed to simulate various management strategies, incorporating key sustainability indicators such as food security, energy security, water security, and environmental durability.

Results

The inclusion of the Kandadji Dam significantly reduced unmet water demand during dry seasons and increased net benefits through hydropower generation. Expanding irrigation zones to 287,000 hectares substantially boosted food security but slightly compromised water availability in the Niger River. Adding a new irrigation zone in the Sirba watershed further enhanced food security with minimal environmental flow disruption. The introduction of the Sirba Dam provided a comprehensive solution, stabilizing water supply, reducing flood losses, and ensuring complete coverage of instream flow requirements.

Conclusions

Our findings highlight the critical role of integrated water management strategies in addressing the multifaceted challenges of the Niger basin. The construction of the Kandadji and Sirba Dams, combined with optimized irrigation practices, presents a viable solution for achieving sustainable water resource management. This project underscores the importance of interdisciplinary collaboration, robust data infrastructure, and adaptive management in developing resilient water management plans for climate-affected regions.



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sciforum-096352: Developing a Geomorphologic-Based ANN Model for Daily Runoff Simulation in Golpayegan Watershed, Central Plateau of Iran

Zahra Piri ^{1,*} and Seiyed Mossa Hosseini ²

¹ Ph.D. Student of Geomorphology, Physical Geography Dept, University of Tehran, Tehran, Iran

² Associate Professor, Physical Geography Dept, University of Tehran, P.O. Box 14155-6465, Tehran, Iran

Over the last two decades, Artificial Neural Networks (ANNs) have been increasingly used to predict watershed responses due to their effectiveness in modeling complex precipitation-runoff phenomena. In this research, a multi-layer ANN model named GANN, based on watershed geomorphology, was created for long-term daily runoff simulation in a watershed upstream of a reservoir dam. A continuous genetic algorithm (CGA) was utilized for model training. To showcase the GANN model's performance in simulating the precipitation runoff process, the well-known hydrological model HEC-HMS was calibrated as a reference model using daily recorded time series data from the study basin. Geomorphological characteristics of the basin, such as the number of stream orders, average upstream area, and average stream length, were directly incorporated into the ANN structure. The model was trained using a sequence of previous time-step precipitation and runoff as input variables and current flow as the output. The GANN model was applied to predict daily runoff in the Golpayegan watershed, situated in a semi-arid region of Iran. The number of potential flow paths in the watershed determined the number of neurons in the hidden layer of the GANN structure, which remained constant during modeling. Furthermore, the calculated stream path probabilities in this watershed were used as connection weights between the hidden layer and the output in the GANN structure. The findings indicate that utilizing the current time-step of rainfall (P_t) and flow at the previous time-step (Q_{t-1}) as input variables for GANN yields the best performance in simulating daily flow compared to other GANN patterns and the HEC-HMS model. Integrating an ANN model with the geomorphological features of the watershed and an efficient metaheuristic optimization algorithm (e.g., CGA) offers computational efficiency and is suitable for daily runoff simulation in semi-arid regions.



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sciforum-095621: Development of a methodological framework to calibrate and validate a hydrodynamic model of the sewer system of a pilot basin. Case study: Quito, Ecuador

Diego Paredes ^{1,*}, Modesto Pérez-Sánchez ² and Francisco-Javier Sánchez-Romero ³

¹ Programa de Doctorado en Ingeniería del Agua y Medioambiental (2218), Universitat Politècnica de València, Valencia, Spain

² Hydraulic and Environmental Engineering Department, Universitat Politècnica de València, Valencia, 46022 Spain

³ Rural and Agrifood Engineering Department. Universitat Politècnica de València. Valencia, 46022 Spain

Urban Drainage Systems (UDSs) have existed since the Babylonian Empire. Their objective is to preserve and promote public health, welfare, and flood protection and avoid water pollution. Population and urbanization growth, climatic change, and aging structures are the main factors to produce failures in sewer systems due to the increase in surface runoff induced by changes in land use and land cover. The consequence is urban flood hazards. Therefore, in this research, a methodologic framework was developed to assess the hydraulic performance of a UDS in a pilot basin situated in Quito, Ecuador. By using three kinds of information, spatial, temporal, and terrain, a number of products were generated, such as design rainfall, historical precipitation, dry weather flows and their patterns, a topological network, land uses, a DTM, a DSM, and an orthophoto, and subsequently, a hydrodynamic 1D model was built by using a PCSWMM model. Calibration and validation of the model was carried out by employing hydrometeorological data that were registered in ultrasonic sensors to measure the depth and velocity of the flow every minute and a gauge station, which were implemented in the study area from January to October 2023. To evaluate the goodness of fit, the ISE, NSE, R², LSE, and RMSE were employed, whose values were within the recommend ranges. The results of this framework could provide support to decision makers to come up with the optimal rehabilitation measures, which could be gray, green, or hybrid, with a combination of these infrastructures, to minimize flood risk and improve the level of service of this important sanitary infrastructure.



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sciforum-091196: Disappearance of Nigerian Streams Amid Climate Changes: Consequences and Future Directions

Ibrahim M. Magami ^{1,*} and Ja'afar M. Ahmed ²

¹ Department of Biology, Usmanu Danfodiyo University Sokoto, Nigeria, PMB 2346 Sokoto Nigeria

² Department of Zoology, Usmanu Danfodiyo University, Sokoto PMB 2346 Sokoto Nigeria

Introduction

Streams in Nigeria, as well as globally, are indispensable resources that are vital for supporting livelihoods and cultural heritage. The disappearance of streams in Nigeria has multifaceted consequences and necessitates urgent attention for future endeavors. Climate change-induced alterations in precipitation patterns, prolonged droughts, and deforestation are contributing factors to the depletion of streams across various regions in Nigeria. This phenomenon has detrimental effects on biodiversity, water availability, agricultural productivity, and community resilience. The loss of a stream threatens aquatic species, exacerbates water scarcity, disrupts essential ecosystem processes, diminishes agricultural yields, and increases vulnerability to climate-related risks.

Methodology

This study involved a meticulous examination of the current literature and systematic review procedures. Steps such as assessing the current state of streams in Nigeria, acknowledging the review's importance within Nigeria's context, identifying consequences such as the disappearance and degradation faced by the streams, and exploring future research directions and potential interventions for sustainable stream management were taken.

Results

To tackle these challenges, it is crucial to implement sustainable land management practices, promote water conservation, develop climate change adaptation strategies, adopt integrated water resource management strategies, reform policies, and invest in research. By prioritizing these actions, Nigeria can mitigate stream disappearance's adverse impacts, enhance ecosystem resilience, safeguard water resources, and promote sustainable development despite climate change uncertainties.

Conclusions

The disappearance of streams in Nigeria amidst climate changes has significant consequences for both the environment and society. The effects range from biodiversity loss to increased vulnerability to climate-related risks, exacerbating water scarcity, and impacting agricultural productivity.



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sciforum-100242: Economic Modeling of the Destructive Potential of Extreme Rainfall Events

Laís Das Neves Santana ¹, Alarcon Matos de Oliveira ^{1,*} and Fabricio Ribeiro Garcia ²

¹ Universidade do Estado da Bahia

² Universidade Federal do Rio de Janeiro

Flooding is a recurring problem in many cities in Brazil, resulting in significant health, material, financial, and environmental losses. The uncertainty regarding extreme rainfall events due to climate change makes this problem even more challenging, especially for the municipality of Catu, in the state of Bahia, which also suffers from recurrent flooding. Critical points include the Santa Rita neighborhood, its surroundings, the supply center, and the city center. This research focused on analyzing and modeling the destructive potential of intense rainfall in the Santa Rita region (Supply Center) of Catu–BA and its effects on the local economy at different recurrence intervals. Hydrological simulation software based on computational and geoprocessing technologies, such as HEC RAS, HEC HMS, and QGIS 3.16, was used. Two-dimensional modeling was applied to assess the flood-prone areas and linear regression was used at different recurrence intervals. The results revealed that the area becomes impassable during flood events, causing significant economic losses, especially for local market vendors. The research concludes that urgent measures are necessary to mitigate the impacts of flooding, proposing the use of modeling and simulation technologies as essential tools for urban management and planning in flood-prone areas. Additionally, the implementation of adequate infrastructure and raising public awareness are crucial to reducing the damage caused by these extreme events.



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sciforum-098602: Enhanced Framework for Sustainable and Secure Water Resource Management

Farva Rubab ^{1*}, Laiba Batool ¹ and Muhammad Bilal ²

¹ Institute of Botany, Bahauddin Zakariya University, Multan 66000, Pakistan

² Department of Agriculture, Forest and Range Management, Bahauddin Zakariya University, Multan 66000, Pakistan

An important area for social advancement, economic expansion, and environmental integrity is water resources. To satisfy the demands of IoT-based quality monitoring, distribution, and water requirements, an innovative approach is presented. This study presents an Internet of Things (IoT)-enabled Water Resource Management and Distribution Monitoring System (IWRM-DMS) for use in rural cities. It uses sensors, gauge meters, flow meters, ultrasonic sensors, and motors. In order to reduce water demand, research suggests that the IWRM-DMS determines the rural water demand and the water supply system. A variety of sensors, including flow meters; pH, water pressure, and flow sensors; and ultrasonic sensors, are included in the suggested system. The village's need for residential water is met by the creation of this water system. The decision support system's demand prediction is made possible by machine intelligence. The outcomes of the simulation validate that the suggested framework may be applied in situations that occur in real life. In comparison to other widely used methods, the proposed IWRM-DMS has been designed to analyze water quality in order to ensure that water distribution in a rural area is achieved with a lower MAPE (20.84%) and RMSE (16.21%), improve efficiency (96.53%) and reliability (97.83%), and enhance predictions (96.45%), the overall performance (95.75%), the moisture content ratio (8.6%), and the cost-effectiveness ratio (96.9%).



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sciforum-103331: Enhancing Water Resource Management: Integrative Technologies and Sustainable Policies

Muhammad Mubashar Hanif ^{1,*}, Shahbaz Nasir Khan ², Mazhar Hussain ¹, Ameer Umar Kharal ¹, Ramsha Arif ³ and Adeen Sajid ³

¹ Agricultural Engineering, Faculty of agricultural engineering and technology, university of agriculture faisalabad

² Department of structures and environmental engineering, faculty of agricultural engineering and technology, university of agriculture faisalabad

³ Environmental Engineering, Faculty of agricultural engineering and technology, university of agriculture faisalabad

Water resource management is a critical component of environmental conservation and sustainable development. However, rising worldwide water demand and a significant decline in availability due to a lack of dynamic management and over-extraction have resulted in a complex scenario in terms of water availability. This paper investigates the integration of advanced technologies and innovative governance frameworks to address the complex challenges of water resource management under the pressures of climate change, population growth, and urbanization. Advanced technologies such as remote sensing, IoT-based hydraulic structures, Geographic Information Systems (GISs), and Artificial Intelligence (AI) are revolutionizing water body monitoring and management. These tools enhance predictive capabilities, optimize water use, and inform decision making by providing comprehensive data on water levels, quality, and distribution. Remote sensing offers vast area coverage, while GIS facilitates spatial analysis. AI algorithms extract valuable insights from large datasets, enabling the prediction of trends and patterns. This study focuses on developing sustainable, resilient, and adaptive approaches to water resource management by considering uncertainties and risks. This paper further examines the role of integrated water resource management (IWRM) and effective governance in achieving equitable water allocation and protection. Case studies are presented to illustrate successful implementations of these technologies and policies. Ultimately, this research aims to contribute to the development of holistic water management solutions that ensure water security for future generations.



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sciforum-097688: Estimation of base flow contribution using hydrograph separation techniques and analysis of temporal variation in upper Mahanadi basin

Prem Chand ^{1*}, Shikha Chaourasiya ² and Nitesh Patidar ³

¹ Research Scholar, Department of Civil Engineering Central University of Jharkhand , Dist.-Ranchi , Jharkhand, India
Pin code-835205

² Assistant Professor, Department of Civil Engineering Central University of Jharkhand, Dist.-Ranchi , Jharkhand, India
Pin code-835205

³ Scientist- C, Groundwater Hydrology Division National Institute of Hydrology, Roorkee, Dist.- Haridwar, Uttarakhand
India, Pin Code-247667

In the Upper Mahanadi basin, base flow estimation is essential for understanding the hydrological cycle and eco-hydrology of that region. As the Mahanadi River is a perennial river, this calculation plays an important role in water resource management, especially in the Upper Mahanadi basin. This study was conducted with help of hydrograph separation methods to analyse the behaviours of the base flow and base flow index of the Upper Mahanadi basin. The observed stream flow discharges along the basin were used to evaluate the base flow trends during the period from 1998 to 2018. This result gives an idea about the average base flow and base flow index (BFI) in the Upper Mahanadi basin, which has drastically decreasing trends. The annual base flow ranged between 0 and 189.075 cumecs for the Upper Mahanadi basin. The BFI varied from 0 to 0.4808 with an average of 0.2404. This study represents that, on average, 24.04% of the long-term stream, flow is likely to depend on groundwater discharge and shallow subsurface flow. This study helps policymakers, engineers, and government officials to understand base flow behaviours and improves awareness among local people, which can help in future strategies to manage river patterns and water quality in this region.



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sciforum-102701: Estimation of Cotton Actual Evapotranspiration in Thessaly (Greece) using ESA's Sentinel imagery and the WRF Model

Marios Spiliotopoulos ^{1,*}, George A. Tziatzios ¹, Nicolas Alpanakis ¹, Ioannis Faraslis ¹, Stavros Sakellariou ¹, Pantelis Sidiropoulos ¹, George Karoutsos ², Nicolas R. Dalezios ¹ and Nicholas Dercas ³

¹ University of Thessaly

² 2General Aviation Applications "3D" S.A., 2 Skiathou str, 54646, Thessaloniki, Greece

³ Agricultural University of Athens

There is a potential significance for improving the monitoring and management of irrigation water needs in semi-arid areas in Mediterranean countries like Greece. This study deals with the estimation of actual evapotranspiration (ET_a) above selected cotton fields located in the semi-arid region of Thessaly, Greece, for the growing season of 2022. The described methodology estimates daily crop evapotranspiration values using a combination of Sentinel-2 and Sentinel-3 satellite images and meteorological data derived from the Weather Research and Forecast (WRF) model. The methodology consists of seventeen separate steps for the estimation of energy parameters and the final estimation of actual daily evapotranspiration values at a 20×20 m spatial resolution. The basic idea of the process is based on the Two-Source Energy Balance (TSEB) methodology. The Sen-ET SNAP graphical user interface developed by the European Space Agency is used to estimate ET_a , with the use of Sentinel 2 and Sentinel 3 satellite data. One of the innovations of the study is the use of the WRF model instead of the initially proposed ERA-5 for the retrieval of the relevant meteorological data. Another innovation is the computation of the regional adjustment factor, which leads to realistic values for daily ET_a . The results are very promising; however, this study still needs validation through in situ experiments.



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sciforum-103262: Estimation of Crop Water Productivity (CWP) of Wheat crop in Mirpur Khas District using Landsat Imagery

Muhammad Faizan Khatri *, Nabeel Ali Khan, Arjumand Zehra Zaidi and Faheem Raza

US-Pakistan Center for Advanced Studies in Water, Mehran University of Engineering & Technology, Jamshoro, Pakistan

Water scarcity is a significant global challenge, particularly in agrarian countries like Pakistan, where 80% of freshwater resources are dedicated to agriculture. As an arid and semi-arid region, Pakistan needs to adopt efficient irrigation practices to ensure sustainable water use. This study calculates Crop Water Productivity (CWP) to identify the most feasible irrigation methods, using the Mirpur Khas (MPK) District in Sindh, Pakistan, as the study area. Wheat, a crucial crop in Pakistan, was selected for analysis during the Rabi season (November to April), which spans 160 days. By employing processed Landsat 8 imagery and the EEFlux model, based on the METRIC (Mapping ET at high Resolution with Internalized Calibration) approach, this study estimated the actual evapotranspiration (ETa) and CWP for the wheat crop. The results revealed that the ETa averaged 296.26 mm throughout the growing season, with the highest ETa values observed during the crop development stage (approximately 152 mm), indicating increased water requirements during midseason. The calculated CWP was 1.17 kg/m³, significantly higher than Pakistan's national average of 0.80 kg/m³, suggesting that the wheat crop in MPK is utilizing water more efficiently. These findings emphasize the potential of advanced remote sensing techniques and models like EEFlux to enhance water use assessments in agriculture, enabling more sustainable management of water resources. The method used in this study is both time-efficient and resource-efficient, offering a viable alternative to traditional methods that require extensive human resources. The method is quite feasible and can be applied to different areas with various crops. This study demonstrates that adopting technological advancements in water resource management can significantly improve irrigation practices, making it a crucial step toward sustainable agriculture in water-scarce regions like Pakistan.



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sciforum-097782: Evaluating the Efficiency of Machine Learning Models in Flood Risk Prediction: A Case Study of the Ottawa River Watershed, Ontario, Canada

Amir Noori * and Hossein Bonakdari

Department of Civil Engineering, University of Ottawa, 161 Louis Pasteur Private, Ottawa, ON K1N 6N5, Canada

Floods are among the most devastating natural disasters worldwide, inflicting severe damage on human life, infrastructure, and socioeconomics. Long-term flood forecasting is crucial for sustainable flood risk management, necessitating the development of accurate and efficient prediction models. This study aims to demonstrate the application of machine learning models in long-term flood risk prediction on the downstream watershed of the Ottawa River in Ontario, Canada. Specifically, it investigates the use of Support Vector Machine (SVM), Artificial Neural Network (ANN), and Extreme Learning Machine (ELM) models for long-term flood forecasting. An additional objective is to assess the impact of various variables on flood risk assessment, utilizing the Pearson method to compare the correlation of inputs like precipitation, rainfall, snow, temperature, wind speed, and humidity with the output water level index. The performance of the three applied models for flood risk forecasting was evaluated. Results indicate that the ELM model outperforms the others, achieving a higher accuracy in both training and testing phases. The ELM model yielded very high correlation coefficients (R) of 0.860 and 0.901; low Root Mean Square Error (RMSE) values of 0.417 and 0.374; and Mean Absolute Error (MAE) values of 0.523 and 0.463 for the training and testing phases, respectively. In addition, a sensitivity analysis of the best-calibrated ELM model revealed a significant dependency on the humidity parameter. The findings underscore the potential of machine learning models, particularly the ELM, in enhancing long-term flood forecasting accuracy. This research contributes to the growing body of knowledge on machine learning applications in natural disaster risk assessment and offers valuable insights for effective flood risk management.



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sciforum-097504: Evaluating the multifaceted impacts of the Tajo--Segura river transfer: a data-driven approach

Virgilio Pérez ^{1,*} and Beatriz Larraz ²

¹ University of Valencia, 46022, Valencia, Spain.

² University of Castile-La Mancha, 45071, Toledo, Spain.

This study addresses the critical need to quantify the multifaceted impacts of river transfers, with a particular focus on the Tajo--Segura transfer initiated in 1981. River transfers have many implications on economic, social, and environmental aspects that remain underexplored. This research aims to compile high-value datasets (HVDs) and propose some indicators to evaluate the impacts of the Tajo--Segura transfer, thereby providing a model for assessing similar projects globally. The methodology involves a dual approach. Firstly, an extensive review and collection of data on the Tajo--Segura transfer were conducted, encompassing hydrological, economic, social, and environmental parameters. Secondly, new HVDs were generated to fill gaps and enhance the existing data. A battery of indicators was then formulated to observe and quantify the changes in areas affected by the transfer. These indicators, derived from the generated datasets, cover various dimensions, such as water quality, agricultural productivity, socio-economic development, biodiversity, and the ecological status of water bodies, among others. Preliminary results indicate that the donor basin faces ecological and social stress, while in the regions receiving the Tajo--Segura transfer, significant variations in economic growth, agricultural yields, and social well-being are observed. Environmental assessments reveal mixed outcomes, with some areas experiencing improved water availability but others facing ecological stress. The newly created datasets and proposed indicators facilitate a deeper understanding of these impacts, demonstrating the importance of quality data in evaluating the implications of river transfers. The proposed indicators offer a practical tool for policymakers and researchers to monitor and evaluate the effects of such projects. The findings from the Tajo--Segura case study highlight the complex interplay between economic, social, and environmental factors, advocating for a balanced approach in future river transfer projects, in case of their occurrence.



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sciforum-096277: Evaluation of water surface dynamics of Manta and Beleu lakes

Ana Jeleapov

Institute of Ecology and Geography, Moldova State university

This study is dedicated to the evaluation of the water surface dynamics of the largest and most important natural lakes in the Republic of Moldova: Manta and Beleu. The lakes' area represents the main natural ecosystem of the country and is a shelter to thousands of animals and plant species which are included in a protected area network. The lakes are situated in the lower Prut floodplain, with main water sources being the river Prut through channels and during floods, as well as groundwater and precipitation. The regulation of the river Prut, climate change and the increasing frequency of droughts and floods have a certain impact on water surface dynamics. The main methods used to evaluate the lakes' extension dynamics are the analysis of satellite images and the application of the NDVI and its variations. The main satellite images used in this study are Landsats, that were identified from 1975 to the present. Thus, the estimation of water surfaces was performed for different decades, and the tendencies were also identified. The increasing magnitude of drought and floods in the last decade influenced the lakes' extension the most. The most recent catastrophic drought in 2022 decreased the surface of Beleu by up to 4 km² and that of Manta by up to 7,5 km², while the most recent floods in 2020 flooded up to 30,2 km² of the area of Beleu and up to 30,4 km² of that of Manta. The average water surface in recent years is 6,2 km² for Beleu and 13,4 km² for Manta.



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sciforum-103279: Examining Extreme Temperature Events in Mainland Portugal: A Comprehensive Analysis with ERA5-Land Data

Laryssa Freitas^{1*}, Maria Manuela Portela^{1,2} and Luis Angel Espinosa^{2,3}

¹ Instituto Superior Técnico, University of Lisbon (IST/UL), Portugal

² Civil Engineering Research and Innovation for Sustainability (CERIS), Portugal

³ Associação do Instituto Superior Técnico para a Investigação e Desenvolvimento (IST-ID), CERIS, Portugal

This study examines extreme temperature events in mainland Portugal, specifically maximum daily temperatures. The data was obtained from ERA5-Land hourly temperature in the period from Oct/1981 to Sep/2023 (42 hydrological years). The study area comprehends 1012 ERA5-Land grid points, approximately covering mainland Portugal, a country located in the Iberian Peninsula and bordered in the north and east by Spain and in the south and west by the Atlantic Ocean. To identify the extreme events, temperature thresholds were defined based on the empirical quantiles of 90.0, 99.0, and 99.9% of the global set of daily maximum temperatures for the entire country and period of analysis (exceeding 15 million values). The nationwide thresholds ensure the comparability of extreme daily temperatures across all the grid-points. The analysis period was divided into two sub-periods of 21 years each: from 1981/1982 to 2001/2002 (late period) and from 2002/2003 to 2022/2023 (recent period). For each of periods (global and sub-periods) and quantiles, the mean daily temperature above the threshold was computed per grid point and made dimensionless by division by the corresponding nationwide quantile. The mean annual number of days with extreme temperatures was also computed. The t-Student test was applied to compare the mean daily temperatures above the threshold in the sub-periods. Regardless the period, the mean annual number of days with exceptional temperatures was higher for the lowest quantile, up to 90 days/year, while for the highest quantile it was less than 5 days/year. The spatial patterns showed more daily occurrences in the southern regions, and fewer in the northern and coastal ones. The results from the t-Student test revealed a statistically significant increase in the mean daily maximum temperatures above the threshold towards the present for most grid points, especially for the highest quantiles. These findings emphasize the need for effective risk mitigation strategies to adapt to changing climatic conditions.



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sciforum-103156: Extreme rainfall analysis including seasonality in Athens, Greece

Konstantinos Vantas * and Athanasios Loukas

Faculty of Engineering Aristotle University of Thessaloniki

Extreme rainfall analysis is crucial for flood hazard assessment. A common approach is to probabilistically analyze observed annual maximum rainfall values, which are then fitted to an extreme value distribution to estimate the probability of maximum rainfall. However, when continuous time series data are available, it is more effective to use methods that incorporate all rainfall data. Such a method is the point process (PP) method, which analyzes both the frequency of exceedances above a given threshold and the values of those exceedances. This study applies the PP method to uninterrupted daily rainfall records from 1901 to 2023 from the National Observatory of Athens meteorological station in Thiseion. Preliminary analysis using annual maxima did not reveal any significant trend but showed monthly seasonality in precipitation. A threshold rainfall of 10 mm was firstly selected for the PP model by examining the stability of parameter estimates across a range of values. Maximum likelihood estimation was then employed on 1509 rainfall data points over the 10 mm threshold using two different models: (a) a stationary model and (b) one that incorporates the observed seasonality into the shape and location parameters of the PP model. A likelihood ratio test for the two nested models confirmed that incorporating seasonality is statistically significant ($p\text{-value } 2.2 \cdot 10^{-16}$). Finally, the results from the PP method were compared to those from the National Flood Risk Management Plans (NFRMPs) derived using the annual maximum approach method. The stationary model's estimates for various return periods were consistent with the NFRMP values. However, the non-stationary model, which accounted for seasonality, produced estimates up to 16% higher for the upper 95% confidence interval. Therefore, the results of this study indicate that incorporating seasonality (non-stationarity) in the probabilistic extreme analysis of rainfall makes a significant difference in the rainfall design values.



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sciforum-102800: Farmers' Perception of Trickle Irrigation System IN THE Mirpur Khas and Tando Allahyar Districts

Raheel Raza ^{1*}, Asmat Ullah ² and Arjumand Zehra Zaidi ²

¹ Department of Integrated Water Resources Management (IWRM) at U.S.-Pakistan Center for Advanced Studies in Water (USPCAS-W) Mehran University of Engineering and Technology, Jamshoro, Sindh.

² U.S Pakistan Center for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering and Technology Jamshoro, Sindh, Pakistan

Water scarcity is a global issue, and with the world population projected to reach 9-10 billion by the year 2050 and changing climate, it will become more serious. The food supply would also be adversely affected by the shortage of water. Ensuring food security for both present and future generations depends on sustainable water management and advancing agricultural productivity through technologies that optimize water use amidst climate change. Therefore, there is an urgent need to improve crop production and water use efficiency, especially in arid and semi-arid regions. In Pakistan's Sindh province, water scarcity presents a significant challenge to agriculture, emphasizing the need for the sustainable management of water resources. The drip irrigation system can save approximately 70-80% of irrigation water compared to traditional methods; however, its acceptance is low in the province despite government interventions to address water scarcity issues and promote sustainable food production. This study explores farmers' perceptions and the factors influencing the non-adoption of drip irrigation. Understanding these factors will guide strategies to enhance the acceptance of drip irrigation, thereby improving agricultural production and water conservation. The adoption of drip irrigation by farmers was influenced by factors such as education level, technical knowledge, labor demands, access to extension services, and availability of irrigation water sources. It was observed that establishing technical backups, raising farmers' awareness of water's value, and shifting their preferences from short-term to long-term gains are essential for efficient and sustainable use of available water resources. The findings of this study will significantly contribute to the capacity building of farmers' organizations and extension services, promoting farmer-to-farmer learning and enhancing sustainable agricultural practices.



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sciforum-093431: Filling of single-walled carbon nanotubes with manganese fluoride

Marianna V. Kharlamova

Lomonosov Moscow State University, Leninskie Gory 1, Russia

It is important to find new materials for water treatment. The interplay of the physical properties of materials leads to new results [1-3]. Combining several methods for the investigation of materials allows the full range of information on the modified physical properties to be deduced. Manganese fluoride (MnF_2)-filled single-walled carbon nanotubes (SWCNTs) show great potential in water treatment. This salt is inert with a very high melting point, and it was introduced into SWCNTs for the first time. Here, we studied the modified electronic structure of the filled SWCNTs with several methods, such as transmission electron microscopy (TEM) and Raman spectroscopy. The TEM method showed the filling of metallic and semiconducting carbon nanotubes with high filling degrees and high purity. The TEM method, along with Raman spectroscopy, is capable of revealing the electronic structure of the filled SWCNTs. These methods are fundamental for finding the Fermi level shifts in the filled SWCNTs. P-doping in the filled SWCNTs was proven by shifts in the RBM and G-band Raman peaks. The obtained information shows the potential of the new compound, MnF_2 , for water treatment applications.

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sciforum-095320: Flood Risk Map For Büyükçekmece District Based On Socioeconomic Factors

Gülşah Kılıç ^{1,*} and Filiz Bektaş Balçık ²

¹ Istanbul Technical University Informatics Institute

² Istanbul Technical University Geomatics Engineering Department

Büyükçekmece District is situated on the European side of Istanbul, with a coastline along the Marmara Sea. However, factors such as climate change, increasing population leading to uncontrolled urbanization, and improperly implemented stream rehabilitation projects expose the district to flood risks. The main objective of this research is to produce a flood risk map of Büyükçekmece District and contribute to the development of flood management strategies by examining its correlation with socioeconomic factors. In this study, fundamental factors affecting flood risk such as slope, aspect, elevation, land use, geological structure, proximity to river, soil type, and precipitation were identified. Using the Analytic Hierarchy Process (AHP), the weights of these criteria were calculated, and flood risk maps were generated based on these weights. Maps based on neighborhood boundaries considering socioeconomic indicators were produced using open data to address social vulnerability in high-risk areas. According to the analysis results, neighborhoods that should be prioritized in disaster management preparedness and damage reduction stages were identified. In conclusion, this research aims to shed light on the development of more effective and comprehensive strategies against flood risks in Büyükçekmece District. It emphasizes the critical role of local socioeconomic dynamics and information in determining flood management strategies.



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sciforum-096985: Flood susceptibility mapping using machine learning boosting algorithms and Geospatial techniques – A Case Study of Subarnarekha River Basin

Mou Garai ^{1,*} and Dr.Dharmaveer Singh ²

¹ M.sc student at Symbiosis Institute of Geoinformatics,Symbiosis International (Deemed) University, India

² Head Department of Geoinformatics at Symbiosis Institute of Geoinformatics, Symbiosis International (Deemed) University, India

Floods are a major natural disaster, particularly in the Subarnarekha River basin in eastern India, where severe monsoon season flooding poses significant risks to communities, agriculture, and infrastructure. Preventing floods is challenging, but technological advancements like machine learning in geospatial analysis offer promising methods for identifying and managing flood-prone areas. This study employs machine learning boosting algorithms and 15 conditioning factors, such as elevation, rainfall, and drainage density, to assess flood susceptibility in the Subarnarekha River basin. Using 25 years of historical flood data (1998–2022) for training and validation, the models are evaluated using metrics like precision, recall, F1 score, and area under the curve (AUC), with AUC values ranging from 0.91 to 0.95. Adaboost proves to be the most effective model with a 95% AUC, followed by XGboost (93%), Gradient Boosting (92%), Catboost (92%), and Stochastic Gradient Boosting (91%). The analysis reveals varying flood hazard conditions, with low hazards in the upper reaches and high susceptibility in coastal areas due to heavy rainfall and runoff. This study highlights the value of machine learning techniques in improving flood risk assessment and management strategies. By leveraging these advanced methods, authorities can develop more effective flood mitigation plans and enhance early warning systems. This integration of technology provides a proactive approach to disaster management, potentially saving lives and reducing economic losses in flood-prone regions.



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sciforum-103325: Flood Vulnerability Assessment and Mapping in Dadu district and Sehwan city, Sindh

Dabeer Ul Mulk Mastoi *, Arjumand Zehra Zaidi and Asmat Ullah

U.S. Pakistan Center for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan

Floods have become increasingly frequent and severe, occurring more often and with greater intensity because of climate change. Pakistan, ranked as the eighth most vulnerable nation to climate change according to the Global Climate Risk Index, has been severely impacted by natural hazards like floods. During floods, vulnerable communities are heavily affected, which causes losses not only to the life of people but livestock, agriculture, infrastructure and socio-economic losses as well. In this study, a GIS-based multi-criteria approach is used to assess flood vulnerability in Dadu district and Sehwan city. The methodology involves Landsat-8 satellite images and data including census, agriculture and rainfall data). With the help of this, we created maps which were further divided into three categories (physical vulnerability, coping capacity and socio-economic vulnerabilities). In total, 14 criteria were selected to develop flood vulnerability maps. These criteria were then weighted with the help of the analytical hierarchy process (AHP), and supporting AHP criteria were standardized into spatial thematic layers. The results demonstrated that the northeast and southwest areas of Dadu district are highly to very highly vulnerable, the central and northwest parts of Dadu district are moderately to highly vulnerable, and southeast areas are low to moderately vulnerable to floods. With this approach, the outcomes of this study will suggest the most vulnerable areas that need the most attention for disaster preparedness. Our results will help policy makers to make communities more resilient and mitigate upcoming disastrous events.



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sciforum-090125: Golina River Water Budget Dynamics Analysis using Remote Sensing Satellite Data, Northern Ethiopia

Hailu Ayene Kebede ^{1,*}, Dr. Birhan Asmame Miheretu ² and Dr. Alem-meta Asefa Agidew ²

¹ Wollo University

² Geography and Environmental studies, Wollo University, Ethiopia

River basin management, the backbone of many economies, relies on understanding historical and projected fluctuations of water budget components: precipitation, evapotranspiration, runoff, soil moisture, which result decline of water availability in the world particularly Northern Ethiopia. Currently, the use of satellite remote sensing information is becoming more critical for acquiring hydrological information in ungauged areas, complementing missing values, and measuring hydrological components/ water budget components in large-scale areas. A concurrent mixed research methodology has been used in this study. The hydrological components are processed using formulas and software, which yields a map and numerical data that require a thorough explanation. The non-gridded statistical data for each component of the water budget was extracted using spatial analytic tools that were accessible in the GIS /Geographic Information System. Rainfall was localized downstream of the study during all research periods, Except for a small amount in 2023, when evapotranspiration varied and was focused in the southeast of the region, soil moisture levels throughout all periods were concentrated in the west. Evapotranspiration was in line with rainfall. This might be the outcome of the study's upper stream, the western section, having a lower temperature than the downstream. As evidence of this, the evapotranspiration map indicates that it was low in the upper stream (Western region) and high downstream (Eastern region). The findings of this study also show that runoff increases as precipitation increases. Rainfall has increased in intensity, which has saturated the soil and expedited runoff. The paper's unique findings, which have values of 5.355 MMC/million-meter cube, 6.960 MMC, 0.882 MMC, and -4.700 MMC, respectively, demonstrate that the trend of the water budget has been declining during the years 1993, 2003, 2013, and 2023. Accordingly, there was a significant potential for evapotranspiration, resulting in a water shortage.



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sciforum-096796: How climate change could impact the water resources of the Aggitis River Basin in Greece?

Paschalis Koutalakis ^{1,*} and George Zaimes ²

¹ Department of Surveying and Geoinformatics Engineering, International Hellenic University

² Department of Forestry and Natural Environment Science, Democritus University of Thrace

Assessing the climate change impacts on hydrologic phases is crucial in order to establish adaptive management strategies for water resources. These assessments are performed by utilizing projected climate change trends for hydrologic model input data to forecast future hydrological processes. The soil and water assessment tool (SWAT) is a well-used hydrologic modelling tool that has been implemented in diverse hydrologic and environmental conditions investigating climate change impacts. This study assesses the potential future climate change effects on the hydrologic phases in the Aggitis River Basin. The SWAT daily streamflow results after being calibrated and validated were very good. Two climate change scenarios (RCP4.5 and RCP8.5) of the WCRP-CMIP3 multi-model dataset were applied. The future (2025–2100) modelled hydrologic conditions showed that, compared to the baseline conditions (1979 to 2022), there will be an average increase in evapotranspiration's participation in the hydrologic cycle from 47% to 74% and 77% for the RCP4.5 and RCP8.5 scenarios, respectively. At the same time, there will be a decrease in groundwater recharge by 61% and 69% under these future scenarios and an overall water yield loss of half (from 16% to 7-8%). Climate change is expected to alter the hydrological regime and will impact the water supply and demand for agriculture. Thus, monitoring and preparation are necessary in planning the water demand at the basin scale. There is a vast range of nature-based solutions and ecosystem-based approaches that aim to increase resilience to climate change and sustain the rural activities and communities.



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sciforum-093000: Hydrological Response to Climate Change in Baro Basin, Ethiopia, Using Representative Concentration Pathway Scenarios

Tolossa Negassa Ebissa ^{1,*}, Shimelash Molla Kassaye ² and Demelash Ademe Malede ³

¹ Department of Water Resources and Irrigation Engineering, Mattu University, Mettu P.O. Box 318, Ethiopia

² Africa Centre of Excellence for Water Management, Addis Ababa University, Addis Ababa P.O. Box 1176, Ethiopia

³ Department of Natural Resource Management, Debre Markos University, Debre Markos P.O. Box 269, Ethiopia

Droughts and floods are common in the Baro basin, and climate change may exacerbate them. This study aimed to investigate the hydrological response to the impact of climate change on the Baro basin. From four climate models, namely the Hadley Centre Global Environmental Model, version 2 (HadGEM2-ES); Myocardial perfusion imaging, low resolution (MPI-ESM-LR); Coupled Model Version 5, Medium Resolution (CM5A-MR); and the European Community Earth System Model (EC-Earth), dynamically downscaled outputs were obtained from an African coordinated regional downscaling experiment programme. Changes in the hydrological response to climate change were compared to the baseline scenario (1971 to 2000) under the Representative Concentration Pathway Scenarios for the medium term (2041 to 2070). The climate data were heavily skewed before being used in the impact analysis and needed correction. In terms of bias, HadGEM2-ES performed the worst, while EC-Earth performed the best. MPI-ESM-LR was the worst performer in terms of RMSE, and CM5A-MR was the best. The GCM predictions for the RCP 4.5 scenarios suggested that, in the medium period (2041 to 2070), the maximum temperature in the Baro River basin will probably rise by 2.1 °C for MPI-ESM-LR and 2.49 °C for CM5A-MR, while the minimum temperature will likely climb by 1.7 °C for EC-Earth and 2.8 °C for HadGEM2-ES. Annual rainfall is expected to fall by 7.02% for CM5A-MR and 17.01% for HadGEM2-ES, while annual evapotranspiration potential is likely to rise. Except for Belg (from March to May), CM5A-MR consistently generated the greatest streamflow change, while MPI-ESM-LR consistently generated the highest magnitude of streamflow change. Generally, climate change is predicted to significantly impact the hydrological response in the Baro River basin under the RCP 4.5 scenario.



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sciforum-098578: Improving Irrigation Water Use Efficiency and Maximizing Vegetable Yields with Drip Irrigation and Poly-Mulching: Climate-Smart Approach

Denis Bwire ^{1,*}, Fumio Watanabe ², Shinji Suzuki ² and Kana Suzuki ²

¹ Department of Agricultural Mechanization and Irrigation Engineering, Busitema University, P. O Box. 236 Tororo, Uganda

² Lab. of Soil and Water Environmental Technology, Department of Agricultural Engineering, Tokyo University of Agriculture, Tokyo, Japan

The increasing prolonged droughts and rainfall variability are significant factors contributing to increasing water scarcity, limiting vegetable yields in addition to weeds. Water scarcity is a global concern, negatively impacting food security and rural livelihoods in developing regions, particularly Sub-Saharan Africa, where livelihoods chiefly depend on rainfed agriculture. Mulching is a soil conservation approach that controls surface evaporation (E), a significant component of evapotranspiration (ET), which influences water use and vegetable growth. The influence of poly-mulch on weed management and water use efficiency was evaluated in a field experiment conducted between May and September 2018 in open greenhouse conditions at Tokyo University of Agriculture, Japan, on a plot of 30 cm² with drip irrigation and tomato cultivation. Three irrigation regimes, 2, 3 and 4 mm/day, defined from evaporation, were applied on black poly-mulch and no-mulch sections. Data on soil conditions—soil pressure head and soil temperature, as well as climatic variables, including solar radiation and temperature—were collected during the tomato cultivation period, while yield components—yield, water productivity, and sugar content—were determined after harvest. The results of a two-way ANOVA showed that poly-mulching with all irrigation regimes reduced the weed biomass and improved yields and water use efficiency compared to no-mulch conditions. Applying poly-mulches with 3 and 4 mm/day had a 5% significant effect on tomato yield compared to no mulch. Poly-mulching is vital for weed management and the application of irrigation regimes; 2-4 mm/day based on evaporation improves water use efficiency for tomato cultivation.



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sciforum-087485: Integrated Approaches to Water Resource Management and Climate Resilience

M Ameer Umar ^{1,*} and Dr. Rana Ammar Aslam ²

¹ Department of Agricultural Engineering, University of Agriculture Faisalabad

² Department of Structures and Environmental Engineering, University of Agriculture Faisalabad, 83060, Pakistan

Effective water resource management is crucial in the face of increasing climate variability and change, which adversely affects water availability, glacier melting, agriculture, biodiversity, and food accessibility. This study advocates for a comprehensive and collaborative framework that integrates sustainable practices, risk management, and adaptive strategies. It underscores the necessity of interdisciplinary cooperation among governmental agencies, communities, and scientific experts to ensure equitable and sustainable water resource management. By addressing various water uses—domestic, agricultural, industrial, and ecological—this approach seeks to balance competing demands and minimize conflicts. A crucial element of this integrated strategy is climate resilience, which involves anticipating risks such as droughts, floods, and shifting precipitation patterns. Key strategies include developing robust infrastructure, implementing water-saving technologies, and preserving natural water systems. Furthermore, proactive policies and practices are essential to enhance the adaptive capacity of communities and ecosystems, securing long-term water availability and ecosystem health. Integrating traditional knowledge with innovative technologies further strengthens the effectiveness of water management practices. This holistic approach not only safeguards water resources but also fosters socio-economic development and environmental sustainability. By promoting resilience and adaptability, integrated water resource management can effectively mitigate the adverse impacts of climate change, ensuring water security for future generations and supporting sustainable development goals.



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sciforum-092946: Integrated study of GRACE-based groundwater storage variability across Ethiopia for sustainable economic development

Agegnehu Kitanbo Yoshe

Department of Water Resources and Irrigation Engineering, Arba Minch University, 21 Post Office Box, Arba Minch, Ethiopia

Surface and groundwater variations are difficult to assess due to complexity and the lack of spatiotemporal observation. The increasing population of Ethiopia is coupled with growth in infrastructure, agriculture, and industries, which are the largest water consumers, leading to the depletion of water resources, including groundwater. From the review of past studies, it is clear that no attempts have been made to study the spatiotemporal variability of groundwater at the country level using GRACE and GLDAS datasets. Nowadays, different parts of Ethiopia face a severe water crisis due to the overexploitation of surface water resources, which adds extra pressure on groundwater. In this study, groundwater storage was estimated using the three products of gravity recovery and climate experimentation from the global land data assimilation system in Ethiopia. The estimated monthly groundwater storage ranged from 1948.69 to 28111.07 mm and yearly groundwater storage ranged from 263879.1 to 311505.5 mm for the study period. The monthly, seasonal, and annual variations in groundwater storage were evaluated. This research found that groundwater storage exhibits interannual fluctuation following the seasonal pattern of the study area. The variation in groundwater storage may be occurring as a result of complex activities with natural and anthropogenic impacts. We found that GRACE and GLDAS datasets can be combined effectively to evaluate the long-term GWS in large-scale basins with limited hydrological data.



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sciforum-097971: Issues of associated water utilisation management at hydrocarbon fields in the north of the West Siberian oil and gas producing region

Rimma Nailevna Abdrashitova ^{1,*} and Yulia Ivanovna Salnikova ^{2,3}

¹ Laboratory of geological and hydrogeological support for the development of hydrocarbon fields at Industrial University of Tyumen, Tyumen, 625000, Russia

² Institute of Petroleum Geology and Geophysics. A.A. Trofimuk, Siberian Branch of the Russian Academy of Sciences, West Siberian Branch, Tyumen, 625000, Russia

³ Laboratory of geological and hydrogeological support for the development of hydrocarbon fields at Industrial University of Tyumen, Tyumen, 625000, Russia

At present the only relatively environmentally safe and economically feasible method is the utilisation of surplus produced water into the receiving horizon. The purpose of the presented study was to demonstrate the necessity of chemical compatibility control during mixing of formation and injected associated waters at the Zapolyarnoye oil and gas condensate field. Mixing takes place during injection of produced water into the receiving aquifer. The amount of associated water to be utilised is measured in hundreds of thousands of m³ per year. Discharge of such water into surface water bodies is prohibited due to its high salinity and sodium chloride ion salt composition. Mineralization of waters of the receiving horizon is 10.5 g/dm³. The source of associated waters are productive horizons of Jurassic age with mineralisation of more than 20 g/dm³. The following tasks were solved in the course of the study: hydrogeological features of the target horizon-receiver were analysed, composition and volumes of associated water injection at the field were studied, chemical compatibility of formation water of the receiving horizon and associated water was calculated by thermodynamic modelling under given formation conditions. The programme was developed on the basis of the normative document 39-229-89 «Water for oil reservoir flooding». We obtained that at formation pressure of 88.23 atm and formation temperature of 42°C a sediment of 0.153 g/dm³ is formed in the receiving horizon when the share of associated water in the mixture reaches 40%. The formed sediment may cause colmatization of the receiving horizon. Obtaining correct data on the chemical compatibility of two types of waters of different compositions mixed in reservoir conditions is one of the aspects of environmental protection under conditions of long-term anthropogenic impact on the geological environment of the region.



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sciforum-097604: Microplastics in wetlands with different land uses: latitudinal differences (Spain - United Kingdom)

Alicia Herrador-Rodríguez ^{1,*}, Francisco Guerrero ¹, Genoveva Esteban ², Ben Parker ³ and Juan Diego Gilbert ¹

¹ Experimental Sciences' Centre, University of Jaén, Jaén, 23071, Spain

² Department of Life and Environmental Sciences, Bournemouth University, Poole, Dorset BH12 5BB, UK

³ Department of Biosciences, Faculty of Health and Life Sciences, University of Exeter, EX4 4QD, UK

Microplastics, plastic particles of 5 mm, are well-known emergent pollutants, ubiquitous in all ecosystems on the planet. They are considered a global threat, being aquatic ecosystems the most affected by them and inland freshwater ecosystems less studied in regards to this matter. When microplastics enter the ecosystems, they produce a wide range of impacts on biodiversity, ecosystem functions, production and animal health. Microplastics enter these ecosystems mainly due to the human activity, for this reason, in this research, the comparison of the microplastic content of sixteen wetlands from Spain and United Kingdom with two different land uses in their catchment basin was carried out: agricultural-livestock and forestry. In the process, two filter sizes were compared to demonstrate which one is more suitable for these studies, which is a smaller pore size filter. Microplastics were found in fifteen wetlands, although no significant difference was found between the ponds of the United Kingdom, nor comparing them with the Spanish. However, in Spain it was evident that agriculture, especially olive groves, causes an outstanding microplastic pollution in wetlands, likely due to the intensification of this cultivation, more use of plastic and more waste caused by olive farmers and higher erosion of the soil. Lastly, some measure to minimize microplastics inputs are suggested.



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sciforum-097674: Mountain and Foothill Wetlands Surrounding Guadalquivir Valley (Jaén, Andalusia, Spain): Recent Historical Evolution and Main Anthropical Agressions

Gema Ortega González ^{1,*}, Juan Manuel Barragán Valdivia ¹, Fernando Ortega González ¹ and Francisco José Guerrero Ruiz ²

¹ University of Jaén. Department of Animal Biology, Vegetal Biology and Ecology.Campus de Las Lagunillas, s/n. 23071 Jaén (Spain)

² University of Jaén. Department of Animal Biology, Vegetal Biology and Ecology.Campus de Las Lagunillas, s/n. 23071 Jaén (Spain). University of Jaén. Center for Advanced Studies in Earth, Energy and Environmental Sciences. Campus de Las Lagunillas, s/n.

Wetlands are considered one of the most valued ecosystems in the world, due to their transitional role between the terrestrial and aquatic environments, which favors biodiversity. Ponds also provide some ecosystem services that are very useful for the population, such as flood regulation, or their involvement in essential processes, such as nutrient cycles. That is why the analysis of the historical evolution of these ecosystems and the effects they have suffered is a key aspect to understanding the current state of the conservation of wetlands in a given territory. The study area is located in the mountains and foothills of the province of Jaén, Andalusia (Spain); this is a set of mountain ranges that border the Guadalquivir valley. In total, this study covers 48 ponds, whose recent evolution is studied over a period of 68 years, starting from the study of American flights in 1956 to the PNOA images of today. The objective of this study is to establish a baseline on the main aggressions that, from an anthropic point of view, can affect the ecological alteration of wetlands and their environment in this period of time. Human action and changes in land use have led to a progressive decrease in the surface area of some of these wetlands, which has led to the invasion of the wetland basin area, in most cases due to the intensification of olive grove cultivation, especially in the last quarter of the twentieth century and in the present twenty-first century.



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sciforum-102602: Nature-based solutions applied in urban drainage systems: a case study using GIS hydrological based modelling

Lineker Max Goulart Coelho

Technical University of Denmark - DTU, Dept. of Engineering Technology, Ballerup, 2750, Denmark

This work aims to present a case study in which Nature-based Solution (NbS) scenarios were tested using computational modelling to verify the effectiveness of such systems as an alternative for solving flooding problems in urban areas. This case study corresponds to a central area in the city of Frederiksberg, a municipality located in Denmark. Different scenarios for Nature-based Solutions were considered and evaluated based on the estimated flooding area defined based on precipitation, infiltration, and surface coverage. Scenario 1 consisted of increasing areas of vegetation cover. Scenario 2, in turn, consisted of infiltration trenches combined with linear gardens along the sidewalks. Scenario 3 was based on the use of rain gardens. For hydrological modeling, the Scalgo software was used, which combines Georeferenced Information System (GIS) tools with an analysis of flood spots based on the amount of precipitation, local topography, and infiltrated water. The flood spot analyses were carried out based on an intense rainfall event, resulting in a total rainfall of 50 mm. Water infiltration into soil was estimated based on the type of soil and type of coverage (paved or natural) using Horton's equation. The results obtained show that in the case of scenario 1, aimed at simply increasing vegetation cover, a reduction of 50 m³ of runoff was achieved, but it was not enough to significantly mitigate the flooded area on the main road, whose total flooded volume was 286 m³. Scenarios 2 and 3, in turn, were able to efficiently avoid flooding of the main road, with no flooding spots being observed in both, which was expected considering that the interventions in both scenarios enable increased infiltration and temporary storage of rainwater. The results of this study indicate a possible approach to be followed to compare different NbS with a view to its use as a measure of rainwater management.



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sciforum-097211: Precipitation Frequency Applied Research and Development for the United States Army Corps of Engineers Dam and Levee Safety Program

Brian E. Skahill ^{1,*}, C. Haden Smith ², Andrew Verdin ² and John F. England ²

¹ US Army Engineer Research and Development Center Coastal and Hydraulics Laboratory

² US Army Corps of Engineers, Institute for Water Resources Risk Management Center

The United States Army Corps of Engineers (USACE) has been assessing risks at all USACE dams over the last ten years to manage its dam portfolio in a risk-informed manner. For each risk assessment, a reservoir stage–frequency curve is estimated. This critical piece of information conveys the probability of exceeding each reservoir stage within a given year and forms the foundation for estimating probabilities of failure. Within the USACE, the stage–frequency curve is usually derived using an inflow volume–based approach that makes use of historical stream gage data and potentially rainfall–runoff data when considering extreme events. For performing a rainfall–runoff analysis, areal precipitation frequency estimates are needed. The only national scale precipitation frequency product is the NOAA Atlas 14, which is limited to a precipitation frequency of 1 in 1,000 years, or an annual exceedance probability (AEP) of 0.001. Dam safety studies routinely evaluate risks with frequencies of up to 1 in 1,000,000 years (1E-6 AEP) or less. As such, project-specific studies must be conducted to obtain the necessary point and areal precipitation frequency estimates.

Current practice in precipitation frequency for dam safety uses L-moments and areal reduction factors. However, advances in the field of extreme value theory (EVT) have demonstrated the capacity to efficiently, flexibly, and credibly model spatial extremes of pointwise maxima using a max-stable process (MSP), the infinite-dimensional analog of the multivariate extreme value distribution. Applying this, one can not only compute pointwise return level maps but also model the joint distribution and carry out more complex areal-based assessments of risk while working within the theoretically justified mathematical framework provided by EVT. The MSP-based modeling approach allows for spatially varying trend surfaces for parameters and the ability to directly estimate area-based exceedances within an EVT-based framework. Importantly, the MSP modeling approach has a strong and coherent mathematical basis for model fitting, selection, extrapolation, and uncertainty quantification.



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sciforum-097241: Propagation of Climate Model Variability to Coastal Groundwater Simulations under Climate Change

Alkaterini Lyra ^{1,*} and Athanasios Loukas ²

¹ Department of Civil Engineering University of Thessaly

² Department of Rural and Surveying Engineering, Aristotle University of Thessaloniki

This study investigated the impact of climate change on water resources and the propagation of climate model variations in the Almyros basin, Greece, with a particular focus on the intensively utilized groundwater reserves essential for irrigation. Facing significant degradation in both their quantity and quality, understanding the future trajectory of groundwater resources is imperative. Climate change effects are evaluated through the employment of bias-corrected Med-CORDEX climate model projections, specifically considering the RCP8.5 emission scenario. Utilizing an Integrated Modelling System (IMS) comprising surface hydrology (UTHBAL) and groundwater hydrology (MODFLOW) modules, the future status of coastal water resources was simulated. The methodology involved a multi-step process: First, we acquired climate model data for various future climate model simulations. Subsequently, these data were used as an input for an Integrated Modelling System (IMS) simulating variables like recharge rates, evapotranspiration, groundwater levels, and others. The findings provide crucial insights for sustainable water resource management in the Almyros basin amidst changing climatic conditions. Through this approach, this study aimed to elucidate the propagation of climate model variability in the hydrological variables and processes, and it highlights the necessity of integrating advanced climate model projections with comprehensive hydrological modelling to project and estimate the variability of climate change impacts on coastal groundwater systems.



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sciforum-102442: Regional frequency estimates of annual rainfall maxima and sampling uncertainty quantification

Marios Mpillios * and Lampros Vasiliades

Laboratory of Hydrology and Aquatic Systems Analysis Department of Civil Engineering, University of Thessaly Pedion Areos, 38334 Volos Greece

Successful hydraulic infrastructure design necessitates information about future precipitation conditions, i.e., the return period for a specific event magnitude, which is why we need to treat rainfall as a random variable controlled by a distribution law. Our research addresses the sampling uncertainty associated with parameter estimation of the GEV distribution, providing a comparison between at-site and regional approaches. Regional frequency analysis was performed in the region of Thessaly, Greece, using annual maximum rainfall data from 55 rain gauges. To identify statistically homogeneous regions, four spatial covariates (rain gauge elevation, mean annual precipitation, latitude, and longitude) were used as inputs to the principal component analysis followed by the k-means clustering algorithm. We then calculated the parameters and their confidence intervals using two distinct methods. For the regional estimates, we used Bayesian MCMC sampling using the metropolis algorithm with non-informative priors, while for the at-site estimates, we used a typical L-moments procedure along with bootstrap resampling. Lastly, we compared the results to identify relationships with the aforementioned covariates. The results indicate that the gauge elevation and the mean annual precipitation are the best covariates. The location and scale parameters show a strong correlation with these covariates, while the shape parameter does not. The study procedure demonstrates the sampling uncertainty of the regional frequency analysis method for precipitation maxima. The results will be useful for hydrologic studies in the area.



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sciforum-097096: Representation of water cycle dynamics under climate change in an agricultural watershed

Giuseppe Pulighe *, Alice Carlotta Tani and Flavio Lupia

CREA Research Centre for Agricultural Policies and Bioeconomy

Highly managed Mediterranean river basins are experiencing severe environmental issues due to the overexploitation and degradation of both groundwater and surface water resources. Water resource managers face mounting concerns over the allocation of these limited resources, environmental quality, and planning amidst current and future climatic uncertainties. Understanding the hydrological components and water balance is crucial to addressing key questions related to water availability under various scenarios and future climatic conditions. In this study, the Soil and Water Assessment Tool (SWAT+) was utilized to develop an eco-hydrological model for the Cervaro river basin in Southern Italy. The objective was to evaluate baseline conditions and assess future climate projections towards the end of the 21st century. The model was driven by high-resolution data from Regional Climate Models (RCMs) under the Representative Concentration Pathways (RCP) 4.5 and RCP 8.5 scenarios. The baseline model was calibrated using observed streamflow data, ensuring a robust assessment of goodness-of-fit objective functions. Future hydrological responses were projected for the mid-century time scale. Our simulations revealed significant spatial variations in water fluxes, with an increase in potential evapotranspiration and a decrease in precipitation and surface runoff. These findings underscore the substantial impact that future scenarios may have on sustainable water resource management and the evaluation of climate change effects in this region. The insights gained from this study are essential for informing adaptive management strategies and policy decisions aimed at mitigating the impacts of climatic changes on water resources in highly managed Mediterranean river basins.



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sciforum-103311: Satellite-based monitoring of wheat crop consumptive water use

Mirza Muhammad Ahmed *, Ghulam Hussain Dars and Arjumand Zehra Zaidi

U.S. Pakistan Center for Advanced Studies in Water (USPCAS-W), Mehran University of Engineering and Technology, Jamshoro, Sindh, Pakistan

Evapotranspiration (ET) is the combined process of water loss to the atmosphere from the Earth's surface through evaporation from soil and water bodies, and transpiration from plants and vegetation. The accurate estimation of evapotranspiration (ET) plays a crucial role in optimizing agricultural water use and irrigation practices, especially in semi-arid regions with limited freshwater resources. This study aims to evaluate the performance of the Operational Simplified Surface Energy Balance (SSEBop) model in estimating the actual evapotranspiration (ETa) of wheat crops at the field scale in Tandojam, Sindh, Pakistan. The SSEBop model is a satellite-based energy balance approach that derives ETa by integrating remote sensing observations with ground-based meteorological data. In this study, 30 m resolution Landsat 8 and 9 imagery was utilized to map land surface parameters, while ancillary data from an on-field meteorological station provided inputs for computing reference evapotranspiration. The methodology involved preprocessing satellite data and computing vegetation indices, land surface temperature, and net radiation fluxes required by the SSEBop algorithm. Actual ET across different wheat growth stages (initial, mid, and late) was mapped for the study area. This research highlights the potential of the SSEBop approach for mapping ETa at field scales, which can inform sustainable irrigation management and water accounting practices for wheat cultivation in semi-arid regions like Pakistan.



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sciforum-104995: Semi-distributed hydrological modelling of streamflows in the Huancané river using Hydro-BID

Vladimir Guzmán Mamani-Arizapana ^{1,2,*}, Apolinario Lujano ³ and Efrain Lujano ²

¹ Administración Local del Agua Huancané, Autoridad Administrativa del Agua Titicaca, Autoridad Nacional del Agua, Huancané, Peru

² Escuela Profesional de Ingeniería Agrícola, Universidad Nacional del Altiplano, Puno 21001, Peru

³ Autoridad Nacional del Agua, Peru

The effective management of water resources requires the precise distribution of streamflows in both temporal and spatial terms. In areas where direct measurements are lacking, data on average flows are often limited. This research aimed to evaluate the semi-distributed hydrological modeling of streamflows in the Huancané River using Hydro-BID. The model evaluation was conducted through qualitative analyses, such as time series graphs, and quantitative indicators, including Nash--Sutcliffe efficiency (NS), the correlation coefficient (r), the modified correlation coefficient (Rmod), and the overall volume error (OVE). The validation results showed good model performance and adequate representation of the seasonal dynamics of streamflows. For daily flows, the OVE was -12.48, the correlation coefficient (r) was 0.82, the modified correlation coefficient (Rmod) was 0.62, and the NS was 0.67. For monthly flows, the values were 12.52 for OVE, 0.90 for r, 0.68 for Rmod, and 0.79 for NS. The application of the calibrated parameters to data from the Putina station also showed good results, with an OVE of 14.29, an r of 0.85, an Rmod of 0.82, and an NS of 0.69 for monthly flows. In conclusion, the model demonstrates good performance in simulating flows in basins with limited information and can be useful for transferring flow information and assessing water availability in unmeasured areas, facilitating appropriate water resource planning in the Huancané River basin.



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sciforum-097887: Social Adoption of Ecotechnology for the Self-Management of Water in Community Spaces and Processes

Blanca Yessica Sevilla Angulo ^{1,*}, Daniel Tagle-Zamora ², Alex Ricardo Caldera Ortega ²,
Jesús Mora Rodríguez ¹ and Xitlali Delgado-Galván ³

¹ University of Guanajuato, Guanajuato, Mexico

² University of Guanajuato, León, Mexico

³ Universidad de Guanajuato, Guanajuato, México

The integral process of ecotechnology postulates that it is possible to change from a globalized context, which consists of mass productions as well as a high consumption of resources, to a context that is concerned with the resolution of local issues, also seeking to eradicate the relations of domination and strong inequality gaps. Although ecotechnology makes use of ancestral techniques and practices, nevertheless, it is not seen as an outdated, obsolete alternative or as a marginal technology; on the contrary, it is of great significance due to its process of knowledge exchange, which is based on scientific inputs for its development and construction. This highlights the need to generate a social model that contains democratic, fair and plural knowledge, which would allow the reduction of inequality gaps and marginalization. Thus, within this framework, the social adoption of ecotechnology allows us to legitimize original and cultural knowledge in a forceful way, as well as to seek the necessary change of paradigm and generate a process of implementation in an integral way, leading to the confrontation of problems through strategic technological answers with a high social impact.



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sciforum-099146: Soil Moisture Variations and Their Relationships with Different Vegetation Types in The Upper Blue Nile River Basin

Sintayehu Abebe ^{1,*}, Tianling Qin ² and Denghua Yan ²

¹ Hydraulic and Water Resources Engineering Department, Debre Markos University Institute of Technology, Debre Markos, Ethiopia

² State Key Laboratory of Simulation and Regulation of Water Cycle in River Basin, China Institute of Water Resources and Hydropower Research, Beijing, China

The vegetation–soil moisture relationship is complex and nonlinear. Vegetation activity determines the space–time distribution and availability of soil moisture. In this study, we have used the 3rd generation Global Inventory Monitoring and Modeling Systems (GIMMS3g.v1) Normalized Difference Vegetation Index (NDVI) dataset to represent the vegetation activity in the Upper Blue Nile River Basin (UBNRB). We also used the distributed Water and Energy Processes (WEP) hydrological model to generate the soil moisture data. We used the Global Land Cover (GLC2000) data to identify specific land cover types. To examine the trends in the NDVI and soil moisture information, we employed the non-parametric Mann–Kendal trend test along with the Theil–Sen slope estimation technique. We applied another non-parametric correlation analysis named Spearman correlation to investigate the degree of relationship between soil moisture changes and vegetation responses. We limited our study to growing season (April–October) NDVI and soil moisture values to reflect the vegetation's growth status better. The results show that shrublands in northwestern lowlands along the Ethio–Sudan border and southern Ethiopian highlands exhibit a significantly increasing trend. Overall, 32.3% of the NDVI pixels and 66.6% of the soil moisture pixels show a significant trend. The sparse grassland of the southwestern lowlands shows a decreasing vegetation activity trend. In total, 28.8% of the valid pixels (excluding pixels of no data, cities, and waterbodies) show a higher correlation ($\rho > 0.7$), whereas 49.7% indicate a correlation between 0.5 and 0.7, mainly in the shrubland, grassland, and forested areas. The correlation between same month (lag0) NDVI and soil moisture is substantially higher than the subsequent previous month's (lag1–lag5) soil moisture values. This quick response relates to croplands, shrublands, and grasslands, confirming their sensitivity to short-term soil moisture changes. Forested areas of the basin did not show an appreciable correlation with soil moisture fluctuations.



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sciforum-097669: The Application of Multivariate Statistics and Geospatial and Machine Learning Techniques to the Prediction of Water's Suitability for Irrigation in the Sokoto–Rima Catchment in Nigeria

Rasaq Rahman owolabi ^{1,*}, Rebecca A Olaoye ², Johnpaul Olaniyi Popoola ¹, Lateef Lanre Kolawole ³ and Oluwaseyi O Abe ⁴

¹ Department of Geological Sciences, Achievers University, Owo

² Department of Civil Engineering, Ladoké Akintola University of Technology, Ogbomosho

³ Department of Earth Sciences, Achievers University Owo

⁴ Department of Computer Sciences, Achievers University Owo

In the Sokoto–Rima catchment, over 70% of the population depends on groundwater for subsistence farming. The use of the conventional techniques in the assessment of water quality is expensive because it requires several parameters, so developing an accurate and reliable model is essential in the management of water resources for effective agricultural practices. This study applied multivariate statistics, geospatial analyses and machine learning (ML) models to groundwater chemistry and irrigation indices to determine the classification and the spatial-temporal distribution. MS Excel was used to calculate the irrigation suitability parameters, such as SAR, KR, ESP, Na%, PI and ESP, and then PAST4.0 statistical software and machine learning algorithms such as multiple linear regression (MLR), a Decision Tree (DT), Random Forest (RF), a Support Vector Model (SVM) and K-NN Neighbors (K-NN) were used for the model predictions, based on a composite index that combined all the indices (SAR, KR, EST, Na, MAR, PI) into a single score representing the overall irrigation water quality and then SAR (and subsequently other indices like KR, EST, Na, MAR, PI, etc.). The IDW interpolation technique was used to generate the spatial distribution maps for each parameter of the groundwater dataset for this study. The results from the fifty-element (50) water chemistry dataset obtained from the archive of the Federal Ministry of Water Resources predicted four (4) clusters from the hierarchical cluster analysis, with two (2) principal components, PC1 and PC2, representing the major geochemical processes controlling the groundwater quality. A very strong correlation association was observed between EC-Ca (0.85), KR-SAR (0.95) and Na%-ESP (0.85). The machine learning models indicated for the composite index showed a low MSE of 0.00 and a high R of 1.00 for multiple linear regression and R values of 0.6 and 0.63 and MSE values of 68.5 and 67.86, respectively, for the DT and RF models. Predicting PI as the target variable with KR, SAR, MAR, Na% and ESP demonstrated a notable predictive capability, with a low RMSE of 13.3 and a high R of 0.9836, with RF. While KNN showcases a robust performance for Na% as the target variable, as did the DT and RF for ESP, MLR showed a strong predictive performance for SAR.



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sciforum-097277: The Development and Evaluation of a Novel Precipitation Product for Extreme Events: A Principal Component Analysis Approach

Muhammad Umer Nadeem ^{1,*}, Koji Dairaku ², Ngoc Kim Nguyen Hong ³ and
Llorin Alyssa Gewell Agena ^{1 3}

¹ Department of System and Information Engineering University of Tsukuba Japan

² University of Tsukuba, Faculty of Engineering, Information and Systems, Department of Engineering Mechanics and Energy

³ University of Tsukuba, Graduate School of Science and Technology, Degree program in Systems and Information Engineering, Doctoral program in Engineering Mechanics and Energy

Precise precipitation data are essential for the effective execution of water resource management and risk reduction initiatives, particularly during periods of extreme precipitation. This study introduces a new precipitation product (NPP) that integrates in situ and ERA5 estimations to enhance the identification and quantification of extreme precipitation events. We evaluated the newly generated dataset using a diverse array of statistical indices, in conjunction with two satellite precipitation products (IMERG and PERSIANN-DIR). We also implemented principal component analysis (PCA) to evaluate the efficacy of precipitation products. The PCA algorithm facilitates the interpretation of the primary factors that influence severe precipitation by reducing the number of dimensions in the dataset. We also evaluated the efficacy of newly produced products and SPPs using 11 extreme indices. We found that the NPP is the only newly integrated precipitation product that can track the heaviest precipitation at the highest elevations (> 3000 m), which is similar to how it leads on most extreme indices for tracking extreme events. The NPP monitors the maximum number of days for R50, while others suggest a significant level of underestimation. The PERSIANN PDIR's performance is unsatisfactory, and the IMERG is only marginally capable of monitoring the new dataset's performance. The results suggest that PCA pattern 4 significantly influences the efficacy of all datasets due to displaying circular wind patterns, which can produce localized precipitation zones and potentially complicate accurate capture by satellite products. This research provides a valuable resource for water resource managers and meteorologists to improve flood predictions and risk reduction strategies. A novel precipitation product, in conjunction with PCA insights, establishes a robust framework for improving the mitigation of severe weather impacts in vulnerable regions.



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sciforum-093408: The Impact of Climate Changes ON THE Hydrological Conditions in the Zarqa Main Hydrographic Basin (Dead Sea)

Odai Aloyed, Alexandra Megahed * and Daniel Scrădeanu

University of Bucharest, Faculty of Geology and Geophysics, Doctoral School of Geology, Str. Traian Vuia no. 6, code 020956, Bucharest, Romania

Introduction and Study Objectives

The issue of global climate change has begun to play an increasing role in scientific and policy debates over effective water management. This article describes and discusses the concerning geological and hydrological conditions in the Zarqa Ma'in basin (ZMB), directly conditioned by the climate regime, the geomorphology of the land and the lithology of geological formations.

Recently, evidence that global climate change will have significant effects on water resources in Jordan and, in particular, in the Zarqa Ma'in basin (ZMB) has continued to accumulate.

This study aims to evaluate the risks of flash floods that occur in the study area due to the climatic regime that changes the physical characteristics of the hydrological and hydrogeological system in the Middle East, the impact of which is already evident worldwide.

The Zarqa Ma'in region has moderate to high relief with elevations ranging from -348 m below sea level to 924 m above sea level. Due to the high relief of the study area, especially in the southwestern part, the risk of damage from a flash flood is very high. The Zarqa Ma'in area is very hilly, with steep slopes without soil. Soil erosion and runoff rate are directly proportional to slope and inversely proportional to the permeability of geological formations.



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sciforum-097786: The Integration of Rainwater Harvesting with Urban Water Systems for Simultaneous Reduction in Stormwater Runoff and Groundwater Extraction: A Case Study in Lahore, Pakistan

Shanza Arshad ^{1,*}, Mubashra Mahmood ², Tanveer Ahmed ² and Talal Naseer ³

¹ Forman Christian College, University, Lahore, 54600, Pakistan

² University of Engineering and Technology, Lahore, 39161, Pakistan

³ Food and Agriculture Organization of the United Nations, Pakistan

This study focuses on designing and evaluating a household-level rainwater harvesting system (RWHS) aimed at enhancing groundwater conservation, reducing costs, and mitigating urban flooding. Utilizing WaterGEMS for hydraulic analysis, the research highlights the effectiveness of an RWHS in advancing sustainable urban water management. Initially, this study involved designing the water supply system without a rainwater harvesting component. Subsequently, the rainwater potential and storage tank volumes were computed for 3, 5, and 10-marla houses using four methods, with the SamSam model being identified as the optimal approach. Further, the calculated storage volume was divided into the rain barrel volume and the underground tank volume. Three scenarios were developed based on different percentages of water demand being met through harvested rainwater, with case I (covering gardening, house cleaning, and laundry, meeting 18% of the demand) deemed the most viable. Simulations using the Storm Water Management Model (SWMM) revealed an average of 8.6% reduction in water demand, a 17.38% decrease in electricity consumption, and significant reductions in peak urban flooding for return periods of 2, 5, and 10 years, accompanied by 20-24% less flooding at the society level and 17% energy savings. The implementation costs for RWHS were determined as PKR 550,253 (USD 1974) for 3-marla, PKR 670,890 (USD 2407) for 5-marla, and PKR 1,112,283 (USD 3992) for 10-marla houses, underscoring the substantial potential of RWHS in bolstering urban water supply sustainability through efficient rainwater management and utilization.



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sciforum-096174: Urban growth patterns of Mediterranean cities and their flood risk: possible applications of NBS in the context of climate change

Salvador Garcia-Ayllon

Department of Civil Engineering, Technical University of Cartagena, Cartagena, 30203, Spain

Urban areas in the Mediterranean are currently some of the areas that are most exposed to the effects of climate change due to flooding. The growing increase in the cold drop episodes (as they were previously referred to), both in intensity and frequency, has generated the so-called DANA phenomena with numerous deaths and considerable economic damage in recent years in countries such as Spain. This requires rethinking flood risk mitigation strategies in these environments, where the traditional approach of constructing hydraulic infrastructures for risk mitigation and flood lamination is, in many cases, economically unaffordable, or even technically impossible. In this context, the implementation of nature-based solutions can be a very interesting approach as an operational tool in the future. However, this should not be approached from a segmented view, but from within the framework of an integrated strategy that combines the diagnosis and subsequent analysis of errors in urban and territorial planning to implement actions that are effective in this matter on a large scale. In this work, various case studies of the Spanish Mediterranean façade subjected to the problems of flooding due to climate change are exposed and analyzed using GIS tools and indicators, proposing various strategies and mitigation actions in relation to the risk of flooding based on the improvement of urban planning and management of the territory as a nature-based solution.



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sciforum-103252: Urban Water challenges of Integrated Resources Planning and Management in India

Amit Kumar Jaglan

Department of Architecture, School of Planning and Architecture, New Delhi, 110002, India

Historically, water resource systems have benefited people and economies in many ways. However, many areas lack the capacity to support and maintain resilient biodiverse ecosystems, and many are unable to satisfy the basic demands for drinking water and sanitation. These issues underscore the need for improved water resource systems. Inadequate infrastructure, excessive withdrawals from river flows, pollution from industry and agriculture, nutrient loading, salinization, infestations of exotic plants and animals, overfishing, alterations of the flood plain and habitat due to development, and modifications to the patterns of water and sediment flow are some of the causes of river pollution. In addition to discussing possible water-related concerns and outlining advancements in the field, this research paper offers an overview of the application of Integrated Water Resources Management (IWRM) in India. This study covers planning and management features in integrated policies, development plans, technical aspects, financial, economic, institutional, and governance, as well as the availability of water and related challenges. It helps shape future approaches to effective problem-solving in planning and management difficulties. In order to support effective problem-solving skills, this study makes recommendations for how to improve future IWRM capacity building. In order to improve effective problem-solving skills, the study identifies water availability and water-related issues, makes recommendations for future improvements in International Water Resources Management, and addresses issues with enabling environments, institutional frameworks, and management tools. Also, challenges such as rapid urbanization, water scarcity and pollution, flooding, wastewater management, climate change, and integrated approach highlight the importance of comprehensive planning and innovative solutions to ensure sustainable water management in India's urban areas. These recommendations address issues with the enabling environment, institutional frameworks, and managerial tools.



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sciforum-102940: Visualising Exceptional Rainfall in Portugal: The Severity Heat Map Approach (1981/1982–2022/2023)

Luis Angel Espinosa ^{1,*} and Maria Manuela Portela ²

¹ The Associação do Instituto Superior Técnico para a Investigação e Desenvolvimento (IST-ID), Civil Engineering Research and Innovation for Sustainability (CERIS)

² Instituto Superior Técnico (IST), Civil Engineering Research and Innovation for Sustainability (CERIS)

This study develops a Severity Heat Map to analyse the spatiotemporal dynamics of exceptional rainfall in Portugal over 42 hydrological years (1981/1982–2022/2023) using the ERA5-Land reanalysis dataset. By employing four upper quantiles (Q95, Q99, Q99.5, Q99.9), this research identifies exceptional rainfall events and analyses their occurrences, cumulative impacts, and intensity. The ERA5-Land data, validated against local meteorological records, provide a robust foundation for assessing regional variations and temporal changes. The results reveal significant regional variations and temporal changes in exceptional rainfall. While overall cumulative rainfall has decreased, the most exceptional events have intensified in severity. This trend is particularly evident when comparing two subperiods: 1981/1982–2001/2002 and 2002/2003–2022/2023. The innovative Severity Heat Map visualises these changes, illustrating combined characteristics of exceptional rainfall. It shows significant increases in frequency and intensity, particularly in coastal and urban areas. The Severity Heat Map was created using a 2x2 matrix, considering two variables: the mean annual number of occurrences of exceptional rainfall and the mean annual cumulative rainfall above the threshold. Higher severity was assigned to areas where both variables exhibited increased values in the more recent subperiod. This visualisation highlights regions experiencing heightened severity, offering a comprehensive view of the evolving landscape of exceptional rainfall in Portugal. This tool is crucial for understanding the broader impacts of climate change on regional hydrological systems. The findings indicate that despite a decrease in overall rainfall, the intensity and severity of exceptional events have increased, reflecting the broader impacts of climate change. These insights are vital for informing risk management and sustainable development strategies aimed at mitigating the impacts of exceptional weather events in Portugal. The Severity Heat Map approach provides valuable insights for informed decision making in risk management and sustainable development, tailored to the changing patterns of exceptional rainfall in the country.



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sciforum-102902: Water conservation in terms of water footprint calculation for conventional use: a case study of IRB, Pakistan

Umeed Maalik

¹ Department of Environmental Sciences, University of Gujrat, Hafiz Hayat Campus Gujrat, Punjab, Pakistan

² Department of Environmental Sciences, University of Haripur, KPK, Pakistan

Water is a vital component of life systems, highly essential for all life forms. Human water exhaustion is of two types: direct and indirect. Like other natural resources, water demand evaluation is crucial for survival. With increased consumption pressure, “Water scarcity” is globally recognized. The only way out is to change water usage patterns, not only to reduce pollution loads but also to safely meet future needs. The water footprint (wf) measure, an indicator of conservational sustainability, is valid in water assessment and management. In regions of old municipal systems that are not maintained and have never been updated, urban flooding is a common occurrence each rainy season. Traditional methods of growing cereals, predominantly rice and wheat, have made conditions worse. In such environments, introducing ecological water use is fundamental. The evaluation of water in a certain system of production in a given scenario is regularly required. In this study, Indus River Basin (IRB), Pakistan was selected to apply the conception of ‘wf’ using GIS technology. This plotting will help to demonstrate statistics about water: depletion, stress, and exploitation in definite space and time. The green, blue, and grey components of ‘wf’ scheming will make available the estimation of precipitation, ground reserves, the water table, and contamination ratios generated during domestic, commercial, industrial, and agriculture practices conducted. This study will surely allow for a circumstantial baseline of water resource management, refrain from floods, and the ability to meet future demands for farming, food supplies, and economic development in the region. Its a method of assuming, accomplishing, and executing new sustainable processes of water use, measurement, management, and conservation, thereby avoiding life-threatening urban flooding, over evaporation in farms during roasting weather, and extensive drilling for performing daily tasks in each sector. This addresses the issues of increasing demand for excessive water from ground assets and subsequent energy costs.



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Grosspeteranlage 5
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