The 5th International Symposium on Water Resources and Environmental Impact Assessment in North Africa

المؤتمر العالمي الخامس للموارد المائية و تقييم التأثيرات البيئية بشمال افريقيا

WREIANA 2025

Proceedings of the 5th International Symposium on Water Resources and Environmental Impact Assessment in North Africa WREIANA 2025

Organized by :

International Association of Water Resources in the Southern Mediterranean Basin

الجمعية العالمية للموارد المائية بالحوض الجنوبي للمتوسط

30-31 OCT - 01 NOV

Sousse, Tunisia

Edited by:

- Prof. Younes Hamed, University of Gafsa- Tunisia
- Prof. Rihab Hadji, University of Sétif 1- Algeria
- Prof. Salem Bouri, University of Sfax-Tunisia

www.wreiana.com

Disclaimer

Any papers included in this program reflect the personal opinion of the authors.

The publisher does not accept any liability for the correctness, accuracy or completeness of the information or for the observance of the private rights of any third parties. Any papers submitted by the authors do not necessarily reflect the editors' opinion; their publication does not constitute any evaluation by the editors.

PARTNERS

Chairmen

Prof. Dr. Younes Hamed

Univ. Gafsa-Tunisia

Phd Prof Full. Hydrogeology and geochemistry

Prof. Dr. Salem Bouri

Univ. Sfax-Tunisia

Phd Prof Full. Geothermy and geochemistry

Prof. Dr. Dr. Riheb Hadji

Univ. Setif-Algeria

Phd Prof Full. GeoAI, GIS and remote sensing

Organisation committee

Elimame Elaloui
Univ. Gafsa-Tunisia

Riadh Ahmadi
Univ. Sfax-Tunisia

Riheb Hadji
Univ. Sétif.Algeria

Amor Hamad
AGIRE. Tebessa-Algeria

Romdhane Benassi
Univ. Gafsa-Tunisia

Salem Bouri
Univ. Sfax-Tunisia

Younes Hamed
Univ. Gafsa-Tunisia

Inas Gaballah
Univ. Cairo-Egypt

Ammar Mlayeh
Univ. Carthage-Tunisia

Fadoua Hamzaoui Azaza
Univ. Carthage-Tunisia

Khadija Feki
Univ. Noura Princess-Saudi Arabia

Yosra Ayadi
Univ. Gafsa-Tunisia

Malika Abbes
Mascara Univ-Algeria

Bassem Hidouri
Univ. Gafsa-Tunisia

Amina Ben Sâad
Univ. Gafsa-Tunisia

Zouhour Moussaoui
Univ. Gafsa-Tunisia

Kaouther Ncibi
Univ. Gafsa-Tunisia

Ismail Arif
GeoLab-Sétif-Algeria

Soumaya Hajji
Univ. Sfax-Tunisia

Walid Chebiki
Geoplus-Tunisia

Naima Hidouri
Univ. Gafsa-Tunisia

Rim Missaoui
Univ. Gafsa-Tunisia

Fatma Ben Brahim
Univ. Gabes-Tunisia

Iheb Saad
Univ. Sousse-Tunisia

Assaad Ahmed Al-Hussein
Univ. Al-hamdaniya-Iraq

Abdulrasoul M. Alomran
King Saud Univ-Saudi Arabia

Ziyadin Çakir
Istanbul Univ-Turkey

Achref Melki
Mekyel Company-Saudi Arabia

Salwa Saidi
Univ. Tunis-Tunisia

Tarek Drias
Univ. Betna-Algeria

Sami Yahiaoui
Polytechnic National School Algiers-Algeria

Basim Asghar
Univ. Umm al-Qura-Saudi Arabia

Zoubir Aoulmi
Univ.T ebessa-Algeria

Scientific committee

Riheb Hadji
Univ.Sétif-Algeria

Matteo Gentilucci
Univ.Camerino-Italy

Nouridine Hamdi
Univ.Gabes-Tunisia

Hakim Gabtni
Univ.Tunis-Tunisia

Wided Bouguerra
Univ.Gafsa-Tunisia

Rayan Khalil
Univ.Jedda-Saudia Arabia

Mohammed El Gettafi
Univ.Ouejda-Morocco

Ammar Maoui
Univ.Guelma-Algeria

Sahal Samir
CRDA Mednine-Tunisia

Adel kharoubi
Univ.Gabes-Tunisia

Hichem Chaffai
Univ.Annaba-Algeria

Mohamed Gaied
Univ.Sousse-Tunisia

Aziz Amine
Univ.Casablanca-Morocco

Anis chkirbene
Univ.Tunis-Tunisia

Rabah Laouar
Univ.Annaba-Algeria

Fadoua Hamzaoui Azaza
Univ.Tunis-Tunisia

Malika Miky
Univ.Houari Boumediene-Algeria

Kadour Benmarce
Univ.Sétif-Algeria

Sonia Hassini
Univ. McMaster-Canada

Amor Hamad
AGIRE-Tebessa-Algeria

Paola Adamo
Univ.Napoli Federico II-Italy

Antonio Caporale
Univ.Napoli Federico II-Italy

Caroline King-Okumu
Univ.Exeter-UK

Marwa El Haouari
ICA-Malysia

Kamil Ahmed Qureshi
Univ.Houston-USA

Belgacem Agoubi
Univ.Gabes-Tunisia

Salah Mahmoudi
Univ.Gabes-Tunisia

Djoher Abedrahmane
Univ.Oran-Algeria

Serhane Brahmi
Univ. Bab Ezouari-Algeria

Adel Zghibi
Univ.Tunis-Tunisia

Abedlhakim Bouajila
Univ.Gabes-Tunisia

Abdesselam Malek
Univ.Tizi Ouzou-Algeria

Messaoud Louafi
Univ.Tebessa-Algeria

Khadija Ouerghi
Univ.INRAT-Tunisia

Wissem Guellala
Univ.Sousse-Tunisia

Enzo Rizzo
MISSS Research Group-Italy

Lynda Allouche
Univ.Barcelona-Spain

Hichem Zerrouki
Univ.Oum El Bouaghi-Algeria

Sadek Ben Salem
Univ.Gabes-Tunisia

Osama El Fallah
Univ.Omar Al-Mokhtar-Libya

Imen Hamdi Nasr
Univ.Bizerte-Tunisia

Zaineb Amri
Univ.Kairouan-Tunisia

Abdelhamid Khedidja
Univ.Betna-Algeria

Laetitia Van den Bergen
Univ.Belgium

Hajer Azaeiz
Univ.Carthage-Tunisia

Gaidi Laouni
Univ.Mascara-Algeria

Fehdi Chemseddine
Univ.Tebessa-Algeria

ShuhabD.Khan
Univ.Houston-USA

Debi Prasanna Kanungo
CBRI, Roorkee-India

Fatma Trabelsi Bouchendira
ESIER-Tunisia

Hanene Zater
Univ.Oum El Bouaghi-Algeria

Salwa Saidi
Univ.Tunis-Tunisia

Kamel Boukhalfa
Univ.Bizerte-Tunisia

Oumaya Marzouk
CEREMA-France

Zouheir Nasr
INRGREF-Tunisia

Nouioua Ismail
Univ.Tebessa-Algeria

Adoum Abdraman Abgassi
Univ.N'Djamena-Tchad

Giovanni Mastrolonardo
Univ.Florence-Italy

Margarida HR Antunes
Univ. Minho-Portugal

Romulus Dumitru
Univ.Costache-Romania

Lhoussaine Bouchaou
Univ. Agadir-Morocco

Ali Ben Belgacem
IRA-Kebili-Tunisia

Lahcen Benaabidate
Univ.Fes-Morocco

Chabou Moulley Charaf
Univ. Setif-Algeria

Mabrouk Boughdiri
Univ.Bizerte-Tunisia

Chedly Abdelly
ANPR-Tunisia

Monder Brahmi
Univ.Sousse-Tunisia

Miloudi Abdelmone
Univ.El Oued-Algeria

Zaiz Issam
Univ.El Oued-Algeria

Farid Zahri
Univ.Sétif-Algeria

Karim Zighmi
Univ.Sétif-Algeria

Adel Djellali
Univ.Tebessa - Algeria

Ashok Kumar Rathoure
Saraca Research - India

Fethi Lebdi
FAO-Saudi Arabia

Amina Mabrouk
Univ.Tunis-Tunisia

Chafai Azri
Univ.Sfax-Tunisia

Amina Ben Sâad
Health ministry-Tunisia

Mubaraka S.Alghariani
Univ.Trabouls,Libya

Habib Smida
Univ.Jeddah-Saudi Arabia

Mohamed Ali Chokri
Univ.Gabes-Tunisia

Ismail Brahmi
Univ.Tizi-Ouzou-Algeria

Lotfi Zeghadnia
Univ.Souk Ahras-Algeria

Benaniba Med Taher
Univ.Sétif-Algeria

Olfa Hajji
Univ.Jendouba-Tunisia

Fethi Baali
Univ.Tebessa-Algeria

Med Hamdi
Univ. Sherbrooke Canada

Younes Missaoui
Univ.Gafsa-Tunisia

Mohsen Ben Alaya
Univ.Tunis-Tunisia

Imed Gargouri
Univ.Sfax-Tunisia

Ramzi Azizi
Univ.Bizerte-Tunisia

Moncef Khadraoui
Univ.Sfax-Tunisia

Med Sid
Univ. Khemis Meliana-Algeria

Najet Mokni
Health ministry-Tunisia

Salim Khechana
Univ.El Oued-Algeria

Sek Lakhder
Univ.El Oued-Algeria

Publications

Selected works presented at WREIANA2025 will be invited for submission to the following collaborating Springer journals for consideration in dedicated special issues, subject to peer review:

- Euro-Mediterranean Journal for Environmental Integration (Impact Factor: 2.1)
- Arabian Journal of Geosciences (Impact Factor: 1.3)
- Journal of Water Engineering and Environmental Sciences (newly launched)

In addition, high-quality papers will be encouraged to submit to:

- Water (Impact Factor: 3.5)

PREFACE

The North Africa countries are suffering from water scarcity, unsustainable management of water resources, vulnerability to climate change, pollution and lack of sanitation infrastructure and suitable treatment technologies. These problems are often worsened by lack of governance and supporting legislative tools. The progressive developments of all sectors and the present water policy in several countries of North Africa have resulted in the current water pollution, water scarcity, unsustainable management of water resources, lack of sanitation infrastructure and suitable treatment technologies. Increasing pressure on water resources in the region encompasses various challenges: Socio-economic challenges, ScientificEnvironmental, and technical, Governance challenges, Stability and Health challenges...

The organization of the International Symposium on Water Resources and Environmental Impact Assessment in North Africa « WREIANA » will create a forum for exchange and debate on the knowledge of water topics. This International Conference is an opportunity of dialogue between scientists, industries and experts to address challenges and to inspire actors in the field of water. It aims at expanding the exchange of experiences and research results and allowing to initiate regional cooperation initiatives, Gathering the experts from the North Africa countries together with scientists from other countries to discuss issues related to the climate impact on water resources to identify the most relevant pollutants and their potential hazardous effects on the environment and on human health..

WREIANA 2025, Chairmen
Prof. Younes Hamed
Prof. Rihab Hadji
Prof. Salem Bouri

CONFERENCE TOPICS

- **Topic 1:** Artificial intelligence application on water resources management.
- **Topic 2:** NEXUS Water-Food-Energy.
- **Topic 3:** Hydro-Geophysical exploration and hydrogeology modelling.
- **Topic 4:** Radioactivities contamination, anthropogenic activities and health risks.
- **Topic 5:** Transboundary Water Management and Hydro Diplomacy.
- **Topic 6:** Hydrogeology, Hydrology and risks impact.
- **Topic 7:** Innovative techniques in water treatment and water reclamation.
- **Topic 8:** Organic, inorganic, nanomaterials and their technological application for water resources management.
- **Topic 9:** Isotopes in water resources modelling and paleoclimate reconstruction.
- **Topic 10:** Biotechnology, food security, green chemistry and smart agriculture.
- **Topic 11:** Watering and dewatering.
- **Topic 12:** Remote sensing and GIS application in natural hazard.
- **Topic 13:** Phosphate and petroleum-natural gas resources and their environmental impact.
- **Topic 14:** Environmental and climate change impacts on water resources.
- **Topic 15:** Desertification, water, food and health security.
- **Topic 16:** Air, soil and water depollution.

KEYNOTE SPEAKERS

Prof. Dr. Sonia Hassini

McMaster University, Hamilton, Canada

Communication Title:

Adapting Urban Water Management to Climate Challenges: Insights from Probabilistic Models.

Prof. Dr. Ramla Gheith

University of Monastir Tunisia

Communication Title:

From heat transfer optimization to green hydrogen production: towards a circular energy economy.

Dr. Houda Hachem

Technology Centre of Energy, CRTE-Tunisia

Communication Title:

Drying Methods and Quality Preservation in Prickly Pear Fruits.

KEYNOTE SPEAKERS

Prof. Dr. Dr. Riheb Hadj

Univ. Setif-Algeria

Communication Title:

Integrating Geospatial Technologies and AI for Enhanced Natural Hazard Assessment in North Africa and the Mediterranean.

Dr. Djamel Eddine Abbas

Univ. Bejaia-Algeria

Communication Title:

Landslide Susceptibility Assessment in the Edough Massif Region: Utilizing Geospatial Platforms and the Weights of Evidence Method.

Dr. Dehni Abdellatif

Algerian Space Agency - ASAL-Algeria

Communication Title:

Development of optimized 3D trajectory wells tool based on geometric, mechanic, hydraulics, geophysics and hydrogeology parameters implication for water resource planning and exploration – NW of Algeria.

From heat transfer optimization to green hydrogen production: towards a circular energy economy

Ramla Gheith

University of Monastir – ENIM, LESTE

Abstract

The energy transition requires a deep reflection on how we produce, consume, and valorize energy. In the context of a circular economy, it is essential to consider every energy flow as a resource to be exploited, in order to reduce losses and limit the carbon footprint. The transport sector is a striking example: nearly 70% of the energy contained in fuels is lost as waste heat.

My research addresses this challenge by developing innovative solutions to recover waste heat in transportation systems. The focus is on micro-cogeneration systems based on external combustion engines, which can convert these thermal losses into useful mechanical and electrical energy, thereby significantly improving the overall efficiency of energy systems.

A particularly promising approach is to integrate these devices with green hydrogen production via electrolysis. Electricity recovered from waste heat can be used to produce hydrogen, a storable, versatile, and decarbonized energy carrier. This coupling creates a fruitful synergy between energy efficiency, renewable storage, and circular economy principles, contributing simultaneously to emission reduction and energy supply resilience.

Keywords: *Energy, circular economy, green hydrogen production*

An eco-responsible approach to mercury removal: adsorption on activated carbon derived from olive pomace

Imad Alouiz, Mouhssine Benhadj, Dahmane Elmontassir, Mohamed Sennoune, Mohamed Yassine Amarouch, Driss Mazouzi*

*R.N.E Laboratory, Multidisciplinary Faculty of Taza, University Sidi Mohamed Ben Abdellah, Fez, Morocco. *Correspondence to: dris.mazouzi@usmba.ac.ma.*

Abstract

Mercury contamination of aquatic environments is a significant environmental issue due to its high toxicity, bioaccumulation in the food chain, and adverse effects on human health and ecosystems. Faced with this threat, the development of effective, sustainable, and economical pollution control solutions has become a priority. In this context, this work proposes the valorization of olive pomace, an abundant agro-industrial byproduct, for the manufacture of activated carbon for the adsorption of mercury from aqueous solutions. The material was prepared by chemical activation with H_3PO_4, followed by controlled pyrolysis, and characterized by SEM, EDS, HR-TEM, FTIR, and TGA. The resulting adsorbent was evaluated for its efficiency in removing Hg^{2+}, studying the influence of operating parameters such as pH, contact time, adsorbent dose, and temperature. A maximum removal efficiency of 99% was achieved at pH = 6, with a dose of 7.5 g/L and a contact time of 2h. The experimental data follow pseudo-second-order kinetics (R^2 = 0.998), suggesting chemisorption, while the isothermal fit is better with the Freundlich model, indicating heterogeneous adsorption. Based on the Langmuir model, the maximum adsorption capacity was estimated at 40.65 mg/g. Thermodynamic parameters confirm an endothermic and spontaneous process. A comparison with a commercial activated carbon was carried out under the same experimental conditions. The results showed that the prepared activated carbon had a comparable and competitive mercury removal capacity, confirming its high performance. The results obtained demonstrate that activated carbon derived from olive pomace is an ecologically relevant and economically viable solution for decontaminating mercury-contaminated water, thereby contributing to the sustainable management of organic waste and environmental protection.

Keywords: *Olive pomace, activated carbon, mercury, removal, adsorption mechanism*

Assessment and prediction of irrigation groundwater suitability in northern Gabès aquifer system

Amna Bouri[1,2]*, Fatma Ben Brahim[3,4], Zied Haj-Amor[3], Adel Kharroubi[1,2] and Salem Bouri[3,5]

[1] *Higher Institute of Water Sciences and Techniques, University of Gabès, Tunisia.*

[2] *Applied Hydro-sciences Laboratory research, Campus universitaire, 6072 Zrig ,Gabès , Tunisia, Email: adel.kharroubi@yahoo.com*

[3] *Water, Energy, and Environment Laboratory, National Engineering School of Sfax, 3038 Sfax, Tunisia, Email: ziedhadj@yahoo.com*

[4] *Department of Earth Sciences, Faculty of Sciences of Gabès, University of Gabès, Tunisia, Email: bfatma27@yahoo.fr, ORCiD: https://orcid.org/0000-0002-6022-6840*

[5] *Department of Earth Sciences, Faculty of Sciences of Sfax, University of Sfax, Tunisia, Email: salem_bouri@yahoo.fr, ORCiD: https://orcid.org/0000-0003-3994-6859*

**Corresponding Author: Amna Bouri (e-mail: bouri.emna@gmail.com)*

Abstract

Maintaining groundwater quality for irrigation is crucial, yet financial constraints in agricultural nations often limit sampling frequency, hindering accurate assessments. This study evaluates the irrigation water quality index (IWQI) in Northern Gabès Aquifer, Tunisia, using standard methods and machine learning models. Hydrochemical and geospatial analyses determined groundwater suitability for irrigation. Machine learning models, including Extreme Gradient Boosting (EGB), Support Vector Machines (SVM), and Resource Description Framework (RDF), were employed to predict IWQI for 42 groundwater samples. Standard methods showed varying suitability, with SVM demonstrating superior predictive accuracy ($R^2 > 0.99$). These findings underscore the importance of machine learning for effective groundwater management and advocate for sustainable water practices, including improved irrigation and alternative water resources. Future work should integrate real-time monitoring and advanced technologies to enhance groundwater quality assessment.

Keywords: *Groundwater; Irrigation; Machine Learning Models; Northern Gabès Aquifer; Water Quality Index*

.

Potential of Dam Sediment Valorization in Cement Production

Amel TALIA[1*], Imene BENSTAALI[1], Laouni BENADELA[1], Belkacem Samir BEKKOUSSA[1]

[1]*Sciences and Techniques Water Laboratory (LSTE). Mustapha Stambouli University of Mascara. BP. 305 Algeria.*

**Corresponding author:* a.talia@univ-mascara.dz

Abstract

This study investigates the potential of using dam sediments as alternative raw materials in cement production. It aims to address sediment management challenges while promoting sustainable construction practices. The research evaluates the technical feasibility and environmental implications of incorporating sediments from three Algerian dams—Ouizert, Bouhanifia, and Chorfa—into cement formulations, contributing to global efforts in circular economy and resource efficiency.

A comprehensive characterization of the sediments was conducted using X-ray fluorescence (XRF) for elemental composition and X-ray diffraction (XRD) for mineralogical analysis. The sediments were incorporated into CEM I 52.5 cement mortars at substitution rates of 5%, 10%, and 25%. The resulting formulations were evaluated based on consistency, setting time, expansion, Blaine fineness, and compressive strength. A comparative analysis with international studies on sediment-based cement formulations was performed to assess the competitiveness of the results.

The findings indicate that sediment composition significantly influences cement performance. Ouizert sediments, with high sulfate (1.03%) and sodium oxide (0.45%) content, pose potential durability risks but achieve the highest compressive strength (55.1 MPa at 5% incorporation). Chorfa sediments, rich in silica (22.71%) and calcite (35.63%), enhance hydration and durability, making them the most promising candidate. Bouhanifia sediments, with a high silt content (38.49%), prolong setting time, requiring formulation adjustments. Importantly, all sediments are free from hazardous heavy metals, ensuring environmental safety.

This study demonstrates the viability of dam sediment valorization in the cement industry. The competitive performance of these Algerian sediments highlights their potential as sustainable alternatives to traditional raw materials. The findings support sediment reuse as a practical strategy for resource conservation and sediment management on a broader scale.

Keywords: *cement production, sediment reuse, environmental sustainability.*

Characterization and recovery of process and utility water discharges

Rabeb Lassoued[1,2]*, Amel Abdi[1,3] and Brahmi Wejden[3]

[1]*Higher Institute of Technological Studies of Zaghouan.*

[2]*Laboratory of Materials Molecules and Applications, IPEST, BP 51, 2070 La Marsa, Tunisia*

[3]*The Sidi Bouzid Dairy Plant*

**Correspondence to: lassouedrabeb@yahoo.fr.*

Abstract

This study was conducted at the Sidi Bouzid Dairy Plant to characterize and enhance industrial water discharges from utilities and processes. The analyses involved various discharge points, including discharge water from electrical cabinets (aseptic tanks), engines, and discharges from sand filters, softeners, and reverse osmosis units. The physicochemical results showed that reverse osmosis units high concentrations of dissolved salts, characteristic of the concentrate. However, microbiological non-conformities. Two solutions were proposed: the first aim store cover the cooling water in a buffer tank to reinject it in to the closed circuit of the cooling tower after thermal regulation; these cond involves installing a new reverse osmosis unit to treat the concentrate from existing osmosis units, thus allowing recovery. These solutions are part of an approach to reducing discharges, optimizing water consumption and strengthening the environmental performance of the industrial unit.

Keywords: *water, characterization, physicochemical microbiological*

Assessment of Soil Infiltration in the Oued Fekan Watershed (Algeria) Using Experimental Measurements and Modeling Approaches

Imène BENSTAALI[a]*, Amel TALIA[a] , Malika ABBES[b] , Laouni BENADELA[a] , Belkacem BEKKOUSSA[a] .

a University of Mascara, Laboratory of Water Science and Technology (LSTE), Algeria

b Hydrometeorological Institute for Training and Research (IHFR), Oran, Algeria E-mail: ibenstaali@yahoo.fr

Abstract

Soil infiltration is a fundamental process in the hydrological cycle, directly influencing groundwater recharge, surface runoff, and flood hazards. This study evaluates the infiltration capacity of soils in the semi-arid Oued Fekan watershed, located in northwestern Algeria, by combining field-based experiments with infiltration modeling approaches. Infiltration tests were conducted at representative sites covering the main soil types and land use categories within the watershed. The data collected allowed the estimation of infiltration rates and the classification of soil permeability. In parallel, empirical models, namely Horton's and Philip's equations, were applied and calibrated with the field measurements to simulate infiltration behavior under varying conditions. The results indicate considerable spatial variability in infiltration rates, primarily controlled by soil texture, vegetation cover, and anthropogenic activities. In several agricultural areas, infiltration was significantly reduced due to compaction and surface crusting, leading to increased runoff and erosion potential. The comparison between observed and modeled data confirms that empirical models can reliably represent field conditions, provided that proper local calibration is performed. This work offers critical insights into the hydrological functioning of semi-arid basins. It emphasizes the importance of integrated experimental–modeling approaches for supporting sustainable water management and flood risk reduction strategies at the watershed scale.

Keywords: *Soil infiltration, Watershed modeling, Experimental measurements, Semi-arid region, Flood risk*

Tracking Long-Term Changes in Land Use and Land Cover using Landsat Time-Series in Gafsa Basin, Southern Tunisia

Hadhami MCHICH*[1], Bouajila ESSIFI[1], Virginia ELENA GARCIA MILLAN[2], Elisabeth CARPINTERO GARCÍA[3] and Mohamed OUESSAR[1]

** Higher Institute of Water Sciences and Technologies, University of Gabes, Zrig 6072, Gabes, Tunisia*

1 Laboratory of Eremology and Desertification Combating, Institut Des RégionsArides, E Fje 4119, Medenine, Tunisia

2 Khaos Research Group, Edificio de Investigación Ada Byron, Arquitecto Francisco Peñalosa, 18, Campanillas, 29010 – Málaga, Spain

3 Laboratory for Research Methods in Quantitative Remote Sensing (QuantaLab, IAS-CSIC), Instituto de Agricultura Sostenible (IAS) Consejo Superior de InvestigacionesCientíficas (CSIC) Alameda del Obispo, 14004 – Córdoba, Spain *mchich.hadhami94@gmail.com

Abstract

Desertification is a challenging and multi-factorial process that causes a variety of socio-environmental changes in drylands, such as loss of vegetation cover, increased soil erosion, disruption of hydrological cycles and changes in plant ecosystems, which can lead to permanent environmental degradation. Soil deterioration and desertification are greatly dependent on land use and land cover (LULC); unsustainable farming methods and urbanization increase them. We explored the arid Gafsa basin in southwestern Tunisia to better understand the long-term (1984–2024) drivers of LULC changes. Google Earth Engine (GEE) was employed to calculate vegetation indices (NDVI, EVI and SAVI) and to map LULC using Landsat imagery and the Random Forest (RF) classifier. Later, a change detection analysis was performed across 40 years, by evaluating the changes between the land cover maps generated from the RF classification. Collect Earth Online (CEO) was used to evaluate the accuracy of our environmental assessment by performing a detailed visual interpretation of our results against high-resolution satellite images. The integration of Earth observation data and Machine learning techniques improves monitoring, analysis, and decision-making over natural resources and land management. Our observations show that the percentage of bare soil increased from about 7% to 14% in the Gafsa basin between 2001 and 2024, accompanied by a significant decrease of vegetative cover, which leads to greater vulnerability to water runoff and soil erosion. In the same period, the percentage of cropland area dropped from 18% to about 11%, which reduced agricultural production (and therefore, it compromises food security) and contributes to land degradation. The integration of CEO with remote sensing and GIS technologies reveals several important insights about the capabilities and benefits of using this platform for land monitoring and environmental assessment.

Keywords: *Land Use Land Cover, Remote sensing, GEE, Vegetation indices, Tunisia.*

The Impact of Climate Change on Water Security in North Africa: Environmental Challenges and Sustainable Governance Prospects

Manel Sakhri[1]

Lecturer at the Faculty of Law and Political Science ,University of Blida2- Algeria-

**masakhri@yahoo.fr.*

Abstract

North Africa is increasingly vulnerable to the adverse impacts of climate change, particularly on its already scarce water resources. This region, situated within the arid and semi-arid climate belt, is experiencing rising temperatures, declining precipitation, and more frequent droughts. These climate shifts are exacerbating water stress, affecting surface and groundwater availability, and threatening agricultural productivity and food security.

This study provides a regional analysis of the environmental challenges associated with climate-induced water scarcity in North Africa. It adopts a qualitative, analytical approach using recent regional reports, climate scenarios, and national policy reviews from countries such as Algeria, Morocco, Tunisia, Egypt, and Libya. The paper identifies key vulnerabilities in water governance frameworks and explores the gap between existing institutional capacities and the increasing climate risks.

Findings highlight that most North African countries lack integrated and adaptive water resource management systems. However, emerging national strategies—such as Algeria's efforts in mobilizing non-conventional water resources—reflect initial steps toward sustainable adaptation. The paper concludes by emphasizing the importance of regional cooperation, climate-resilient infrastructure, and inclusive water governance as critical pillars for strengthening water security in a changing climate.

Keywords *: Climate Change, Water Security, North Africa, Environmental Governance, Adaptation*

Contamination Géogénique des Eaux de la Zone Minière de Kherraza, Annaba (Nord-Est de l'Algérie)

Janet Bouguebrine[1*], Ibtissem Chouaf[2], Habiba Major[3], Badra Attoui[4]

[1,2,3,4]*Laboratoire Géodynamique et Ressources Naturelles (LGRN), Faculté des Sciences de la Terre, Université Badji Mokhtar Annaba B.P.12, Annaba. 23000, Algérie.*

*janette.bouguebrine@univ-annaba.dz

badra.attoui@univ-annaba.dz

habiba.major@univ-annaba.dz

[2] *Institut d'Architecture et des Sciences de la Terre, Département de Géologie, Université Farhet Abbas Sétif, Algérie.*

Ibtissem.chouaf@univ-setif.dz

Résumé

La zone d'étude se situe dans un bassin versant secondaire, délimité au sud par le massif de Kherraza, dans la région d'Annaba, au nord-est de l'Algérie. Ce bassin est caractérisé par une lithologie cristallophyllienne dominée par des gneiss, traversés par des formations basiques (amphibolites/pyroxénites) et carbonatées (cipolins magnésiens et skarns). Il abrite des eaux de surface, des sources permanentes ainsi que des eaux souterraines exploitées par plusieurs puits.

Les analyses géochimiques des faciès lithologiques et des eaux ont permis d'identifier l'origine des fortes concentrations en certains éléments chimiques (Mg, Fe, Al, etc.). Si le fer provient principalement d'une contamination anthropique due aux rejets miniers et aux haldes riches en oxydes de fer, les autres éléments en excès sont d'origine géogénique. Les eaux souterraines sont majoritairement bicarbonatées-sulfatées-chlorurées calciques et fortement magnésiennes, sans cation ou anion dominant, à l'exception d'un échantillon. Elles sont enrichies en Mg (lessivage des amphiboles et biotite), Ca (dissolution des carbonates des skarns), ainsi qu'en Na et K (lessivage des feldspaths, micas et minéraux argileux). En revanche, les eaux de surface, de type bicarbonaté-chloruré-sulfaté calcique et faiblement magnésien, sont plus riches en Al (lessivage des sols argileux) et en Fe (provenant des haldes).

L'étude de la stabilité des phases minérales montre que les eaux évoluent dans le domaine de la kaolinite (Kln), avec une sursaturation par rapport au quartz et une sous-saturation vis-à-vis de la silice amorphe. Les eaux souterraines sont proches du domaine de stabilité de la montmorillonite magnésienne (Mnt-Mg), ce qui témoigne d'une forte altération des roches et de la formation de minéraux argileux. Comparées aux eaux naturelles non polluées, les eaux étudiées sont considérées comme contaminées, avec une origine à la fois géogénique et anthropique.

Mots clés : *Qualités Eaux, Kherraza, pollution, géogénique*.

Predicting heavy metal adsorption from water using machine learning algorithms

S. Lamsiah[1], M. Benhadj[1], I. Alouiz[1], M. Bouhadda[1], M. Y. Amarouch[1], D. Mazouzi[1] and M. Sennoune[1*]

[1]R.N.E Laboratory, Polydisciplinary Faculty of Taza, University Sidi Mohamed Ben Abdellah, B.P 1223 TazaGareTaza, Morocco

**Corresponding author: mohamed.sennoune@usmba.ac.ma*

Abstract

Heavy metal contamination in water is a serious environmental concern due to its toxicity, persistence, and bioaccumulation potential in living organisms. Among the various treatment techniques, adsorption using activated carbon remains one of the most effective and economical methods for removing metal ions such as Cu(II), Zn(II), Ni(II), Pb(II), Cd(II), Cr(VI), and As(V). Optimizing this process through conventional experimentation, however, is often time-consuming and resource-intensive. In this study, a predictive framework based on machine learning was developed to estimate the amount of metal adsorbed (Qe, in mg/g). A large dataset comprising 1,480 experimental records was assembled, incorporating key adsorbent textural parameters (BET surface area, pore diameter, pore volume), operational variables (pH, temperature, initial concentration, dosage, contact time), and intrinsic ionic properties (ionic radius, hydrated radius, electronegativity). Five supervised learning algorithms were implemented and evaluated: Decision Tree, Random Forest, Extra Trees, Gradient Boosting, and XGBoost. Among them, Gradient Boosting exhibited the highest predictive performance (MSE = 1.12, RMSE = 1.05, R^2 = 0.981), followed closely by XGBoost (MSE = 1.64, RMSE = 1.28, R^2 = 0.965). The results highlight the significant potential of machine learning approaches in accurately simulating adsorption behavior, offering a valuable alternative to labor-intensive experimentation and contributing to the design of more efficient water treatment systems.

Keywords: *Adsorption, Heavy metals, Machine learning, Water treatment, Predictive modeling*

Magnetic $TiO_2/Co_{0.6}Cu_{0.25}Zn_{0.15}Fe_2O_4$ Heterostructure for Photocatalytic Removal of Paracetamol under Sunlight

Rostom Lakhdar[1],· Nahla Dhen[1] and Kais Elghniji[1]

[1]*Laboratory of Materials applications in Environment, water and Energy LAMEEE (LAM3E), Faculty of Sciences of Gafsa, University of Gafsa, Gafsa, Tunisia*

Abstract

This study presents the synthesis of a magnetic $TiO_2/Co_{0.6}Cu_{0.25}Zn_{0.15}Fe_2O_4$heterostructure aimed at efficiently degrading paracetamol in water under natural sunlight. Magnetic ferrite nanoparticles were synthesized by co-precipitation using CTAB as a surfactant and incorporated into a titanium precursor solution. Subsequent calcination crystallized the $TiO_2$and facilitated the integration of magnetic nanoparticles on its surface. X-ray diffraction and Raman analyses confirmed the formation of $TiO_2$and spinel ferrite phases without impurities. UV-Vis absorption spectra revealed a redshift compared to pure TiO_2, indicating enhanced visible-light response. Photocatalytic experiments showed 94.2% degradation of paracetamol after 150 minutes, outperforming commercial Degussa P25 and pure TiO_2. The enhanced activity results from improved charge separation at the heterojunction, reducing electron-hole recombination. Additionally, the catalyst demonstrated excellent stability and recyclability over five cycles. The magnetic properties enable easy recovery of the catalyst, making this heterostructure a promising candidate for sustainable water treatment targeting pharmaceutical contaminants.

Keywords : *Heterostructure, Heterojunction, TiO_2 ,$TiO_2/Co_{0.6}Cu_{0.25}Zn_{0.15}Fe_2O_4$*

Integrating Remote Sensing and Machine Learning for Water Stress Monitoring in Arid Ecosystems: A Case Study Using Random Forest and LSTM Models in North Africa

Moemen Gaiji[1]

[1]*Eötvös Loránd University, Institute of Cartography and Geoinformatics, Hungary*

*moe96men@gmail.com

Abstract

Accurate and timely assessment of soil moisture and vegetation water stress is essential for sustainable water resource management, especially in arid and semi-arid regions. This study presents a comprehensive approach combining remote sensing data with machine learning techniques to model and predict water stress dynamics in a representative dryland environment from 2016 to 2022 in North Africa.

A Random Forest classifier was trained on geospatial inputs including NDVI, rainfall, evapotranspiration, and soil moisture data, achieving a macro F1-score of 0.98 and Cohen's Kappa of 0.97 after data resampling with SMOTE. Classification performance was improved significantly by recalibrating the model using balanced class distributions, enhancing detection of vegetation stress patterns that were previously underrepresented.

To explore temporal prediction capabilities, a Long Short-Term Memory (LSTM) network was developed using monthly time-series data of environmental parameters. The LSTM model showed strong potential for short-term prediction of soil moisture levels, complementing spatial classification with temporal forecasting.

The integration of advanced remote sensing products, ensemble learning, and deep learning models offers a robust, scalable framework for monitoring water stress. This hybrid methodology supports data-driven decision-making for agricultural planning and climate resilience in water-scarce regions.

Keywords: *Water Stress, Remote Sensing, Random Forest Classification, LSTM Time-Series Forecasting, North Africa.*

Enhancement of Mechanical and Antibacterial Properties of Polymer Inclusion Membrane: Application for Nickel Extraction from Acidic Effluents.

Sana Ncib[a,b], Kemla Othman[a,b], Hayet Mahmoud[a,b], Afef Barhoumi[a], Lasaad Dammak[b], Elimame Elaloui[a], Wided Bouguerra[a]

[a] *L. R. Laboratory of Application of Materials to the Environment, Water and Energy (LR 21ES15), Department of Chemistry, Faculty of Sciences of Gafsa, Sidi Ahmed Zarroug University Campus - 2112 Gafsa, Tunisia, wided.bouguerra@fsgf.ugaf.tn*

[b] *Institute of Chemistry and Materials Paris-Est (ICMPE), UMR 7182 CNRS - Paris-Est Creteil University, 2 Rue Henri Dunant, 94320 Thiais, France, dammak@u-pec.fr*

Abstract

This study presents the development of a polymer inclusion membrane (PIM) composed of cellulose triacetate (CTA) and di-2-(ethylhexyl) phosphoric acid (D2EHPA) with the incorporation of acetylated kraft lignin (AKL) to improve mechanical stability and antibacterial properties. The membrane was thoroughly characterized using various techniques including Fourier-transform infrared spectroscopy (FTIR) and scanning electron microscopy (SEM), to get insights on the composition and morphology. Mechanical testing confirmed that the optimal application of 15% wt. AKL improved the mechanical properties of the membrane. AKL exhibited strong antibacterial activity against Pseudomonas aeruginosa, Klebsiella pneumoniae, and Escherichia coli after 24 hours, enhancing the antifouling property of the membrane. The suitability of the new PIM was evaluated by nickel ion transport studies under acidic conditions. Although the AKL addition did not improve the initial flux, it significantly improved membrane stability under acidic conditions.

Keywords *: Polymer membranes; D2EHPA; Lignin; antibacterial activity; nickel extraction.*

Assessment Of Relative-Active Tectonics In Cheria Basin (NE Algeria) – Observations From The Morphometric Indices and Hydrographic Features Obtained By The Digital Elevation Model

Hassan Taib [1,2]*, Khaoula BEDRI [3], Chams Abid[4].

1-Department of Geological Sciences, Faculty of Earth Sciences, Geography and Regional Planning, Univer-sité Frères Mentouri - Constantine 1 BP, 325 Route d'Ain El Bey, Constantine, Algeria, email: hacentaib68@gmail.com.

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment. Algeria.

3-Mining Engineering Laboratory, National Polytechnic School of Algiers, email: Khaoula.bedri@g.enp.edu.dz

4-Faculty of Earth Sciences and Architecture, Larbi Ben M'hidi University, Oum El Bouaghi 4000, Algeria email: abid.chams98@gmail.com

** Correspondence to Hassan Taib* email: hacentaib68@gmail.com*

Abstract

The Tell Atlas of Algeria is characterized by a complex neotectonic framework that includes reverse, normal, and lateral strike-slip faults. The landscape of the Neogene basin in Cheria was constantly impacted by the effects of erosion and tectonic activities. Neotectonics have greatly influenced the stream network's geometry and the topography of the basin. Morphometric analysis of five sixth order drainage basins along the Cheria Basin has been carried out for evaluating relative tectonic activity of the region. Based on the combination of various geomorphic indices namely, the basin-shape index (Bs), stream-length gradient (SL), hypsometric integral (HI), mountain front sinuosity (Smf), basin asymmetry factor (AF),and transverse topographic symmetry factor (T) were estimated to reach an average index of relative tectonics (Iat), indicating the intensity classes of tectonic activity namely, very high (VH), high (H), moderate (M), and low (L). The study highlighted the importance of studying morphotectonic features, which can help us gain a better comprehension of neotectonic activities within North Africa..

Keywords: *Tell Atlas, Neotectonic, Cheria Basin, IAT.*

Comparative Performance of Non-Activated and Chemically Activated Posidonia oceanica-Based Carbons for Congo Red Removal

Samia Ahmadi[1]*, Najah Mahjoubi[1], Nawel Tlili[1-2], Elimame Elaloui[1]

[1] *Laboratory for the Application of Materials to the Environment, Water, and Energy (LAM3E), Faculty of Sciences of Gafsa, University of Gafsa, Gafsa 2112, Tunisia.*

[2]*National Engineering School of Gafsa, University of Gafsa, University Campus, Sidi Ahmed Zarroug, 2112, Gafsa, Tunisia.*

**Correspondence to: samia.ahmadi@univ-poitiers.fr*

Abstract

The presence of synthetic dyes such as Congo Red (CR) in aquatic ecosystems demands efficient, sustainable remediation strategies. This study investigates the adsorption performance of three carbon materials derived from Posidonia oceanica: non-activated carbon, KOH-activated carbon (CA-KOH), and ZnCl2-activated carbon (CA-ZnCl2), all carbonized at 700 °C. By comparing these materials, the research aims to unveil the most effective and sustainable solution for CR removal from aqueous solutions.

Comprehensive characterization of the carbons included BET surface area analysis and pHpzc determination. Batch adsorption experiments assessed the influence of pH, contact time, adsorbent dosage, and initial dye concentration on removal efficiency. Remarkably, the non-activated carbon exhibited the highest adsorption capacity (29.67 mg/g), surpassing CA-KOH (25.12 mg/g) and CA-ZnCl2 (20.20 mg/g). Adsorption equilibrium adhered to the Langmuir isotherm, indicating monolayer adsorption, while kinetics aligned with the pseudo-second-order model.

This study highlights the effectiveness of non-activated Posidonia oceanica carbon as a simple and sustainable adsorbent for dye removal.

Keywords: *Activated/ non-activated carbon, Congo Red, adsorption, Posidonia oceanica, sustainable dye removal*

Raw Posidonia Oceanica Carbon As An Innovative And Sustainable Adsorbent For Congo Red Dye Removal

Samia Ahmadi[1]*; Najah Mahjoubi[1]; Nawel Tlili[1-2]; Elimame Elaloui[1]

[1] *Laboratory for the Application of Materials to the Environment, Water, and Energy (LAM3E), Faculty of Sciences of Gafsa, University of Gafsa, Gafsa 2112, Tunisia.*

[2]*National Engineering School of Gafsa, University of Gafsa, University Campus, Sidi Ahmed Zarroug, 2112, Gafsa, Tunisia.*

**Correspondence to: samia.ahmadi@univ-poitiers.fr*

Abstract

The release of synthetic dyes into wastewater presents a major environmental challenge, with Congo Red (CR) being among the most resilient and toxic contaminants. This study evaluates the adsorption capabilities of a raw, non-activated carbon derived from Posidonia oceanica, carbonized at 700 °C, as a low-cost, eco-friendly alternative to conventional activated carbons. By eliminating the chemical activation process, this material offers a sustainable and accessible solution for wastewater treatment.

The carbon's physicochemical properties were analyzed using BET surface area measurements and pHpzc determination. Adsorption experiments investigated key parameters, including pH, contact time, adsorbent dosage, and initial dye concentration. Findings revealed optimal CR removal at pH 4, achieving an exceptional adsorption capacity of 29.67 mg/g. The Langmuir isotherm model confirmed monolayer adsorption, while kinetics were best described by the pseudo-second-order model, emphasizing the material's efficiency.

This study demonstrates that non-activated Posidonia oceanica carbon is a promising, sustainable adsorbent for anionic dye removal.

Keywords: *Non-activated carbon, Posidonia oceanica, adsorption, Congo Red, sustainable wastewater treatment.*

Contamination of water resources and health risks of the neighboring population

MAJOUR Habiba, BOUGUEBRINE Janet and ATTOUI Badra.

Laboratoire de Géologie. Université d'Annaba, BP 12, 23000 Annaba, Algérie.

Mail :habiba.majour@univ-annaba.dz

Abstract

The region of Berrahal has shown in recent years, a population expansion and a large economic boom related to the significant development of agricultural and industrial activities. It is considered as the largest industrial area in region of Annaba (121 ha). This zone is likely to contaminate groundwater that is highly exploited by the habitants for drinking water needs, industrial activities and irrigation of arable lands. In order to highlight the anthropogenic pollution of the Berrahal aquifer, we have determined the physico-chemical characteristics of groundwater and surface water (20 wells, 12 boreholes, and 7 releases).

The analytical results show that, water sampled from wells and boreholes in the vicinity of the industrial area, is contaminated. Indeed, the recorded high loads of dissolved salts (mostly chlorides), organic matter and metallic trace elements (Cu, Pb, Fe and Ni) show a potentially toxic contamination. The index of risk in the child and adult shows that the population adjacent to the southern industrial zone incurs a risk of poisoning, especially by the lead element.

Keywords: *Water resources – anthropogenic Pollution - Health risk – Berrahal - Algeria*

Evolution of Neotectonic Deformation in Southeastern Tunisia: Interpretations and Modeling.

Mohamed Sadok BENSALEM[1], Mohamed BEDCHICH[1], Soulef AMMARIA [1]

University of Gabes, Faculty of Sciences, Erriadh City, 6072 Gabes, Tunisia, Research Laboratory of Geosystems, Georessources and Geoenvironments.

Abstract

This study aims to studied the neotectonics activity of the Matmata region with a morphotectonic approach combined with the Geographic Information Systems (GIS). Based on digital elevation models (DEMs), geological maps, and hydrographic data, several geomorphometric indices were extracted: topographic index, drainage density, lineament density, slope, lithology, and seismic risk.

These parameters were weighted, and integrated into an IAT (Input–Action–Transformation) model to map tectonically active zones. The results reveal tectonic activity ranging from moderate to high, mainly influenced by the Médenine, Mareth, and Zarat faults, which control the evolution of the hydrographic network and the terrain morphology.

High drainage density, slope breaks, and observed hydrographic anomalies—such as abrupt changes in direction, sinuosity, or the disappearance of wadis—demonstrate the significant influence of tectonic structures. Furthermore, the landslide susceptibility map highlights unstable areas, mainly located on the slopes of the Matmata Mountains and along the wadis.

This multidisciplinary approach, combining geological, geomorphological, and seismic data, provides essential elements for the sustainable management of natural hazards in areas under strong tectonic stress.

Keywords: *Active tectonics, Geomorphometry, Geographic Information Systems (GIS), IAT models, Seismic hazards.*

Tectonic Evolution of the Northern and Southern Chotts Chains: Insights from Sedimentary, Seismic, and Gravimetric Data"

Soulef AMMARIA[1], Islem FARES [2], Mohamed Sadok BENSALEM[1]

University of Gabes, Faculty of Sciences, Erriadh City, 6072 Gabes, Tunisia, Research Laboratory of Geosystems, Georessources and Geoenvironments.

University of Tunis El Manar, 2092 El Manar, Tunisia.

Abstract

This work studies the tectonic evolution of northern and southern chotts chains focusing on sedimentary, structural, seismic and gravimetric data. Based on these data we interpret the thickness variations and faults rectivations contributing to propose the structural limit between southern and northern chotts chains. The study area is dominated by an extensional tectonic activity marked by E-W normal faults which have controlled the facies distribution and basin evolution. These faults controlled the subsidence in Fejij basin, including the role of titled blocks and graben structures in the Aptian-Albian. This tectonic activity marked by the conglomerates depositions that indicate the episodes of intense deformations that controlled by halokinesis of Triassic series.

Keywords: *chotts chains, Fejij basin, conglomerates depositions, halokinesis*

Evaluation of the Water Quality of Seybouse Wadi for Agricultural Irrigation: An Index-Based Approach

Hamza BOUGUERRA[1]*, Moncef BOUROUGA[1], Salah Eddine TACHI[1,2] and Mohamed GUETTAF[3]

[1]*Water Resources and Sustainable Development Laboratory, Department of Geology, Faculty of Earth Sciences, Badji Mokhtar—Annaba University, P.O. Box 12, Annaba, 23000, Algeria.*

[2]*Laboratoire de Recherche Science de l'Eau, Ecole National Polytechnique, 10 Rue des Frères OUDEK, El Harrach, Algiers,16200,Algeria.*

[3]*Laboratoire de Biologie, Eau et Environnement, Université 8 Mai 1945 Guelma, BP 401, Guelma, 24000, Algeria.*

* hamza.bouguerra@univ-annaba.dz

Abstract

The Guelma province possesses significant surface water resources, notably through Seybouse Wadi, one of the region's major watercourses. It drains the Middle Seybouse watershed, covering an area of 820 km². The Guelma plain is primarily dedicated to agriculture, although numerous agro-industrial activities have developed along both banks of the river. This plain includes a large irrigated perimeter, Guelma-Bouchegouf (13,000 ha), mainly supplied by releases from the Hammam Debagh dam. In recent decades, rapid population growth and the expansion of the agricultural and industrial sectors have led to increased pollution of Seybouse Wadi, primarily due to illegal discharges and uncontrolled waste dumping. This study aims to evaluate the suitability of Seybouse water for agricultural irrigation by analyzing various indicators, including sodium-related risks (SAR, %Na, RSC), magnesium hazard (MR), permeability index (PI), and Kelly's index (KI). Additionally, the Irrigation Water Quality Index (IWQI) method was applied. This approach, validated by several researchers, is based on five key parameters: electrical conductivity, sodium, bicarbonate, chloride concentrations, and the sodium adsorption ratio.

For this assessment, twenty-four water samples were collected from twelve stations along Seybouse Wadi during both dry and wet seasons. The results indicate that water from eight out of twelve stations is of good quality and can be used for irrigation without major environmental risks. However, the water quality at the remaining four stations is classified as moderate to poor, requiring particular caution for irrigation purposes. The deterioration in water quality at these stations is mainly attributed to untreated urban and industrial wastewater discharges, as well as leachate and solid waste runoff, especially during the rainy season. These findings highlight the urgent need for stricter management of anthropogenic discharges to preserve the quality of Seybouse Wadi water for sustainable agricultural use.

Keywords: *Quality, Irrigation, Pollution, Seybouse Wadi, IWQI.*

Electromembrane Extraction of Cadmium (II) Using a Polymer Inclusion Membrane

C. Jadlaoui [a] , S. NCIB[a], W. BOUGUERRA[a]

Laboratoire d'application Matériaux, Environnement et Energie (LAMEE) (UR 14 ES26), Département de chimie, Faculté des Sciences de Gafsa, Campus universitaire Sidi Ahmed Zarroug - 2112 Gafsa, Tunisie, bg_wided@yahoo.fr

Abstract

This work presents an in-depth investigation into the extraction behavior of cadmium (II) ions using electromembrane extraction (EME) based on a polymer inclusion membrane (PIM) system. The membrane was synthesized using cellulose acetate as the polymer matrix and methyltrioctylammonium chloride (Aliquat 336) as the ion carrier, chosen for its high selectivity toward heavy metal ions. A series of experiments were conducted at varying voltage levels to determine the optimal conditions for cadmium transport. The results demonstrated that the efficiency of cadmium(II) extraction is highly dependent on the applied potential, with the highest recovery rates achieved at a threshold voltage that maximizes ion mobility while maintaining membrane integrity. The data also confirmed that the dominant transport mechanism is based on ion exchange between cadmium(II) ions in the aqueous phase and chloride ions associated with Aliquat 336 within the membrane matrix. These findings offer deeper insight into the physicochemical interactions governing EME performance and highlight the importance of tuning electrical and membrane parameters for efficient metal recovery. This study underlines the potential of EME coupled with PIM technology as an effective and selective method for cadmium(II) removal from contaminated aqueous environments, with promising applications in wastewater treatment and industrial effluent remediation.

Keywords : *Electromembrane extraction (EME), Cadmium recovery, Polymer inclusion membrane, Wastewater treatment*

From Contamination to Remediation: A Comparative Study of Electromembrane and Conventional Extraction of Cadmium(II) as a Green Alternative

C. Jadlaoui[a] , S. NCIB[a], W. BOUGUERRA[a]

Laboratoire d'application Matériaux, Environnement et Energie (LAMEE) (UR 14 ES26), Département de chimie, Faculté des Sciences de Gafsa, Campus universitaire Sidi Ahmed Zarroug - 2112 Gafsa, Tunisie, bg_wided@yahoo.fr

Abstract:

This study presents a comparative investigation of two membrane-based techniques for the extraction of cadmium(II) ions from aqueous solutions: electromembrane extraction (EME) and conventional membrane extraction without the application of an electric field. Both methods utilized a polymer inclusion membrane (PIM) composed of cellulose acetate as the base polymer, Aliquat 336 as the ion carrier, and NPOE as the plasticizer, chosen for its high selectivity toward heavy metals. The extraction performances were evaluated in terms of efficiency, selectivity, and membrane stability. Results revealed that EME significantly enhances cadmium(II) transport due to the applied electric field, leading to faster and more efficient extraction. Conversely, the conventional method, although less efficient, demonstrated superior membrane stability. These findings emphasize the critical role of electrical parameter optimization in EME and highlight the advantages and limitations of each technique. Overall, the study supports the potential of EME-PIM systems as a selective and efficient approach for heavy metal removal in water treatment applications

Keywords: *Electromembrane extraction, Cadmium recovery, Polymer inclusion membrane, Environmental Remediation*

Integrated Assessment of Groundwater Quality for Irrigation in an Arid Context: Application of the IWQI Index and Artificial Intelligence Models to the Southern Gabès Aquifer (Tunisia)

Khyria Wederni [1,2], Boulbaba Haddaji[2], Younes Hamed [3], Salem Bouri [1,4]

1. Laboratory of Water, Energy and Environment, National School of Engineers of Sfax, University of Sfax, B.P. 1173, Sfax, 3083, Tunisia

2. Higher Institute of the Sciences and Techniques of Waters of Gabès (ISSTEG), University of Gabès, Gabès, Tunisia

3. Faculty of Sciences of Gafsa, University of Gafsa, Tunisia

4. Department of Earth Sciences, Faculty of Sciences of Sfax, Sfax, Tunisia

Khyria Wederni : khyriawederniii@gmail.com

Abstract

In the context of increasing pressure on water resources, especially in arid regions, assessing groundwater quality for irrigation is a strategic challenge for agricultural sustainability. This study proposes an innovative approach combining conventional hydrochemical analyses with artificial intelligence models to evaluate water quality in the Gabès South aquifer (Tunisia). The Irrigation Water Quality Index (IWQI), incorporating five critical parameters (EC, Na^+, HCO_3^-, Cl^-, SAR), was used to classify 83 water samples according to their suitability for irrigation. In addition, two supervised learning algorithms: Support Vector Machine (SVM) and Classification and Regression Tree (CART), were implemented to model and predict water quality. The results reveal a predominance of water classified as "satisfactory" (62 %), "unsatisfactory" (31%), "good" (6%) and "verry good" (1%) highlighting the aquifer's vulnerability to agricultural inputs and natural salinization processes. The CART model demonstrated outstanding predictive capability (R^2 = 0.99), significantly outperforming the SVM model (R^2 = 0.88). This study stands out for its integrated and reproducible approach at the intersection of hydrogeology and data science, offering a robust decision-making tool for the sustainable management of water resources in sensitive environments.

Keywords: *Water quality, Irrigation, Artificial Intelligence CART, SVM, Southern Gabès Aquifer, Sustainable Water Management*

Caractéristiques géoélectriques de sous-sols de Hammm Sokhna W. Setif Algérie

Samir Djenba[a], Sonia Adjroud[b] , Abdelhamid Khedidja[c]

[a] *université de Batna2 Algerie*

[b] *department of regional planning and geography, ictu, university of Batna2 Algeria*

[c] *département de géologie, université de Batna2 Algerie*

Resume

La région de Hammam Sokhna est renommée au niveau national pour ses sources hydrothermales à vocation thérapeutique. Actuellement, ces eaux sont captées par des forages peu profonds. Dans le but d'optimiser ces installations et de rationaliser leur productivité, des profils de prospection géophysique par sondages électriques verticaux ont été réalisés sur la plaine de Hammam Sukhna.

L'inversion des données a mis en évidence un empilement de faciès argileux, gréseux et de calcaires lacustres. Ces derniers constituent vraisemblablement le réservoir principal des eaux chaudes de la région.

Toutefois, un niveau inférieur très conducteur, situé sous les formations miopliocènes, empêche le passage du courant électrique vers des profondeurs plus importantes. Cette couche limite ainsi la possibilité de cartographier la structure géologique profonde responsable du phénomène géothermal.

Keywords : *prospection électrique vertical, hammam sokhna, mioplicène.*

Level of methoxylated polybrominated diphenyl ethers in seabream (Sparusaurata) from Bizerte Lagoon, Tunisia

Walid Ben Ameur[1]*and Ali Annabi[1]

[1] *Laboratory of Ecology and Environment (LR24ES17), Faculty of Sciences of Gabes, University of Gabes, Gabes, Tunisia*

**Correspondence to:* benameurwalid@gmail.com

Abstract

Aquatic pollution is a major driver of environmental change in marine ecosystems. Over the past few decades, increasing human activities have significantly contributed to rising pollution levels, posing a growing threat to marine biodiversity worldwide. Many contaminants have already been identified as hazardous to ecosystem health, and advancements in analytical techniques now allow for the detection of trace levels of emerging pollutants. Seafood is a key source of nutrition for human populations. However, in addition to essential nutrients, marine species can accumulate halogenated natural products, some of which exhibit toxic effects similar to those of industrial pollutants. Given the continuous increase in pollution, further research is essential to assess the presence and impact of both anthropogenic and naturally occurring compounds in marine organisms.

This study investigates the concentrations of naturally occurring brominated compounds, specifically methoxylated polybrominated diphenyl ethers (MeO-PBDEs), in sea bream (*Sparusaurata*) collected from the Bizerte Lagoon and the Mediterranean Sea. To the best of our knowledge, this is the first report of MeO-PBDEs in this fish species from Tunisia. Muscle samples were extracted using Accelerated Solvent Extraction and analyzed by gas chromatography-mass spectrometry in negative chemical ionization mode.

Total MeO-PBDE concentrations in sea bream from the Bizerte Lagoon ranged from 0.06 to 77.72 ng g^{-1} lipid weight (lw), whereas levels in the Mediterranean Sea were higher, between 0.05 and 206.65 ng g^{-1} lw. MeO-BDE-47 was the predominant congener detected in both study areas. Overall, the MeO-PBDE concentrations in sea bream from the Bizerte Lagoon were comparable to or slightly lower than those reported for other fish species worldwide.

These findings provide important baseline data on MeO-PBDE contamination in Tunisian marine ecosystems and emphasize the need for further research into their sources, distribution patterns, and potential ecological risks.

Keywords: *MeO-PBDEs, Fish, Sparusaurata, Bizerte Lagoon, Tunisia*

Towards Sustainable Agriculture: Valorization of Treated Wastewater and Risk Assessment

BOUROUGA Moncef[1*], BOUGUERRA Hamza[1], TACHI Salah Eddine[2], Rania SAIDI[1], Majda FOUGHALI[1]

[1] *Water Resources and Sustainable Development Laboratory, Badji Mokhtar - Annaba University P.O. Box 12, 23000, Algeria.*

[2] *Laboratoire de Recherche Science de l'Eau, Ecole National Polytechnique, 10 Rue des Frères OUDEK, 16200, Algiers, Algeria.*

** Email: moncef.bourouga@univ-annaba.dz*

Abstract

Water resource management in Algeria represents a major challenge for the country's economic development. The continuous increase in water demand, combined with the growing pressure exerted by economic and social activities, accentuates this problem. The agricultural sector, the main consumer of water, suffers from inefficient management, both at the level of farmers and the authorities responsible for distribution. In this context, the mobilization of alternative water resources, in particular the reuse of treated wastewater, appears to be a promising solution to ensure sustainable water management in agriculture.

This work aims to assess the feasibility of using treated wastewater for agricultural irrigation. More specifically, we examined the suitability of water treated by the Guelma treatment plant to be used for irrigation. The study is based on the analysis of risks related to sodium (SAR, %Na, RSC) and magnesium (MR) contents. In addition, we evaluated other parameters that determine the quality of irrigation water, including the permeability index (PI), the Kelly index (KI) and the recently developed irrigation water quality index (IWQI).

In order to analyze the impact of the reuse of treated water, we mixed the water treated by the Guelma WWTP (EE) with the raw water from the Hammam Debagh dam (EB), located upstream of the plant. Five combinations were studied: E01 (100% EB + 0% EE), E02 (0% EB + 100% EE), E03 (25% EB + 75% EE), E04 (50% EB + 50% EE), E05 (75% EB + 25% EE). The results found show that the treated wastewater, alone or mixed with the raw water from the dam, has a quality generally suitable for irrigation. The SAR, RSC, %Na, PI, KI and MR indices confirm a low usage constraint. The IWQI index indicates a moderate restriction for certain compositions, requiring the choice of salt-tolerant crops.

Keywords: *Sewage treatment plant, reuse, treated wastewater, agricultural irrigation, Guelma.*

Environmental Migration to Britain: From Climate Crisis to Cultural Displacement and Identity in Motion – The Case of Bangladeshi immigrants

Bassem Hidouri

(University of Gafsa, Tunisia)

Abstract

As global climate change continues to intensify, it is not only reshaping geographies but also reconfiguring human mobility and cultural identity. While climate-induced migration is increasingly addressed within policy, economic, and humanitarian frameworks, its cultural dimensions remain underexplored. This paper approaches environmental migration through a cultural studies lens, proposing that forced displacement due to environmental degradation is also a form of cultural displacement. The loss of home, land, and ecological familiarity disrupts not only livelihoods but also memory, identity, and belonging.

Drawing on interdisciplinary literature from migration studies, cultural theory, and environmental humanities, this paper examines how displaced communities negotiate cultural continuity in the face of climate disruption. Particular attention is given to populations migrating from North Africa—such as Tunisian migrants—who may be compelled to leave areas affected by desertification, water scarcity, or rural degradation. Once relocated, these migrants are not only adapting to new physical environments but also to cultural landscapes that often fail to acknowledge the specificities of environmental displacement.

This paper argues that understanding climate-induced migration as a cultural experience, one of dislocation, memory loss, and identity reconfiguration, can deepen and humanize ongoing debates about mobility and environmental justice. The study calls for the integration of cultural analysis into climate migration discourse and suggests that recognizing migrants' cultural attachments to place can inform more sensitive and holistic responses.

By foregrounding narratives of identity and loss, this paper contributes to an emerging interdisciplinary dialogue that sees environmental crisis not only as an ecological or economic emergency but also as a cultural one.

Key terms: *Climate change; mobility; identity; culure; immigration; migrants*

Etude spatiale de la qualité des eaux phréatiques à Oued M'Zab, Algérie

Hadjira BENHEDID[1]*, Mansour ACHOUR[2], Hadjer GUESSOUM[3], Hamza NEGAIS[4] et Mustapha DADDI BOUHOUN[5]

[1]*Univ. Ghardaia, Lab. Protection des Ecosystèmes en Zones arides et Semi-arides, Ghardaïa, Algérie*

[2] *Univ. Oran 2, Lab. Géo-ressources, Environnement & Risques Naturels, Oran, Algérie*

[3]*Univ. Ghardaia, Ghardaïa, Algérie*

[4]*Univ. Ghardaia, Lab. de recherche en phoeniciculture, Ghardaïa, Algérie*

[5]*Univ. Kasdi Merbah, Lab. Protection des Ecosystèmes en Zones arides et Semi-arides, Ouargla, Algérie*

**Correspondence to:* benhedid.hadjira@univ-ghardaia.edu.dz

Résumé

Ce travail de recherche porte sur la variation spatiale de la qualité des eaux phréatiques à Oued M'Zab. Notre méthodologie consiste à faire une caractérisation hydro-chimique des eaux phréatiques et à les classifier selon les normes de qualité. Les principaux résultats montrent que les eaux phréatiques sont claires, proches de la neutralité et fortement salines, augmentant d'amont en aval. Le faciès des eaux varie, présentant une dominance sulfatée équilibrée, calcique, magnésienne et sodique. La qualité médiocre des eaux pour l'irrigation pose des risques de salinisation et d'alcalinisation des sols. Notre recherche met en évidence la dégradation des ressources hydriques souterraines de la vallée du M'Zab. Nous recommandons une évaluation continue de la qualité de ces eaux, ainsi que des aménagements pour préserver la qualité des eaux souterraines contre toute pollution.

Mots clés *: Spatiale, qualité, hydro-chimique, Oued M'Zab, Algérie.*

Assessing Flash Flood hazard in the Wadi Mellègue Basin: A GIS-Based Morphometric Analysis

Arif Ismail[1-2-3], Soumaya Hadji[3], Younes Hamed [3]

1-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria.

2-Laboratory of geotechnical studies, Earth Scope Consulting

3-International Association of Water Resources in the Southern Mediterranean Basin. Tunisia

Abstract

Flash flooding is a prevalent natural disaster that leads to considerable property damage and loss of life, with its severity escalating in recent decades due to factors such as climate change, urbanization, and development in vulnerable areas. The Wadi Mellegue basin is particularly susceptible to these hazards. This research examines how the morphometric characteristics of drainage basins influence the occurrence of flash floods. Utilizing a Geographic Information System (GIS) approach, the study integrates various thematic layers, including stream order, length, bifurcation ratio, elongation ratio, texture ratio, circulatory ratio, stream frequency, drainage density, and other basin attributes such as length, width, area, perimeter, relief, slope, and form. Specific empirical equations are applied to calculate and delineate 14 morphometric parameters for each sub-watershed. An index is assigned to each sub-watershed to reflect the relevance of these parameters to flash flood risk. A linear overlay method is then used to create a detailed flash flood hazard map for the watershed, classifying it into five risk categories, from very low to high. This GIS-based methodology offers crucial insights into the spatial distribution of flash flood risks in the Mediterranean region, enhancing understanding of varying flood vulnerabilities across the watershed. The findings are essential for informing disaster management and mitigation efforts, ultimately contributing to improved strategies for addressing flash flood risks.

Keywords: *Flash flooding, Morphometric parameters, GIS, Wadi Mellegue, Disaster management*

L'Intelligence Artificielle au Service de l'Ingénierie Géotechnique: Vers des Infrastructures Résilientes

Lamri Dahoua

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University.

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria.

3-International Association of Water Resources in the Southern Mediterranean Basin. Tunisia

Résumé

L'intégration de l'intelligence artificielle, et de de l'apprentissage automatique, dans la géotechnique révolutionne le développement et l'entretien des infrastructures. Cette étude examine l'intersection entre l'analyse des données géotechniques et l'apprentissage automatique, montrant comment cette combinaison améliore la modélisation prédictive et l'évaluation des risques dans des contextes géotechniques. Les progress récents en matière de technologies de capteurs et de collecte de données ont conduit à l'accumulation de vastes ensembles de données géotechniques. Ces ensembles, remarquables par leur taille, leur diversité et leur rapidité, offrent une opportunité précieuse pour l'application de techniques d'apprentissage automatique. Les algorithmes, en particulierceux du deep learning, ont montré une capacité exceptionnelle à discerner des motifs et à faire des prédictions à partir de jeux de données complexes. Lorsqu'ils sont appliqués aux informations géotechniques, ces algorithmes peuvent considérablement améliorer la précision des prédictions concernant le comportement des sols, l'efficacité des fondations et les risques de Géorisques. Notre communication dévoile l'application réussie de modèles d'apprentissage automatique en ingénierie géotechnique. Parmi les exemples, on trouve l'utilisation de réseaux de neurones pour la classification des de sols, des réseaux de neurones récurrents pour évaluer le risque de glissement de terrain, et l'apprentissage par renforcement pour optimiser la conception de tunnels. Les résultats de ces recherches suggèrent que l'apprentissage automatique améliore non seulement l'efficacité et l'efficacité des évaluations géotechniques, mais conduit également à des pratiques d'ingénierie plus sûreset plus économiques. En tirant parti des capacités de l'IA, les ingénieurs géotechniques peuvent aborder des problèmes complexes avec une précision accrue, aboutissant à des systèmes d'infrastructure plus fiables et résilients.

Mots clés : *Intelligence artificielle, Apprentissage automatique, Ingénierie géotechnique, Modélisation predictive, Risques géotechniques.*

Modélisation 3D automatisée des surfaces de rupture et estimation des volumes de glissements de terrain par approche numérique

Khaber Larbi[1], -Hadji Riheb[1-2-3]

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University.

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria.

3-International Association of Water Resources in the SouthernMediterranean Basin. Tunisia

Résumé

Cette étude présente une approche pour estimer la surface de rupture et le volume des glissements de terrain en utilisant un modèle numérique de terrain. En supposant les valeurs tangentielles de la surface de rupture et en intégrant des profils verticaux transversaux, le modèle calcule la profondeur de la surface de rupture potentielle, qui est visualisée à l'aide d'une fonction de grille 2D. Le processus est convivial, permettant une visualisation aisée des résultats grâce à l'exécution de codes qui détaillent chaque étape.

La méthodologie évalue la profondeur de la surface de rupture à chaque point de la grille, estimant des sections transversales perpendiculaires à la pente entre les points d'altitude les plus élevés et les plus bas dans les contours définis. Une courbe spline cubique est générée en utilisant ces points et leurs premières dérivées. Les valeurs Z à chaque centre de grille sont calculées en fonction de ces paramètres, aboutissant à la création d'une surface de rupture 3D, facilitant ainsi les calculs de volume.

Le code MATLAB automatise l'ensemble de ce processus, permettant d'obtenir des résultats rapides avec un minimum de travail de terrain requis. De plus, le modèle peut être amélioré en intégrant des contraintes supplémentaires sur les angles des sections transversales basées sur des mesures de terrain. Cet outil prédictif est essentiel pour évaluer la zone affectée par la masse de la surface de rupture et établir des zones de danger prédéfinies afin de réduire les risques et les blessures futurs.

Mots-clés : Glissements; MNT; Surface de rupture 3D; MATLAB; risques géologiques

Landslide Susceptibility Assessment in the Edough Massif Region: Utilizing Geospatial Platforms and the Weights of Evidence Method

DjamelEddine Abbas[1-2], Riadh Boukarm[1-2], Mohamed Fredj[1-2], Abderrazak Saadoun[1-2], Hadji Riheb[3-4-5]

1-University of Bejaia, Faculty of Technology, Mining and Geology Department, Bejaia, Algeria

2-University of Bejaia, Faculty of Technology, Construction Engineering and Architecture Laboratory (LGCA), 06000 Bejaia, Algeria

3-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University, El Bez, Setif, 19000, Algeria ;

4-Laboratory of AppliedResearch in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, El Bez, Setif, 19000, Algeria;

5-International Association of Water Resources in the SouthernMediterranean Basin.

Abstract

The NE of Algeria, particularly the Edough massif, is significantly affected by landslides during the rainy season, posing challenges for local communities. Current research and data on landslide occurrences in this area remain insufficient. This study aims to (*i*) develop a multi-temporal landslide inventory map using geospatial platforms in a data-scarce environment; (*ii*) assess landslide susceptibility utilizing the Weights of Evidence (WoE) method within a GIS; and (*iii*) provide insights into recent advancements, existing gaps, and future research directions regarding landslide inventory, susceptibility mapping, and risk assessment in the context of the Tellian mountain chain. Ten causative factors were selected based on prior studies, including geology, geomorphology, soil type, slope angle, slope aspect, proximity to faults, distance from streams and roads, land use/cover, and altitude zones. The WoE method was employed to determine the weights for each factor, resulting in a detailed landslide susceptibility map categorized into five classes: very high, high, medium, low, and very low. Validation of the susceptibility map was conducted using ARCGIS 10.8 software, comparing the results against randomly selected landslide occurrences. Findings indicate that areas with medium to very high susceptibility are predominantly located in non-forest regions such as scrubland, pastureland, and barren land, particularly at higher altitudes. Additionally, susceptibility is heightened in regions with significant relief, shallow soils, and steep northwest-facing slopes near thrusts and faults. The WoE method demonstrated a prediction accuracy of 92.30%, underscoring the model's effectiveness. This landslide susceptibility map can serve as a vital tool for local decision-makers in mitigating landslide hazards, optimizing land use planning, and enhancing landscape protection efforts.

Keywords: *landslides susceptibility; landslide inventory; WoE; Google Earth; GIS-RS*

Integrating Geospatial Technologies and AI for Enhanced Natural Hazard Assessment in North Africa and the Mediterranean

Hadji Riheb

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University.

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria.International Association of Water Resources in the Southern Mediterranean Basin, Gafsa, Tunisia.

3-International Association of Water Resources in the SouthernMediterranean Basin.Tunisia

Abstract

Recent advancements in geospatial technologies, machine learning (ML), and artificial intelligence (AI) have significantly transformed Earth science research, offering innovative approaches to geological and environmental challenges. This study examines the influence of these technologies on natural hazards in North Africa and the Mediterranean basin, regions marked by intricate geoenvironmental conditions and susceptibility to diverse geological events.

GeoAI technologies facilitate the automation of data analysis and interpretation of satellite and airborne imagery, utilizing geospatial big data and cloud computing platforms like Google Cloud. These tools provide essential spatial data for analyzing and monitoring geological and environmental hazards. By employing Geographic Information Systems (GIS) and remote sensing (RS) techniques, researchers can effectively map hazard-prone areas, track changes over time, conduct dynamic monitoring, and create predictive models. Machine learning and AI enhance these capabilities by analyzing extensive datasets to identify patterns and correlations that may not be obvious. This synthesis reviews recent studies addressing landslides, flash floods, and seismic activities, achieving notable accuracy in hazard prediction and risk assessment. These models have proven vital in developing early warning systems and guiding disaster preparedness efforts.

A key finding is the necessity of interdisciplinary collaboration. By integrating geospatial data with geological, hydrological, and climatic information, we have established comprehensive hazard assessment frameworks. These frameworks deepen our understanding of underlying processes and support the design of targeted mitigation strategies. This work highlights applications of GIS and ML in assessing vulnerability to landslides in Algeria, Tunisia, and Italy, examining climate change impacts in the Mediterranean, and utilizing AI for predicting geological hazards. Challenges such as data validity and the need for local expertise are discussed, along with strategies to address these issues.

Keywords: *Geospatial Technologies; Machine Learning; Artificial Intelligence; Natural Hazards; Interdisciplinary Collaboration.*

Geophysical Techniques for Assessing Water and Geotechnical Parameters in Road Embankment Projects in Semi-Arid Regions: A Case Study from the Aures, Algeria

Serrai Mohcene[1-2]Kedidja Abdelhamid[3], Zighmi Karim[2-4], Farid Zahri[2]

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University, 19137, Setif, Algeria.

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria. zahrifarid@yahoo.fr

3-Department of Geology, Institute of Earth and Universe Sciences, Batna 2 University

4-International Association of Water Resources in the Southern Mediterranean Basin, Gafsa, Tunisia.

Abstract

This study investigates the complexities of water and geotechnical parameters impacting the technical feasibility of road embankment and urban development projects in semi-arid regions, specifically the Aurès in northeastern Algeria. Current monitoring of structural deformations relies primarily on visual inspections and localized measurements, which often prove inadequate for ensuring safety. There is a growing demand for rapid and precise investigation methods, such as geophysical techniques, which offer non-invasive, cost-effective, and efficient alternatives to traditional methods.

Three geophysical techniques—electrical resistivity tomography (ERT) and Ground Penetrating Radar (GPR)—were applied across various test sites featuring large embankments. The results from these techniques were calibrated against geotechnical investigations, highlighting their strengths and limitations in identifying specific embankment features. Key findings reveal that water presence significantly affects soil stability and compaction, critical factors for infrastructure durability. Seasonal variations in water availability further complicate soil behavior, presenting engineering challenges.

The study provides recommendations for improving infrastructure planning and sustainability in linear and urban projects, emphasizing the importance of integrating geophysical data with direct evidence for reliable interpretations. Ultimately, this research aims to enhance understanding of essential factors for infrastructure development in semi-arid regions, supporting informed decision-making in urban planning and engineering while mitigating risks for local communities.

Keywords: *Geophysical techniques; Geotechnical behavior, Embankments; Soil stability, Aures.*

Health Risks of Storing Drinking Water in Reused PET Bottles in North Africa

Difallah Besma[1] Hadji Ala[2]

1-International Association of Water Resources in the SouthernMediterranean Basin, Gafsa, Tunisia;

2-Department of Medicine, Faculty of Medicine, Ferhat Abbas University, Setif, Algeria.

Abstract

This study examines the health risks associated with storing drinking water in reused PET bottles, a common practice in North African countries like Algeria and Tunisia. Many individuals repurpose these bottles without adequate sanitation, leading to potential contamination. The research highlights the leaching of harmful substances, including formaldehyde, acetaldehyde, and antimony, which can migrate from the plastic into the water over time. Samples from reused PET bottles were tested for bacterial contamination and chemical leachates, revealing concerning levels of pathogens that pose significant health risks, including gastrointestinal infections and exposure to endocrine disruptors. The study also discusses the challenges in accurately assessing chemical safety, as improper testing methods can produce misleading results about the presence of toxins in bottled water. Findings indicate that inadequate cleaning and extended use of these bottles can exacerbate health hazards. Additionally, inconsistencies in existing toxicological studies on PET-bottled water highlight the need for standardized analytical methods and exposure assessments. This research emphasizes the importance of raising public awareness regarding the dangers of reusing PET bottles for water storage. It advocates for clear guidelines on effective cleaning practices and encourages the use of safer, reusable containers made from non-toxic materials. Ultimately, this investigation aims to inform public health initiatives and promote safer water storage practices to protect community health in the region.

Keywords : *PET Bottles; Water Contamination; Public Health; Chemical Leaching; Reuse Practices*

Assessment of Dust Pollution from Aggregate Quarry Operations in Southern Setif, Algeria

Maamri Roufaida[1-2] Zahri Farid[1-2-3]

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University, 19137, Setif, Algeria.

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria.

3-International Association of Water Resources in the Southern Mediterranean Basin, Gafsa, Tunisia.

Abstract

This study examines dust pollution resulting from aggregate quarry operations at the Jebel Gustar and Jebel Youcef sites in southern Setif, Algeria. Its primary aim is to evaluate the degree of dust emissions and their implications for both the environment and public health. Using the AFNOR NF X 43-007 standards, dust deposition was monitored with an Owen gauge, facilitating the collection and analysis of particulate matter. The results revealed a significant dust fall rate of 94.45 g/m²/month, substantially exceeding the accepted threshold of 30 g/m²/month set by regulatory standards. This elevated dust concentration poses serious health risks, particularly respiratory problems for workers and nearby residents.

The study emphasizes the urgent need for effective dust control measures to mitigate environmental damage and protect public health. It highlights that dust emissions not only degrade air quality but also lead to equipment wear and diminished material quality, resulting in broader economic consequences.

The findings underscore the critical requirement for robust regulatory frameworks and sustainable management practices in quarry operations to address the environmental challenges associated with mining activities. Ultimately, this research seeks to enhance awareness of dust pollution within the mining industry and advocate for strategies that promote environmental protection and community health. By exploring the relationship between quarry operations and dust emissions, this study lays the groundwork for future initiatives aimed at reducing the adverse effects of dust pollution in the region.

Keywords: *Public Health, Dust Pollution, Aggregate Quarry, Environmental Impact, Public Health, Regulatory Frameworks.*

A method for rapidly assessing landslide hazard, taking the landslide in Biban mountain chain a case study

Ouadfel Oum El Kheir[1-2] , Zighmi Karim[1-2-3]

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University, 19137, Setif, Algeria.

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria.

3-International Association of Water Resources in the SouthernMediterranean Basin, Tunisia

Abstract

The assessment of landslide hazards in the Biban mountain chain, northeastern Algeria, employs a GIS-AHP-based multicriteria method that integrates nine key factors: geological, anthropogenic, climatic, and environmental influences. This approach utilizes Geographic Information Systems (GIS) alongside the Analytic Hierarchy Process (AHP) to effectively evaluate landslide susceptibility.

To enhance evaluation efficiency and accuracy, the study also incorporates rapid assessment techniques inspired by existing research methodologies. By analyzing the interplay of various factors, the research identifies specific zones of heightened risk, particularly in steep slopes and marly outcrops, which are critical for geological stability.

The findings reveal that the region is significantly vulnerable to landslides, underscoring the importance of both natural and human-induced factors in hazard assessment. This comprehensive framework not only facilitates better planning and risk management strategies but also assists local authorities in implementing effective disaster preparedness measures.

Comparative techniques, such as the AHP combined with the Information Value (IV) method, Certainty Factor (CF) method, and Frequency Ratio (FR) method, provide a nuanced understanding of landslide risks. The results indicate that the AHP-IV and AHP-FR methods align closely with field investigation outcomes, while the AHP-CF method shows limitations due to its failure to consider certain environmental factors.

Overall, this integrated approach improves the understanding of landslide dynamics in the Biban mountain chain and offers valuable insights for future studies and interventions aimed at mitigating risks.

Keywords: *hazard assessment, Ahp, IV, CF, FR method,*

Multidimensional Assessment of Water Erosion, Sediment Transport, and Reservoir Siltation in the Senegal River Basin Using Geomatics Tools

Ali Mohamed Abdellahi, Hadji Riheb

Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University.Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria.

Abstract

The Maghreb region, particularly the Mauritanian section of Lake Senegal, faces significant challenges related to water erosion and sediment transport, which threaten local ecosystems and surrounding communities. This study aims to analyze these phenomena by employing a multidisciplinary approach that enhances our understanding of the interactions between this natural disaster, resource utilization, and environmental sustainability.The methodology involves comprehensive data collection, which includes gathering existing geological and hydrological data, particularly focusing on sediment surveys and erosion dynamics. This foundational data is essential for assessing the current state of the ecosystem and understanding historical trends that have shaped the landscape. To identify areas vulnerable to erosion, automatic models will be utilized, allowing for a detailed evaluation of the potential impacts on local infrastructure and ecosystems. This analysis will consider the interplay of human activities, such as agriculture and urbanization, with natural processes that exacerbate erosion rates. Remote sensing techniques will also be employed to map areas prone to erosion and sediment transport, as well as to assess the availability of water resources. These advanced technologies provide a comprehensive view of the spatial distribution and dynamics of erosion and sedimentation processes, enabling researchers to monitor changes over time and identify critical intervention areas. Integration of these data into GIS will facilitate the visualization of the impacts of environmental changes on erosion and sediment transport. This spatial analysis is crucial for developing predictive models that can inform management strategies and policy decisions. Furthermore, the study will formulate actionable recommendations for the sustainable management of water and soil resources. These recommendations will include strategies for erosion prevention and risk mitigation, tailored to the specific ecological and socio-economic contexts of the region. This research aspires to contribute to a deeper understanding of the issues surrounding water erosion and sediment transport, while supporting sustainable development and resilience among communities through innovative and context-specific solutions. By addressing these critical environmental challenges, the project aims to promote responsible stewardship of natural resources and foster a sustainable future for the region.

Key Words: *Water Erosion; Sediment Transport; Environmental Sustainability; RS; GIS.*

Groundwater Quality Assessment in the Setifian High-Plains, Algeria

Kaddour Benmarce[1-2-3], Maou Amel[1-2],

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University, El Bez, Setif, 19000, Algeria ;

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, El Bez, Setif, 19000, Algeria;

3-International Association of Water Resources in the Southern Mediterranean Basin, Gafsa, Tunisia;

Abstract

The Setifian high-plains region in northeastern Algeria faces significant challenges in the management of its water resources. As demand for water escalates across various sectors, a thorough assessment of groundwater quality becomes essential. This study addresses the urgent need to evaluate groundwater quality in the Wadi Boussellam sub-watershed. Utilizing a Geographic Information System (GIS)-based approach, we conduct a comprehensive analysis of groundwater geochemistry by estimating the Water Quality Index (WQI), which provides an integrated overview of water suitability for consumption.

Our analysis of groundwater samples reveals distinct hydrochemical facies, including calcic bicarbonate, calcic chloride, calcic sulfate, and magnesium sulfate, thereby enhancing our understanding of the region's hydrochemical composition. Hydrochemical indices, notably the WQI, Sodium Adsorption Ratio (SAR), and percentage of sodium (Na%), are employed to evaluate groundwater suitability for diverse applications, including agricultural irrigation and human consumption.

The findings indicate that while most crops are generally suitable for irrigation purposes, caution is advised regarding the use of this water for human consumption due to potential quality concerns. This study highlights the critical importance of regular monitoring to prevent groundwater contamination and to ensure the sustainable use of water resources in the Setif region. By providing valuable insights into groundwater quality, our research underscores the ongoing necessity for effective water resource management and the preservation of this essential resource's integrity.

Key Words: *Groundwater Quality; WQI; Hydrochemical Facies; GIS; Water Management*

Evaluating Climate Change Impacts on Semi-Arid Watersheds

Nour Charrouf[1-2], Maou Amel[1-2], Kaddour Benmarce[1-2-3]

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University, El Bez, Setif, 19000, Algeria ;

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, El Bez, Setif, 19000, Algeria;

3-International Association of Water Resources in the Southern Mediterranean Basin, Gafsa, Tunisia;

nour.charrouf456@gmail.com, amelmaou@gmail.comkaddour.benmarce.24@gmail.com,

Abstract

The northeastern region of Algeria, particularly the Safsaf watershed, has faced significant hydric stress over the past decade, primarily due to the adverse impacts of climate change. This study employs Landsat satellite imagery spanning from 2012 to 2022 to calculate the Normalized Difference Vegetation Index (NDVI), revealing a troubling decline in both water surfaces and vegetation cover. This decline coincides with an increase in human activities and rapid urbanization driven by population growth. Furthermore, we explored the relationships between NDVI and Land Surface Temperature (LST), as well as between the Normalized Difference Water Index (NDWI) and precipitation. Data from the Moderate Resolution Imaging Spectroradiometer (MODIS) and the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) were extracted using Google Earth Engine (GEE) for this analysis. Pearson's correlation analysis indicated a moderate negative correlation between NDVI and LST, suggesting that rising temperatures adversely affect vegetation health. Additionally, a weak negative correlation was found between NDWI and precipitation, highlighting the complex interplay between water availability and vegetation dynamics. These findings present a concerning overview of the conditions in the Safsaf watershed, indicating not only a decline in vegetation recovery but also the significant influence of temperature and precipitation on critical environmental indices. The study underscores the urgent need for comprehensive strategies to mitigate the impacts of climate change and prevent further degradation of the Safsaf watershed. It advocates for the integration of ecological and hydrological considerations into environmental management practices to foster resilience and sustainability in this vulnerable region.

Key Words: *Climate Change, NDVI; RS; GIS; Hydric Stress.*

Algeria's Strategic Response to Water Stress: Desalination and Sustainable Management

Hadji Riheb 1,2

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University.Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria

2-International Association of Water Resources in the Southern Mediterranean Basin, Gafsa, Tunisia.

Abstract

Algeria is facing an increasing water stress crisis, exacerbated by climate change and the rising demand for water due to population growth and rapid urbanization. In response to this pressing issue, the country has implemented several strategic initiatives, particularly focusing on the development of desalination technologies for seawater and brackish water.

Desalination has emerged as a national priority, leading to the construction of multiple mega desalination plants along the Mediterranean coast. These facilities are crucial for transforming seawater into potable water, thereby diversifying Algeria's water supply sources. By 2025, Algeria successfully enhanced its desalination capacity, achieving a production rate exceeding one million cubic meters of potable water per day. This significant output not only addresses immediate water needs but also serves to alleviate the pressures on freshwater resources.

In parallel, the Algerian scientific researchers are exploring the desalination of brackish water drawn from saline aquifers. This approach aims to harness previously overlooked resources, while simultaneously reducing the strain on freshwater supplies. Pilot projects have been initiated to assess the viability of this technology across various regions of the country, focusing on optimizing energy use and minimizing environmental impacts.

Furthermore, Algeria is actively engaging in public awareness and educational efforts regarding water management. Initiatives promoting conservation practices and sustainable water use are being implemented to foster a culture of responsible water consumption among citizens. Additionally, international cooperation is being encouraged, with partnerships established with countries and organizations specializing in hydrology and water resource management.

These combined efforts not only seek to ensure a reliable water supply for future generations but also aim to enhance the country's resilience against the impacts of climate change. Through these initiatives, Algeria aspires to transform its water challenge into an opportunity for sustainable development. By investing in innovative technologies and fostering community engagement, Algeria is positioning itself as a proactive player in the global dialogue on water security and climate adaptation.

Key Words: *Water Stress; Desalination; Climate Change; Sustainable Development; Freshwater Resources.*

Comprehensive Assessment of Rockfall Hazards at Cap Oukass Cliff, Northeast Algeria

Zahri Farid[1-2-3*] Zohra Ladjel[1]

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University, 19137, Setif, Algeria.

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria. zahrifarid@yahoo.fr

3-International Association of Water Resources in the Southern Mediterranean Basin, Gafsa, Tunisia.

Abstract

Rockfall hazards pose a significant threat to rocky slopes, often resulting in severe consequences, including loss of life and damage to infrastructure. The Cap Oukass cliff in Northeast Algeria is particularly susceptible to recurrent rockfalls, which have tragically claimed human lives. This research aims to provide a comprehensive assessment of the rockfall risk in this region by integrating probabilistic, structural, and photogrammetric techniques to identify the underlying contributing factors.

Our methodology combines kinematic analysis with the Matterock method to accurately identify zones prone to rockfall mobilization. Additionally, we perform three-dimensional trajectory simulations to analyze the behavior of individual rockfall blocks, allowing us to predict their potential paths and impacts. A significant focus of our study is the examination of fault sets within the cliff and their influence on the overall stability of the rock mass.

Utilizing the energy-return period couple, we generate a detailed hazard map that categorizes the RN9 road as falling within the medium to high hazard range. Our qualitative assessment of rockfall risk takes into account various predisposing and triggering factors, providing a nuanced understanding of the dynamics at play.

The findings from this study not only offer valuable insights into the specific rockfall risks associated with the Cap Oukass cliff but also suggest effective mitigation strategies to reduce these risks. Furthermore, our approach is applicable beyond this specific location; it can be extrapolated to assess and categorize rockfall hazards in other rocky slopes exhibiting similar geological characteristics. These results contribute to the development of effective management strategies aimed at mitigating the risks associated with rockfall hazards, thereby enhancing safety for both human populations and infrastructure in vulnerable areas.

Key Words: *Rockfall Hazard, Cap Oukass, Kinematic Analysis, Mapping, Mitigation.*

Developing a Landslide Susceptibility Map for the Tellian Atlas, Algeria: A GIS-Based Approach

Zighmi Karim[1-2*]Zahri Farid[1-2]

1-Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University, 19137, Setif, Algeria.

2-Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, AlgeriaAlgeria. zahrifarid@yahoo.fr

Abstract

Algeria's mountainous regions, particularly the Tellian Atlas, are highly susceptible to landslides, underscoring the urgent need for effective hazard assessment and mitigation strategies. This study employs a Geographic Information System (GIS)-based multi-criteria approach to develop a Landslide Susceptibility Map (LSM) for the Tellian Atlas, integrating advanced statistical modeling techniques. To create a comprehensive landslide inventory, we utilized satellite imagery, aerial photograph interpretation, and extensive field surveys, ensuring a robust dataset for analysis.

We analyzed eleven critical conditioning factors that contribute to landslide occurrence, including slope angle, aspect, altitude, curvature, Stream Power Index (SPI), Topographic Wetness Index (TWI), lithology, precipitation, and proximity to rivers, faults, and roads. These factors were systematically extracted from various sources, including satellite images, geological maps, digital elevation models (DEMs), and rainfall databases.

The Analytical Hierarchy Process (AHP) was employed to generate the susceptibility map, which was rigorously validated using the Receiver Operating Characteristic (ROC) curve analysis. The results indicate that the Tellian Atlas region faces significant challenges related to slope instability, with our model demonstrating an accuracy rate of 75%.

The generated Landslide Susceptibility Map serves as an essential decision-support tool for land-use planning, risk mitigation, and emergency response efforts. By providing detailed insights into areas at risk, this study enhances geohazard management in Algeria's mountainous terrain, ultimately contributing to improved safety and resilience for local communities.

Keywords: *Landslide Risk Assessment, GIS; Tellian Atlas; AHP; Slope Stability.*

Effect of climate change on the Intensity-Duration-Frequency curves in the Seybouse watershed, Northeast Algeria

Moncef CHABI1 *, Amina AMARCHI1 , Fares LAOUACHERIA1 and Lotfi ZEGHADNIA2

*1 Soil and Hydraulic Laboratory, Hydraulic Department, Technology Faculty, Badji Mokhtar Annaba University, P.O.Box 12, Sidi Amar, Annaba, algeria. 2Laboratory of Modeling and Socio-Economic Analysis in Water Science "MASESE", Mohamed Cherif Messaadia University, Souk Ahras, 41000, Algeria. *Correspondence to: Moncef.chabi@univ-annaba.dz*

Abstract

The increasing intensity and frequency of precipitation, a phenomenon closely associated with climate change, presents a significant challenge for the development of intensity-duration frequency (IDF) curves used in climate projections. These curves play a vital role in infrastructure planning; however, the non-stationary nature of extreme precipitation events raises concerns about their applicability under future climate conditions. This study addresses these challenges by analyzing observed precipitation data from weather stations, particularly with regard to the validity of adjustment laws, which suggest that precipitation percentages increase with each degree of temperature rise. We propose recommendations for adjusting IDF curves to reflect both current and future climate realities, based on the evaluation of changes in extreme precipitation and scaling factors. The analysis focuses on the Seybouse watershed in northeastern Algeria, using the Quantile Mapping method.

Keywords: *IDF curves, extreme precipitation, future climate, adjustment laws, Quantile Mapping method.*

Spatio-temporal Dynamics of Agricultural Drought: An Integrated Monitoring Framework for Tunisia's Upper Medjerda Valley

Sahar Abidi[1*], Islam Hamad Eljack Elameen[2] and Diego Pons[3]

[1]*Laboratoiredes RessourcesSylvo-Pastorales, Institut Sylvo Pastoral de Tabarka, Université de Jendouba, 8110 Tabarka, Tunisia.*

[2]*Geographic Planning Collaborative Group - Information & Communications, 12384 Riyadh, Saudi Arabia.*

[3]*National Institute of Agricultural Technology, Manfredi Experimental Station, National Route 9, km 636Manfredi, Cordoba, Argentina.*

**Correspondence to: Sahar.abidi@uj.rnu.tn*

Abstract

Semi-arid regions face increasing drought vulnerability, requiring monitoring approaches that capture complex climate-vegetation interactions beyond traditional linear methods. This study advances drought monitoring in Tunisia's Upper Medjerda Valley (2017–2023), a critical agricultural region producing over 40% of the country's cereals and supporting extensive olive cultivation vital to rural livelihoods and national food security. We integrate physically meaningful relationships between satellite-derived NDVI from Google Earth Engine, multi-station SPI data, and climate variables to quantify complex non-linear interactions.

We establish robust temporal correlations between vegetation and drought indices, identifying a critical 3-month vegetation response delay (r = 0.72, p< 0.01) that provides an effective early warning window. Our integrated approach captures conditional drought thresholds (e.g., NDVI < 0.25 occurs only when SPI < −1.5 and temperatures exceed 290K), improving drought severity classification accuracy to 91% (F1=0.89) compared to conventional linear regression methods (78%).

Statistical analysis reveals system-specific drought dynamics unique to this semi-arid Mediterranean basin: vegetation productivity shows twice the sensitivity to spring precipitation deficits compared to summer temperature anomalies, with threshold effects emerging at specific SPI values. Model robustness is demonstrated through dual validation against independent meteorological station data and agricultural crop loss reports (R^2 = 0.81), establishing a transferable methodology for operational drought monitoring. Results demonstrate how integrated satellite-climate analysis can effectively distill complex hydroclimatic processes into actionable drought indicators, providing decision-makers with spatially explicit, timely information for agricultural planning and water resource management in drought-prone regions.

Keywords: *Drought monitoring, NDVI, Machine learning, Tunisia, Water resources*

Estimating wheat water needs using machine learning and vegetation indices in the Setif region of Northeastern Algeria

Tarek Bouregaa

Laboratory of crop and animal production improvement, Department of agronomy, Faculty of Nature and Life Sciences, University Ferhat Abbas Setif1, Setif, Algeria

Correspondence to: ibnziad_1983@hotmail.com

Abstract

Efficient irrigation planning in semi-arid areas relies heavily on accurate estimation of wheat water requirements. This study investigates the use of machine learning algorithms combined with vegetation indices specifically, NDVI, MSAVI, and NDRE, to predict wheat water needs in Algeria's Setif region. Six machine learning algorithms-Support Vector Machine (SVM), Linear Regression (LR), AdaBoost (AB), Gradient Boosting (GB), Random Forest (RF), and Decision Tree (DT), were applied to estimate water requirements. The models were evaluated using R^2 and RMSE metrics. Among the tested models, AdaBoost and Gradient Boosting performed best, achieving the highest accuracy and lowest error rates. In March, Gradient Boosting using NDVI data achieved an R^2 of 1.00 during training and 0.827 in testing, with corresponding RMSE values of 0.066 and 2.077 mm. AdaBoost also performed well, with R^2 scores of 0.97 (training) and 0.818 (testing), and RMSEs of 1.756 and 2.126 mm. Model performance declined slightly in April, with Gradient Boosting reaching R^2 values of 0.920 (training) and 0.652 (testing). The accuracy of MSAVI and NDRE predictions varied, with some models showing negative R^2 during testing in April. Overall, the study demonstrates the promise of ensemble methods in forecasting wheat water needs, providing a practical tool for enhancing irrigation strategies in cereal-producing semi-arid zones.

Keywords*: Wheat irrigation demand, machine learning, remote sensing, semi-arid.*

Analysis of the trajectory representation modes and reflection on the process of the drilling trajectory - GIS approach in the mapping of the drilling trajectory

BRAHMIA Nadjet*[1] , Dehni Abdellatif[1] , Meguenni Bouhadjar[1]

[1]*Algerian Space Agency - ASAL, Space Center Techniques - CTS, SIRS Department, Space Phenomena Modelling, BP13, 01 Avenue of Palestine, Arzew, Oran, 31200 – Algeria*

**Correspondence to:*nbrahmia@cts.asal.dz*, adehni@cts.asal.dz, bmeguenni@cts.asal.dz

Abstract

According to the research realized on the means and tools to be involved in extracting and exploiting natural reserves such as : water, gas, oil, drilling appears to be the only means and the only method to be used in such an operation. Drilling involves all the consecutive processes that allow the target, particularly the reservoir, to be reached as quickly as possible and under the best technical and economic circumstances, with the aim of having a lower cost price. To this end, a lot of techniques, methods and procedures have gradually appeared to resolve problems related to drilling, as well as to the recovery of deposits. Currently, to monitor the trajectory of a drilling, we use Geomatics techniques and tools such as GIS like ArcGis Desktop, ArcGis Pro, etc. which remain a requirement to achieve a very precise mapping of the drilling trajectory thus ensuring its own management. In general, drilling characterized by horizontal movements is a more expensive practice, however, it has the advantage of having greater penetration to reduce the number of wells needed to exploit the reservoir. The primary objective sought through this article is to analyze the trajectory representation modes and to reflect on the drilling trajectory process, this from a Geomatic perspective, several approaches are possible, which all lead to solutions which call upon the GIS, it is in this framework, where we plan to realize a better mapping of the drilling trajectory.

Keywords: *Drilling trajectory, Geomatics, GIS, Cartography, Process.*

Adsorption of a dye (methylene blue) in aqueous solution on different porous materials

Rabeb Lassoued*[1,2], Wafa Najjar[3], Kaboudi Oumaima[1,3] and Ayadi Samar[1,3]

1. Higher Institute of Technological Studies of Zaghouan

2. Laboratory of Materials Molecules and Applications, IPEST, BP 51, 2070 La Marsa, Tunisia

**lassouedrabeb@yahoo.fr*

3.Laboratory of Composite Materials and Clay Minerals, National Center of Research in Sciences of Materials,Borj Cedria, B.P. 73, 8020 Soliman, Tunisia

Abstract

The main objective of this project was to study the use of widely available natural materials in Tunisia, clay and Quercus pericarp, as adsorbents to purify water from organic pollutants. Several samples were prepared by mixing clay and Quercus pericarp in different proportions.

Experimental results showed that methylene blue adsorption equilibrium was reached quickly for both clay and Quercus pericarp compared to the H sample. The H sample had an adsorption capacity of 14.85 mg/g, while clay and Quercus pericarp had 9.5 mg/g and 10.4 mg/g, respectively, indicating that the H sample had 0.5 times higher adsorption capacity.

Reducing the adsorbent mass increased the adsorption capacity for all samples, with 0.2 g being sufficient to achieve a capacity greater than 20 mg/g. Increasing the initial methylene blue concentration also enhanced the adsorption capacity for all samples. Quercus pericarp showed results almost identical to clay, suggesting it can be used as an alternative adsorbent.

pH variation influenced the adsorption capacity of clay and H samples, with higher capacities in basic conditions, while pH had no effect on Quercus pericarp.

In conclusion, Quercus ilex pericarp is an effective biodegradable adsorbent for the decolorization of methylene blue. Additionally, combining it with clay improves its adsorption capacity.

Keywords*: Quercus pericarp, methylene blue, clay, adsorption.*

Potential recharge assessment of the Mostaganem (Algeria) plateau aquifer using fuzzy logic and GIS

Hafida Boukrentach

Department of Earth Sciences. Faculty of Earth and Universe Sciences. University Oran2 Mohamed Ben Ahmed. B.P 1015 El M'naouer 31000, Oran, Algeria.

E-mail: dekkiche.hafida@univ-oran2.dz*; hboukrentach@yahoo.fr; Tel.: +213795518515*

Abstract

Groundwater is a vital resource in arid and semi-arid regions, essential for domestic use, agriculture and industry. In view of increasing environmental demands, adequate assessment of recharge potential is essential for sustainable management. This study proposes an innovative spatial analysis approach to assess the recharge potential of aquifers by integrating multiple parameters related to infiltration using Geographic Information Systems (GIS) combined with fuzzy logic. Topographic maps, thematic documents and field observations were processed into spatial information layers. These layers were classified and weighted according to their impact on water infiltration using fuzzy membership functions specifically adapted to reflect the role of each parameter in the recharge process. The methodology was applied to the Mostaganem plateau in north-west Algeria, located in a semi-arid Mediterranean climate.

The results produced a detailed map showing varied recharge potential across the region. The most favorable zones for recharge are mainly located in the western and eastern parts of the plateau, characterized by sandy formations, calcareous sandstones, gentle slopes, and vegetative cover conducive to infiltration. Validation using well yield data shows a strong correlation with the recharge potential map, confirming the accuracy and practical value of the fuzzy logic–GIS approach. This methodology offers a reliable tool for strategic groundwater resource assessment and sustainable water management in semi-arid environments.

Keywords*: Fuzzy logic; GIS; groundwater recharge; plateau of Mostaganem (Algeria).*

Traitement des eaux par méthode biologique

Karima Gharsallah[1*], Leila Rezig[2], Rabeb Lassoued[1] et Salma Laabidi[1].

[1]*Institut Supérieur des Etudes Technologiques de Zaghouan, Département Génie des Procédés.*

[2]*Ecole Supérieure des Industries Alimentaires de Tunis*

**Correspondence to: karima.gharsallah@fst.utm.tn*

Résumé

Le *Moringa Oleifera* est une plante dont les graines sont des coagulants primaires de propriétés comparables à celles du sulfate d'aluminium ordinaire. Mise en solution dans l'eau, la graine du *Moringa Oleifera* se comporte comme un poly-électrolyte cationique et permet la sédimentation des particules en suspension. Notre étude présente une investigation sur l'application de ce bio-polymère, dans le traitement des eaux de surfaces par le processus de coagulation floculation.

Pour cela, étant donné que les graines de Moringa sont des graines oléagineuses, une extraction d'huile des graines a été faite en premier temps car il entrave l'activité floculant et ralentit la décantation des flocs. Ensuite, on a procédé à l'extraction du principe actif qui représente les substances hydrosolubles contenues dans les tourteaux de Moringa.

La performance de la coagulation flocculation a été évaluée par la mesure de la turbidité résiduelle du surnagent de la solution aqueuse. Les résultats obtenus sont en faveur du *Moringa Oleifera*. A des faibles concentrations, le *Moringa Oleifera* est apte à réduire la turbidité. Ces propriétés, ajoutées à sa non-toxicité et son faible prix, font du *Moringa Oleifera* un substitut considérable aux polymères synthétiques conventionnels utilisés jusqu'à présent.

Mots clés *: Moringa Oleifera, coagulation floculation, traitement des eaux de synthèses, eaux usées*

Activités biologiques et propriétés physiques de l'huile des graines de *Moringa oleifera*

Karima Gharsallah[1]* et Leila Rezig[2]

[1]*Institut Supérieur des Etudes Technologiques de Zaghouan, Département Génie des Procédés.*

[2]*Ecole Supérieure des Industries Alimentaires de Tunis*

**Correspondence to: karima.gharsallah@fst.utm.tn*

Abstract

La présente étude vise à étudier les activités biologiques et les propriétés physiques de l'huile des graines de *Moringa oleifera* Tunisienne pressée à froid.

Le test DPPH et le test ABTS, prouvent une activité antioxydante importante de l'huile. L'huile a également montré une activité anti-inflammatoire relativement forte suite à son traitement aux différentes concentrations testées (75, 150 et 300 µg/mL). Cependant, aucune activité antimicrobienne n'a été observée.

L'huile des graines de Moringa oleifera pressée à froid a présenté une période d'induction de 30 ± 0,5 h par le test de rancimat. L'analyse thermogravimétrique a montré que l'huile possède une stabilité thermique intéressante avec des températures de début de la décomposition thermique Tonset élevées de l'ordre de 390,72°C et de 357,47°C, respectivement dans les atmosphères d'azote et d'air. Pour toutes les températures étudiées l'huile des graines de Moringa oleifera présente un comportement newtonien à des vitesses de cisaillement variant de 10 à 1000 s-1. Sur la base des résultats obtenus, le MoSO pourrait être utilisé dans diverses applications industrielles, notamment dans les secteurs pharmaceutique, cosmétique et alimentaire, grâce à sa stabilité thermique et à ses intéressantes activités biologiques.

***Mots clés**: Huile de Moringa oleifera; activités biologiques; propriétés physiques.*

Predicting Groundwater Depth in the Chebika Zone of Central Tunisia: A Machine Learning Approach

Mohamed Abdelhedi [1*], Hakim Gabtni[2] and Habib Abida[1]

[1]*Laboratory GEOMODEL (LR16ES17), Department of Earth Sciences, Faculty of Sciences, University of Sfax, BP 3083, Sfax, Tunisia*

[2]*Laboratory Centre de Recherches Et Des Technologies Des Eaux CERTE, Route Touristique de Soliman, Technopole Borj Cedria, BP 273, 8020, Soliman, Tunisia*

Corresponding author: Mohamed Abdelhedi*

E-mail: mohamed.abdelhedi.etud@fss.usf.tn

Abstract

This study introduces a cutting-edge machine learning framework to predict groundwater depth in the Chebika zone of Central Tunisia, leveraging geographic coordinates (longitude, latitude, and altitude) as the primary input data. By focusing on these spatial parameters, the research demonstrates a streamlined and innovative approach to groundwater estimation, eliminating the need for extensive hydrological datasets. Among the models evaluated, the MLP Regressor consistently delivered the highest accuracy, underscoring its effectiveness in groundwater depth prediction.

A key strength of this work lies in its rigorous use of cross-validation to ensure model reliability and generalizability. This methodology not only enhances predictive accuracy but also provides a scalable and cost-effective solution for groundwater monitoring in arid and data-scarce regions.

The implications of this research extend beyond groundwater prediction, offering valuable insights for sustainable water resource management, geophysical exploration, and environmental monitoring. By integrating machine learning with geographic data, this study sets a new standard for efficient and accessible groundwater modeling, with particular relevance for regions like Central Tunisia facing water scarcity challenges.

Keywords : *Groundwater depth; Central Tunisia; MLP Regressor; MAchine learning; Geographic coordinates.*

Gelatin Extraction from *Sepia officinalis*: Characterization and Potential Applications for Food Security

BENCHEGRAK.[1], LAMARA S. C.,GHERRAM M. [1], KHERRAZ Djazia[2], BENSAHLA TALET L.[1] and ABI-AYAD S.-M. E.-A. [1]*

1 :Aquaculture and Bioremediation Laboratory (AQUABIOR), Department of Biotechnology, University of Oran1 Ahmed Benbella, Faculty of Science, Oran,Algeria.

: Environmental Monitoring Network, Department ofBiology, University of Oran 1 Ahmed Benbella, Faculty of Science, Oran, Algeria.

**Corresponding author: benchegra.khadidja@yahoo.fr*

Abstract

Gelatinis a biopolymer widely used in the food, pharmaceutical, and cosmetic industries. However, its traditional sources, such as bovine and porcine tissues, raise health, ethical, and environmental concerns. This study explores the extraction of gelatin from *Sepiaofficinalis*, a marine organism, as a sustainable alternative. The extraction process involves chemical and thermal treatments to convert collagen in to gelatin. The extracted gelatin was characterized for its functional properties, including gelling, emulsifying, and foaming abilities.

The results show that the marine gelatin has a high protein content and low fat levels, similar to halal bovine gelatin, with slightly lower gelling power. These characteristics suggest that marine gelatin could serve as a viable alternative in food and pharmaceutical applications, especially in contexts with cultural and ethical considerations. Additionally, using marine by-products for gelatin extraction contributes to a circular economy by valorizing marine waste and reducing environmental impact.

This research highlights the potential of marine gelatin as a renewable resource that meets global food security needs while supporting sustainable agricultural practices. Further studies are needed to optimize the extraction process and enhance its functional properties to expand its industrial applications.

Keywords*: Gelatin, Sepia officinalis, marine by-products, sustainable alternative, functional properties.*

Characterization and stabilization of urban soils to create a new geo-material (concrete block)

Adel Djellali[1*], Aya Gastel[1], Zied Benghazi[1], Zoubir Aoulmi and Ala Houam

*[*1]Environmental laboratory, Mining Institute, EchahidCheikh Larbi Tebessi University, 12002 Tebessa, Algeria. adel.djellali@univ-tebessa.dz*

Abstract

This study investigates the characterization and stabilization of urban soils to develop a sustainable geo-material for concrete block production. A detailed analysis of physical, chemical, and mechanical properties was conducted, followed by stabilization using Portland cement at varying dosages (2%, 4%, and 6% by weight). Laboratory tests, including Proctor, direct shear, and unconfined compressive strength (UCS) tests, were performed to assess the feasibility of stabilized soil blocks. The results indicate that cement addition significantly improved the mechanical performance of the urban soil blocks. At 6% cement content, the UCS increased by 250%, achieving strength of 5MPa, which meets standard requirements for non-load-bearing concrete blocks. The cohesion decreased by 30%, enhancing durability. However, beyond 6% cement content, improvements plateaued, indicating an optimal dosage range for cost-effective stabilization. These findings demonstrate that cement-stabilized urban soils can serve as an alternative construction material, reducing reliance on conventional concrete and promoting sustainable urban development. The research highlights a practical approach to waste reutilization, offering an eco-friendly and economically viable solution for construction in urban environments.

Keywords: *Urban soils, geo-material, Stabilization, Characterisations, Unconfined compressive strength*

Assessment of the impact of climate change in Kairouan governorate, Tunisia.

Ahlem Mastour[1]*, Mohamed Habib Sellami[1], and Sihem Jebbari[2]

**E-mail:*ahlemlion7@gmail.com *ORCID: 0009-0003-8667-0979*

1: Environmental Hydraulics Laboratory

Higher School of Engineering of Medjez-ElBab

Route du Kef Km 5 University of Jendouba TUNISIA

2: National Institute for Research in Rural Engineering, Water and Forests, Ariana, Tunisia

Abstract

Like all countries in the world, Tunisia is affected by the impacts of climate change. Irregular precipitation, rising temperatures and the repetition and convergence of extreme climatic phenomena are all indicators that expose ecosystems and populations in all Tunisian regions to great vulnerability to the influence of climatic variables.

The Kairouan Governorate is located in the Center West of Tunisia. It covers a total area of 660,522 ha, or 4% of the country's area. Given its geographical location, the Kairouan Governorate occupies a strategic position at the regional and national levels. It is very affected by the effects of climate change. The objective of this work is to study the vulnerabilities and priority measures for adaptation to climate change.

Climate change is seen as having a direct effect on the productivity agricultural sector in the Kairouan governorate. Although the majority of regions show values of100%, some, like Chbika (81%) and El Ala (90%), find a slightly smaller impact, which could indicate relative resilience or the adoption of more suitable agricultural practices in these areas.

Keywords: *Vulnerability, impact, climate change, Kairouan, Tunisia.*

Elimination des nitrates d'une eau souterraine par échange ionique sur une résine spécifique La Purolite A 520 E: Etude en colonne

Maamar BOUMEDIENE

Université de Tlemcen, Faculté de Technologie – Département d'Hydraulique

B.P 230 Tlemcen 13000 – Algérie-

Laboratoire promotion des ressources hydriques, minières et pédologiques Législation de l'environnement et choix technologiques

Email : maamar.boumedien@gmail.com

Résumé

L'objectif de ce travail est d'étudier l'efficacité d'une résine spécifique anionique, fortement basique, dénommée la Purolite A 520 E pour l'élimination des ions nitrates contenus dans l'eau. Le travail expérimental effectué sur une eau souterraine, a été réalisé en mode colonne. L'influence de divers paramètres expérimentaux tels que: la vitesse de passage de l'eau à travers la colonne, la concentration initiale des nitrates et la concentration initiale en sulfates dans l'eau brute, sur l'élimination des ions nitrates par cette résine a été étudiée. Les résultats obtenus ont montré que la fuite ionique en nitrates dans l'eau traitée est d'autant plus faible autant que la vitesse de passage d'eau à travers la colonne diminue. La présence de fortes concentrations en nitrate et/ou en sulfate dans l'eau brute à traiter réduit systématiquement le temps de production de la résine et conduit, de plus en plus, à des fuites ioniques importantes de nitrates dans l'eau traitée.

Keywords *: pollution, eaux souterraines, nitrates, échange d'ions, Purolite A520 E*

Efficacité du traitement de l'azote dans une station d'épuration à boues activées: cas de la STEP de Maghnia

Maamar BOUMEDIENE

Université de Tlemcen, Faculté de Technologie – Département d'Hydraulique

B.P 230 Tlemcen 13000 – Algérie-

Laboratoire promotion des ressources hydriques, minières et pédologiques Législation de l'environnement et choix technologiques

Email: maamar.boumedien@gmail.com

Résumé

Le présent travail étudie l'efficacité du traitement de l'azote contenu dans les effluents urbains en station d'épuration à boues activées. Le travail expérimental a été effectué sur la STEP de Maghnia (Ouest d'Algérie) prise comme étude de cas. Une série de mesure sur une période de trois (03) mois a été réalisée. Les paramètres analysés sont: l'azote ammoniacal ($N\text{-}NH_4^+$), l'azote nitreux ($N\text{-}NO_2^-$) et l'azote nitrique ($N\text{-}NO_3^-$). Les résultats obtenus montrent que les rendements d'abattement de la pollution azotés n'étaient pas satisfaisants durant la période d'étude. L'abattement de l'azote ammoniacal ($N\text{-}NH_4^+$) était faible (soit 36.13 % en moyenne) alors que les rendements d'élimination de l'azote nitreux ($N\text{-}NO_2^-$) et de l'azote nitrique ($N\text{-}NO_3^-$) étaient moyens. Le taux global pour l'élimination de l'azote minéral avoisine une moyenne de 51.71 %.

Keywords *: Station d'épuration, traitement biologique, boues activées, azote, STEP de Maghnia*

Adapting Urban Water Management to Climate Challenges: Insights from Probabilistic Models

Sonia Hassini

McMaster University, Hamilton, Canada As climate change exacerbates urban flooding, combined sewer overflows (CSOs), and water resource challenges, traditional stormwater management strategies are no longer sufficient.

Abstract

This keynote will explore probabilistic modeling and innovative stormwater management strategies that support urban resilience and climate adaptation. A key focus will be the Analytical Probabilistic Stormwater Management (APSWM) model, which blends the simplicity of the design storm approach with the accuracy of continuous simulation, making it highly effective for urban stormwater planning. My work has contributed to APSWM through the development of a statistical rainfall data analysis procedure and a new set of APSWM models, enhancing its ability to support robust stormwater management strategies in diverse urban settings. APSWM is particularly valuable for regions with limited rainfall data, where these approaches can provide reliable solutions for stormwater planning. In addition to modeling, this talk will highlight Low-Impact Development (LID) practices such as bioretention systems, permeable pavements, and rain harvesting systems as effective tools for mitigating stormwater runoff and improving urban resilience. The session will also discuss CSO mitigation strategies and the importance of public acceptance in scaling up LID adoption. With expertise in urban flood management, CSO mitigation, climate change adaptation, stormwater modeling, and rainfall event data analysis, I will offer engineers, urban planners, and policymakers actionable insights on how probabilistic models can improve urban water management and advance climate-resilient infrastructure.

Groundwater overexploitation and land subsidence assessment using SAR Interferometry: a case study of El Malabiod watershed, northeast Algeria

Rayene Sirine Ramdani[*1], Chemseddine Fehdi[1], Nour El Houda Gueraidia[1], Saida Gueraidia[2] and Ilhem Abdeslam[1]

1. Water and Environment Laboratory.

2. Laboratory of Sedimentary Sets and Mineral and Water Resources of North Eastern Algeria.

** Corresponding author: Ramdani Rayene Sirine*

University of Echahid Cheikh Larbi Tebessi – Tebessa, Department of Earth Sciences and Universe, road of Constantine, 12002 Tebessa, Algeria; e-mail: ramdani.rayene-sirine@univ-tebessa.dz

Abstract

The overexploitation of groundwater resources in arid and semi-arid urban regions leads to serious consequences such as declining water tables, land subsidence, and degradation of water quality. The El Malabiod watershed, located in northeastern Algeria, is highly vulnerable to these issues due to its climate and increasing reliance on groundwater for domestic and agricultural use. This study applies Synthetic Aperture Radar Interferometry (InSAR) to analyze spatiotemporal variations in land deformation and groundwater levels. Four Sentinel-1 radar images, acquired between December 2014 and January 2025, were processed to detect ground subsidence. Results reveal a consistent subsidence rate of up to 3 cm per year, indicating progressive land surface deformation linked to declining groundwater levels. A notable expansion of agricultural activity was observed in the central part of the watershed, accompanied by increasing groundwater abstraction for irrigation. This intensification has led to a gradual drop in piezometric levels, reflecting mounting pressure on the Miocene aquifer. Additionally, the region experienced a rise in average temperatures and a decreasing trend in precipitation over the study period, further contributing to water stress. Among the main drivers of land subsidence, intensive irrigation emerges as a key factor, directly tied to groundwater overexploitation. These findings underscore the critical need for improved hydrogeological monitoring and the implementation of sustainable groundwater management strategies to mitigate long-term environmental and geotechnical impacts. The integration of InSAR data in groundwater studies proves effective in supporting decision-making processes for water resource planning in vulnerable regions such as El Malabiod.

Keywords: *Land subsidence, El Malabiod watershed, Synthetic Aperture Radar Interferometry (InSAR), Groundwater overexploitation, Miocene aquifer*

Impact of urban expansion on valley flow in rural areas: A case study of Bartella villages, Northern Iraq

Asaad A. M. Al-Hussein[1,*ID], Mohammed A. M. Sulaiman[2]

[1]*Department of Sensing and Nanophotonics, Laser and Photonics Center, University ofAl-Hamdaniya, Nineveh 41006, Iraq.*

[2]*Department of Laser and Spectroscopy, Laser and Photonics Center, University of Al-Hamdaniya, Nineveh 41006, Iraq*

**Correspondence: asaadahmed944@uohamdaniya.edu.iq*

Abstract

Urban expansion is necessary in rural areas to promote development and improve living conditions, but it carries serious environmental impacts, especially when this expansion is accompanied by an encroachment on nature, specifically on local hydrological systems represented by the flow of valleys. The villages in the Bartella area, located on both sides of the main road connecting Mosul and Erbil, have witnessed rapid urban transformations in recent decades. This has been a result of the forced migration from Mosul following the events of 2003, a significant population increase, and the expansion of economic and social activities. Random urban growth began expanding toward agricultural areas, transforming them into commercial, industrial, and residential districts. Numerous valleys that cross the main roadway via culverts are part of the villages' agricultural areas. Nevertheless, many of these valleys, natural pathways for floods and rainwater drainage, were buried and their paths altered, increasing the likelihood of local floods during periods of intense precipitation and creating an imbalance in the water system in these regions. The importance of the study lies in its addressing the problem of building within the valley boundaries or diverting their path without prior hydrological studies. The study's objectives are to assess the changes in land use between 2003 and 2024, examine the impact of urban expansion on the velocity, volume, and frequency of valley flows, and provide suggestions for sustainable urban design that mitigate adverse effects on the aquatic environment. Furthermore, the findings of the study offer essential future insights that can aid in rural-urban planning initiatives and assist policymakers in creating cohesive and successful surface water management policies, especially in rural-urban transition areas where urban activities intersect with natural water systems.

Keywords *: Urban expansion, Valley flow, Rural areas, Bartella villages, Iraq*

Hydrogeology and geochemistry of the karst aquifer in Tebessa basin – Algeria

Amor Hamad*

AGIRE- Tebessa-Algeria

Abstract

Karst aquifers are important sources of drinking water for many regions of the world, such as in the North Africa Plateau (Algero-Tunisian Atlas.) in North Africa, in different regions of the United States, and much of southwestern China, all areas where ~ 50% of potable water comes from karst aquifers. Examples of urban areas that are fed predominantly by karst aquifers are Tebessa, Gafsa and Kasserine, where 1.5 million people use water pumped from the carbonate Aquifer. The openings forming the karst aquifer may be partly or completely water-filled. The elevation where all pores are filled with water in an aquifer is the water table. The water tables in karst areas can be highly irregular in elevation, however, because water-carrying conduits can develop at various elevations. Water may also be encountered in perched aquifers. Aquifers that are elevated above the lower, regional water table by less soluble, impermeable beds. Additionally, groundwater contamination issues and the most common and effective remediation techniques in karstic terrains are discussed. Lastly, modeling techniques and remote sensing methods, as beneficial and powerful tools for assessing groundwater flow and contaminant transport in karst terrains, are reviewed and evaluated.

Etude de la perméabilité d'une barrière d'étanchéité: cas du CET d'El KEURT (Algérie)

Chahira SAYAD GAIDI*[1], Abbes Malika [2] , Laouni GAIDI[3] et Imane KHEDIM[4]

[1,4] *Lab. Sciences et Techniques de l'eau, Université Mustapha Stambouli, Mascara, Algérie.*

[2] *Hydrometeorological Institute for Training and Research (IHFR), Oran, Algeria.*

[3]*Lab. Etude des Structures et Matériaux, Université Mustapha Stambouli,Mascara, Algérie.*

c.gaidi@univ-mascara.dz ; *sayadchahira@yahoo.fr*

Résumé

La croissance démographique et l'urbanisation rapide ont conduit à une augmentation considérable de la production de déchets solides dans les villes algériennes. Pour faire face à ce défi, plusieurs centres de stockage de déchets (CET) ont été mis en place à travers le pays afin de gérer ces déchets de manière plus encadrée. Cependant, même si ces infrastructures visent à limiter les impacts environnementaux, elles génèrent un sous-produit liquide problématique : le lixiviat. Ce liquide, formé par la percolation de l'eau à travers les déchets, est fortement chargé en polluants organiques et minéraux. S'il s'infiltre dans le sol sans traitement adéquat, il peut contaminer le sous-sol ainsi que les eaux souterraines et donc perturber durablement les écosystèmes locaux.

Le centre de stockage de déchet d'El Keurt, situé dans la région de Mascara (Algérie), illustre bien cette problématique environnementale. Le lixiviat risque de s'infiltrer dans les sols sous-jacents et d'atteindre les nappes phréatiques en l'absence d'un système de collecte ou de traitement performant,. Dans ce contexte, il devient essentiel d'évaluer la capacité de rétention et d'infiltration des sols constituants les barrières de confinement du centre à savoir : barrière passive et active.

Ce travail s'inscrit dans cette optique et vise à étudier le comportement hydraulique des barrières de confinement face à l'infiltration de d'eau. Une étude expérimentale au laboratoire est menée pour étudier la variation de la perméabilité équivalente verticale de ces barrières. À travers une série d'essais expérimentaux (granulométrie, limites d'Atterberg, compactage, perméabilité...), nous cherchons à caractériser les propriétés hydrauliques du sol et à déterminer sa capacité à jouer un rôle de barrière protectrice. Les résultats obtenus permettront d'apporter des recommandations utiles pour la gestion durable du CET d'El Keurt et, plus largement, pour la conception de systèmes de confinement adaptés aux réalités locales.

Keywords *: perméabilité, infiltration, pollution, barriére de confinement, sol fin*

An Integrated Approach to Assessing Groundwater Quality, Soil Salinization Risks, and Fertility in Central Tunisia: Case of the Maknessy Basin

Zouhour MOUSSAOUI [1,2]; Fatma BEN BRAHIM [2,3]; Naima HIDOURI [4]; Younes HAMED [5] ; Salem BOURI [2,6]

[1]*University of Gabes, Higher Institute of Water Sciences and Techniques of Gabès (ISSTEG)*

[2] *Water, Energy and Environment Laboratory (LR3E), National School of the Engineers, B.P.W.3038 Sfax, Tunisia*

[3] *Department of Earth Sciences, Faculty of Sciences of Gabes, University of Gabes, Tunisia*

[4] *Department of Geology, Faculty of Sciences of Bizerte, University of Cartage, Tunisia*

[5]*University of Gafsa, Faculty of Sciences of Gafsa, Department of Earth Sciences, Gafsa, Tunisia*

[6]*Department of Earth Sciences, Faculty of Sciences of Sfax, University of Sfax, Tunisia*

**Correspondence to:* zouhourmoussaoui93@gmail.com, salem_bouri@yahoo.fr

Abstract

In arid and semi-arid regions, groundwater resources are limited and often of variable quality, affecting human health and soil fertility. In the Maknassy region of Central Tunisia, intensive agriculture has led to overexploitation of the upper deep aquifer of Upper Zebbag (UZ), causing a drop in groundwater level and threatening water resources. The objective of this study is to assess the suitability of groundwater for domestic and agricultural uses, taking into account factors related to soil salinization and irrigation practices. The analysis of these indices provides valuable information on the current state of groundwater quality, serving as a basis for the sustainable management of soil and water resources in the study area. To attempt this objective, a multidisciplinary approach was applied, including the assessment of water suitability either for drinking or for irrigation, combined with multivariate statistical simulations. The Drinking Water Quality Index (DWQI) shows that 53% of the area has water of good quality for human consumption, while 47% is of poor quality. Whereas, the Irrigation Water Quality Index exhibits 92% of the study area has water of good quality. Moreover, the application of the Hierarchical Cluster Analysis (HCA) model allowed to identify 3 water groups, highlighting risks related to soil salinization and sodification. These results may serve as a basis for improving the management and preservation of soil and water resources in the study area.

Keywords: *Upper Zebbag deep aquifer; Hydrogeochemistry; WQI; PCA; CHA; Maknessy basin*

Assessment of PTE Contamination in Gafsa South-El-Guettar Shallow Aquifer, Tunisia

Naima HIDOURI[1,2,*], Fadoua HAMZAOUI-AZZAZA[2], Zouhour MOUSSAOUI[3], Noomene SLEIMI[4], Younes HAMED[5,6]

[1]*Faculty of Sciences of Bizerte, University of Carthage, Jarzouna, 7021 Bizerte, Tunisia.*

[2]*Laboratory of Sedimentary Basins and Petroleum Geology (SBPG), LR18 ES07, Geology Department, Faculty of Sciences of Tunis, University of Tunis El Manar, Tunis, Tunisia.* naimahidouri94@gmail.com. fadoua.hamzaoui@fst.utm.tn.

[3]*Water, environment and energy Laboratory, Faculty of sciences of Sfax, University of Sfax, Sfax, Tunisia. E-mail:* zouhourmoussaoui93@gmail.com.

[4]*RME-Laboratory of Resources, Materials and Ecosystems, Faculty of Sciences of Bizerte, University of Carthage, Jarzouna, 7021 Bizerte, Tunisia. E-mail:* noomene.sleimi@gmail.com.

[5]*Department of Earth & Atmospheric Sciences University of Houston, 3507 Cullen Blvd, Houston, Texas 77204-5008, USA.*

[6]*L.R.-LAM3E Application of Materials to the Environment, Water and Energy, Faculty of Sciences of Gafsa, University of Gafsa, 2100 Gafsa, Tunisia. E-mail: hamedhydro.tn@gmail.com*

[*]*Corresponding Author: E_mail:*naimahidouri94@gmail.com

Abstract

Assessing the levels of PTE pollution in groundwater is crucial for managing water resources, safeguarding public health, and reducing environmental impacts. A hydrochemical study was conducted on a shallow aquifer of Gafsa south El Guettar in the agricultural region of the Gafsa south basin. Twelve physical-chemical parameters and four PTE were examined for each of the sixteen water samples that were taken from the aquifer network. The hydrochemical facies of the samples determined their classification. Maps showing the distribution of specific heavy metals revealed alarming pollution levels and indicated areas with a high potential health risk. For both adults and children, the carcinogenic risk (CR) and non-carcinogenic risk (N-CR) were computed. Our results represent the first warning of PTE concentrations in the GSG shallow aquifer, which may have negative health effects on adults and children through ingestion and skin contact. Drinking water from the research region puts both adults and children at risk for N-CR. Children are significantly more vulnerable to cancer risk, as evidenced by comparisons of CRing, CRder, and CRtotal between adults and children. According to the worrisome results, implementing environmental measures strictly and successfully could result in dangerous situations. The safest usage of GSG water ultimately depends on decisions made by all parties involved.

Keywords: *PTE contamination. Hydrochemical Study. Gafsa South -El-Guettar Shallow Aquifer. Agricultural and Mining Activity*.

Remote Sensing and GIS Analysis of Collapsible Soil Risk in Unsaturated Soils of Oued Souf, Algeria

Saida GUERAIDIA[1]*, Mohamed Salah LAOUAR[2], Djamel ATHMANIA[1],Nour El Houda Gueraidia[1], Rayene Sirine Ramdani[1],Chemseddine FEHDI[1]

[1]*Department of Earth Sciences and Universe, Tebessa University, Tébessa 12002 Algeria.*

[2]*Department of civil engineering, Tebessa University, Tébessa 12002 Algeria.*

**Correspondence to: saida.gueraidia@univ-tebessa.dz.*

Abstract

This study synthesizes experimental results on an unsaturated soil from the Djemâa-Eloued region, an arid zone with unique and evolving soil behavior. The soils in this region are shaped by their geomorphological origins and water regime, sharing characteristics such as lack of structure, heterogeneous texture, high porosity, and good surface aeration. The rising water table continues to influence the urban landscape of the Souf Valley, where the soil's open, metastable structure makes it prone to collapse. To examine the effect of suction on selected parameters and soil behavior, physical and geotechnical characterization tests were conducted as part of a detailed experimental protocol. Unsaturation was considered at every stage of the study, providing a valuable database on Souf soils.

GIS was employed to process and analyze spatial and attribute data, offering essential insights for decision-making. This research focuses on advanced GIS analyses for the arid zone of Oued Souf, Southeast Algeria, particularly topographic analysis. Using GIS tools like slope, aspect, hill shades, and contour mapping, the study generated digital simulations to better understand the terrain and hydrological characteristics of the region. These methods offer efficient, cost-effective solutions for analyzing and managing Algeria's diverse landscapes.

Keywords: *Collapsible Soil; Arid Region; Unsaturated Soil; SIG; Remote Sensing; Suction; Lineaments.*

Remote Sensing and GIS pro Applications to Climate Change

Malika ABBES[a*], Fethallah Nourelhouda[a], Beloufa Nabil[a], Otmane Cherif Abdulillah[a], Hachemaoui Anouar[a]

[a] *Hydrometeorological Institute for Training and Research (IHFR), Oran, Algeria. E-mail : malika-abbes@outlook.fr*

Abstract:

Climate change research remains a challenging task, as it requires vast quantities of long-term data to investigate the past, present, and future scenarios of Earth's climate system and other biophysical systems at global to local scales. Both traditional ground based observation methods and remote-sensing technologies are available options for gathering data for climate change research. Observations from weather stations have been widely used to study climate change over long periods of time. However, due to the scarcity of point-based weather observations, our understanding of the Earth's changing climate is very limited. This impedes the advancement of our knowledge of the Earth's climate system and our ability to develop well-suited climate models to simulate future climate change, which further results in considerable uncertainties associated with future climate projections. Thus, the determination of a method for quantifying and minimizing these uncertainties is quickly becoming one of the most challenging issues yet to be addressed by climate change impact assessment and adaptation studies. Remote sensing offers a new method for observing the Earth's climate system with continuous and high-resolution spatial coverage through satellite-based, aircraft-based, or drone-based sensor technologies. This can significantly improve our understanding of climate change and its potential impacts at global, regional, and local scales. The data collected with remote-sensing and GIS pro technologies can also be used to validate our climate models, improve our knowledge of the physical and dynamic processes of the climate system, and help us project future climate change and its impacts with minimized uncertainties.

Keywords: *Remote sensing, GIS pro, Climate change, water resources scarcity*

Toxicological and epidemiological evidence integration for assessing human health risks to environmental chemical exposures

Amina Ben Sâad[1]*, Najet Mokni[1], Samira Othmani[2]

1 Health ministry –Tunisia, Blood center of Gafsa

2 Health ministry – Tunisia, Regional hospital of Gafsa

3 Health ministry – Tunisia, Institue of sport of Gafsa

Abstract

Toxicology and epidemiology are the two traditional public health scientific disciplines which can contribute to investigate harmful health effects of exposure to toxic substances. Several frameworks for integrating different lines of evidence were proposed since 2010, evolving based of the emergence of new methodologies and approaches. Through the comparison of various theoretical frameworks for evidence integration, we examined similarities, differences, strengths, and weaknesses to provide insights into potential directions for future research. We identified several key challenges of the integration approach to be applied to risk assessment. More specifically, collaboration within a multidisciplinary team of biologists, toxicologists, epidemiologists, environmentalists and risk assessors, is strongly recommended to be aligned with key regulatory objectives and promote a harmonized approach. Moreover, literature search transparency and systematicity have to be ensured by following validated guidelines, developing parallel protocols for collecting epidemiological and toxicological evidence from various sources, including human, animal, and new approach methodologies. Also, the adoption of tailored quality assessment tools is essential to grade the certainty in evidence. Lastly, we recommend the use of the Adverse Outcome Pathway framework to provide a structured understanding of toxicity mechanisms and allow the integration of human, animal, and NAMs data within a single framework.

Keywords: *chemical risk, evidence integration, toxicological and epidemiological evidence, human health.*

Joint-Common Methodology for Satellite-Ground Correlation in Critical Infrastructure Monitoring: Preliminary Results Dam Case Study

Fatima Zohra Tebbi[1*], Ouassila Bahloul[2], Moufida Belloula[1]and Abdelmoumen Merdassi[1]

[1]*LRNAT Laboratory, Earth Sciences and Universe Institute, Batna2 University, Batna, Algeria*

[2]*LGC-ROI, Civil Laboratory-Risks and Structures Interactions, Faculty of Technology University of Batna 2, Batna, Algeria*

** f.tebbi@univ-batna2.dz*

Abstract

Dam infrastructure monitoring faces challenges in establishing reliable correlations between satellite observations and ground-based measurements; however, the accuracy of different spatial correlation approaches requires comprehensive evaluation. While remote sensing has been used to detect structural deformations, the reliability of various methodological frameworks needs long-term validation. We use Sentinel-1 SAR and Sentinel-2 optical observations to examine deformation patterns across Beni Haroun dam in northern Algeria using twenty-one years of continuous monitoring records from 2002 to 2023. The timing of satellite anomalies are compared to structural deformation estimates derived from continuous three-dimensional displacement records and baseline measurements established during 2020. First, we develop a Joint-Common correlation method, which requires both ground truth and satellite records, to determine the feasibility of multi-sensor approaches for detecting deformation events. Using this approach, we demonstrate that observations with spatial coincidence should be utilized for deformation detection with satellite data, and that including quartile-based thresholds (Q3 + 1.5×IQR), a statistical framework for anomaly identification, increases reliability compared to conventional averaging methods alone. Accuracy further improves when analysis focuses on critical events informed by magnitude classification and temporal windows, with detection success varying significantly across different event types. After examining potential correlation strength with comprehensive ground validation spanning two decades (peak r = 0.044), we analyze nine critical deformation episodes ranging from 66.3 to 148.5 millimeters using automated tensor decomposition methods independent of manual event selection. While correlation magnitudes remained modest across most events, the Triple Impact episode at joint MJT 28-29 demonstrated measurable satellite response (magnitude 148.5 mm), providing evidence for detection capabilities during major structural changes. We observed 95.7% data completeness across monitoring dimensions and spatial coherence exceeding 98% in deformation patterns, which suggests that satellite observations can detect significant structural events across critical infrastructure with applications in early warning systems and maintenance scheduling.

Keywords: *Infrastructure monitoring, Satellite remote sensing, Ground truth validation, Spatial correlation, Dam safety, Joint-common methodology*

Surface ozone in Tunisian urban/suburban areas: regime, photolysis and (local/regional) contributions of oxidants

Fatma Sellami[1]* and Chafai Azri[1]

[1]*Research laboratory of environmental sciences and sustainable development,* LR18ES32, *University of Sfax, Tunisia*

**Correspondence to:* fatmasellamibrini@yahoo.fr

Abstract

The daily and diurnal variabilities of surface ozone (O_3) and its nitrogen precursors (NO, NO_2) in urban and suburban areas of the main Tunisian cities (Bizerte, Tunis and Sfax) showed the influence of multi-scale sources and meteorological factors. NO, NO_2 and O_3 daily evolutions showed variable concentrations within each area and also from one area to another. The diurnal trends of ozone were characterized by a slightly modulated regime, with a decrease of concentrations at peak-hours. Ozone modeling revealed that the increase of its concentrations is due to the significant effect of NO_2, wind speed, air temperature and solar radiation. At the maximum temperature (14:00, LTh), the computed photolysis rate j_1 at Sfax was evaluated at 0.25 min^{-1}. It was found to be lower than those recorded at Tunis and Bizerte (0.92 and 0.47 min^{-1}; respectively). The ozone accumulation rate in Bizerte was evaluated at 3 ppb h^{-1}. It was shown very high compared with those found in Tunis and Sfax (1.9 and 2.1 ppb h^{-1}, respectively). Under the effect of Rex and Omega-type blocking anticyclones, the average levels of oxidants OX (=O_3 + NO_2) and NOx during the day and the night were characterized by different slopes and showed that the daytime contribution was slightly lower than that at night. The AQI values calculated for the selected study areas revealed that the air quality category was mostly classified as 'good' for O_3, during moderately stable and unstable atmospheric conditions. The category, on the other hand, was classified as 'poor' to 'very poor' during Rex and Omega blocking patterns and cut-off lows.

Keywords : *Surface ozone, nitrogen precursors, extreme conditions, Risk, Tunisia*

The impact of hydromagnetic treatment of irrigation water on water, soil and agronomic parameters of greenhouse tomato cultivation

Naima Anayed[1,4], Wiem Mbarki[3], Béchir Chaouachi[1], Ali Benhmidène[1], Nedia Ebdelli and Rachid Boukhchina[2]

[1]*Laboratory of Energy, Water, Environment and Processes, the National School of Engineering of Gabès, Gabès University, TUNISIA*

[2]*Laboratory of Eremology and Combating Desertification (LR16IRA01), Arid Regions Institute, University of Gabes,4119 Medenine,TUNISIA*

[3] *Higher Institute of Water Sciences and Technologies (ISSTEG Gabes Tunisia)*

[4]*Technical center for protected and geothermal crops*

Correspondence to: naima.anayed2024@gmail.com

Abstract

Climate change in recent years has led to a significant deterioration in the quality and quantity of water resources. For this reason, the intervention of technology is essential to face these challenges. In this context, this study focuses on the use of a GMX 8000 device for the hydromagnetic treatment of geothermal water used for the irrigation of a monotunnel greenhouse installed in the Chenchou region, Gabès, Southern Tunisia.

The study showed encouraging results for water, soil and plants:

- A slight increase in water pH with a decrease in chloride concentration, which affects electrical conductivity,

- Soil electrical conductivity decreased at all three depths (0-30 cm, 30-60 cm and 60-90 cm) as a result of the reduced concentration of various anions and cations (Ca^{2+}, Mg^{2+}, Na^{+}, Cl^{-}, SO_4^{2-}, NO_3^{-}, PO_4^{-}, K^{+}), while soil pH increased slightly,

- All agronomic parameters of the crop are significantly higher (number of leaves, stem diameter, plant height, number of clusters, number of flowers per cluster, leaf length and yield) with a clear improvement in leaf nutrient concentration (Ca^{2+}, Mg^{2+}, NO_3^{-}, PO_4^{-}, K^{+}) and regression of Na^{+} concentration.

Keywords: *magnetic treatment, irrigation water, soil, greenhouse tomato.*

Olive Waste-Based Activated Carbon in Mixed Matrix Membranes for Sustainable lead Removal from industrially contaminated stream water

Roua Gmati[1], Rim Ben Amor[1], Carlo Limonti[2,3], Alessio Siciliano[3] and Catia Algieri[4]

[1] *University of Tunis El Manar, Department of Geology, Faculty of Sciences of Tunis, 2092 Tunis, Tunisia*

[2]*ENEA, Italian National Agency for New Technologies, Trisaia Research Centre, S.S. 106 Ionica, km 419 + 500, MT, Rotondella, 75026, Italy*

[3]*Laboratory of Sanitary and Environmental Engineering, Department of Environmental Engineering, University of Calabria, CS, Rende, 87036, Italy*

[4]*Institute on Membrane Technology, National Research Council of Italy (ITM-CNR), Cubo 17C, Via Pietro Bucci, Rende 87036, Italy*

Abstract

The limited effectiveness of conventional waste water treatment plants has contributed to the persistent contamination of surface waters by toxic heavy metal ions. Mixed matrix membranes (MMMs) have garnered increasing attention for their potential in heavy metals removal from industrial discharges. This study explores the application of innovative activated carbon/polyether sulfone (PES) mixed matrix membranes to enhance lead removal from industrially contaminated water. A preliminary batch mode study reveals that the Pb (II) adsorption mechanism onto synthesized activated carbon derived from olive pomace (OPAC) is best described by the Langmuir isotherm and pseudo-second-order kinetics. The MMMs were fabricated by incorporating different amount soflow-cost OPAC using the phase inversion technique. SEM-EDX analyses, water contact angle, porosity, and mechanical property measurements were performed. Filtration performance was investigated in continuous mode at a TMP of 10 bar. Increasing the weight ratio of OPAC in PES membranes significantly improved water permeability—up to 2.16 times that of the unmodified membrane—mainly due to enhanced membrane hydrophilicity (contact angle 57°), a larger mean pore size of 9.53 nm, and increased overall porosity (77.58%). The M2 membrane (with 0.25 wt% OPAC) showed high-quality permeate with 97% lead removal efficiency from the model solution while also exhibiting improved mechanical strength. Additionally, the best-performing membrane (M2) successfully treated lead-contaminated effluent from the Hamdoun stream in Tunisia, reducing lead concentrations below regulatory limits for surface water discharges. This study demonstrates that the developed MMM can serve as an effective, eco-friendly method for remediating industrial lead-contaminated water.

Keywords: *Mixed matrix membrane, olive pomace activated carbon, Pb(II) removal, industrial discharges, sustainable, surface waters.*

Development of optimized 3D trajectory wells tool based on geometric, mechanic, hydraulics, geophysics and hydrogeology parameters implication for water resource planning and exploration –NW of Algeria

Dehni Abdellatif*[1], Meguenni Bouhadjar[1], Brahmia Nadjet[1], Saidi Kamel[2]

[1]*Algerian Space Agency - ASAL, Space Center Techniques - CTS, SIRS Department, Space Phenomena Modelling, BP13, 01 Avenue of Palestine, Arzew, Oran, 31200 - Algeria*

[2]*Algerian Space Agency - ASAL, ENSGTS,*

**Correspondence to:* adehni@cts.asal.dz*, bmeguenni@cts.asal.dz, nbrahmia@cts.asal.dz, ksaidi@cts.asal.dz

Abstract

The optimization of the trajectory of directional wells is a major problem in the study and design of reconnaissance and production drilling (water resources, mining and oil exploration). The work consists of developing in Python language coupled with Geo-modeling software (Wells planning extension from the LeapFrog Geo and QGIS open-source software's(qjis2threejs and Geoscience extensions) on the restrictive areas of the Northwestern Algeria (Ain Temouchent, Ghriss). The objective of this work focuses on the development of interfaces devoted to the improving the efficiency and accuracy of directional drilling to reach targets that are difficult to access with traditional vertical drilling. The implementation of algorithms in Python from several methods such as the average angle, tangential, calibrated tangential, radius of curvature, and minimum curvatures allow the generation of trajectories. The optimization of the trajectories of deviated wells is validated by the integration of geometric parameters (depth measurement, inclination and azimuth), mechanical (drag and torque), hydraulic and hydrogeological (operating flow rate, piezometric levels, geological formations, hydraulic fracturing), and those from electrical geophysics (Vertical Electrical Soundings: VES, water table thicknesses) offering conceivable exploration and planning comparing to the traditional optimization methods.

Keywords: *Trajectory optimization, directional wells, interface development, Python, resource exploration and planning*

Reaction of a coastal aquifer after a period of intense drought in water scarcity regions: case of Lebna dam influence zone (Cap Bon, Northeast Tunisia)

Mohamed Neji[1,2], Ghassen BenZid[1,2], Sameh Chargui[1], Olivier Grunberger[3], Claude Hammecker[3], I.M.H.R Antunes[4] and Fethi Lachaal[1]

[1]*Georesources Laboratory, Water Research and Technology Centre, PO Box 273 Soliman 8020, Tunisia.*

[2]*University of Tunis El Manar, Faculty of Sciences of Tunis, 2092 El Manar, Tunis, Tunisia.*

[3]*LISAH, Univ. Montpellier, INRAE, IRD, SupAgro, Montpellier, France.*

[4]*ICT Institute of Earth Sciences, Pole of University of Minho, Campus de Gualtar, Braga, Portugal.*

Mohamed Neji: Email:* mohamed.neji@certe.rnrt.tn

Abstract

The coastal aquifer of Lebna (Northeast Tunisia) is used for irrigation and industrial purposes. Since the dam's construction in 1986, a significant drought period was observed in the last three years (2020-2023). This research aims to characterise this drought period and to assess its impact on coastal groundwater resources and agricultural activities based on dam water levels, groundwater monitoring, isotopic composition and analysis of Data (Rainfall intensity and Landsat imagery) through the application of Drought indices (SPI and NDVI). Results indicate a deficit in rainfall (SPI values vary from -0,4 to -1,2), decrease in irrigated agricultural land by 63% compared to 2019 based on surveys of 30 farmers. Moreover, NDVI investigations from 2019 to 2023 show 45% reduction in vegetation cover and 77.78% in water body during the dry season and 93.6% and 84% reductions in the wet season. A comparative analysis of groundwater elevation and salinity measurements from 181 wells in 2019 and 2023 shows a piezometric drop of 9 meters below sea level (mbsl) and a rise in electrical conductivity reaching up to 21 mS/cm, the dam filling in 2019 raised groundwater levels, while its emptying from 2020-2023 lowered them. Isotopic analyses indicates that the aquifer received recharge from the dam in 2019 through geological banks. Conversely, in 2023 isotopic data indicates no aquifer recharge occurred from the dam, corroborating the near-empty state of the dam (lake level between 12.85 and 10.80 m). This study helps anticipate extreme events, enhancing our ability to face and adapt efficiently.

Keywords: *Climate change; Drought; Groundwater monitoring; Groundwater recharge; Isotopic analyses;*

Hydrogeochemical Assessment of Alluvial Aquifer Suitability: The Oued Biskra Wellfield Case Study

Sedrati Nassima[1*], Halimi Fahima[2] and Chaoui Widad[3]

[1]*University of Annaba, Faculty of Earth Sciences, Water Resources and Sustainable Developpment Laboratory,12 PO. Box,23000, Annaba, Algeria*

[2]*University of Annaba, Faculty of Earth Sciences, Geology Laboratory,12 PO. Box,23000, Annaba,*

[3]*University of Annaba, Faculty of Earth Sciences, Head of LR3MI Research Laboratory,12 PO. Box,23000, Annaba, Algeria*

**Correspondence to: nassima.sedrati@univ-annaba.dz*

Abstract

For several decades, the alluvial aquifer of Oued Biskra (wellfield) has represented a strategic resource, playing a vital role in supplying the region with drinking water and irrigation water. However, the growing pressure from human activities particularly agriculture along with changes in the hydrogeochemical regime, raises increasing concerns about the quality of this resource. In this context, the present study aims to assess the groundwater quality of this aquifer through the analysis of 19 samples. An integrated approach was adopted, combining statistical tools (principal component analysis PCA), hydrochemical representations (Piper, Schoeller, and Gibbs diagrams), as well as water quality (WQI) and pollution indices (GPI). The results indicate that groundwater quality is influenced by both natural processes, such as water–rock interactions and evaporation, and anthropogenic sources, mainly irrigation and domestic discharges. Furthermore, the interpretation of irrigation suitability parameters, such as SAR and sodium percentage, reveals that over 80% of the samples exhibit water quality ranging from questionable to unsuitable for agricultural use.

Keywords: *Humain activities; quality; PCA, WQI; Oued Biskra (wellfield).*

Etude de la vulnérabilité de la nappe karstique des Monts de Saïda, Nord Ouest Algerien

BENAMINA Benyekhlef, ABBES Malika, HAMIMED Abderrahmane, CHADLI Ahmed, GRINE Athmane

Résumé:

Les aquifères karstiques sont très vulnérables à la contamination en raison de leurs caractéristiques hydrogéologiques uniques et des pressions anthropiques croissantes. Compte tenu des défis et des coûts liés à la remédiation, cette étude évalue la vulnérabilité des eaux souterraines des formations karstiques du bassin des Monts de Saida à l'aide de la méthode DRASTIC. Les résultats montrent que 25% de la zone d'étude est classé comme très forte vulnérabilité, 66,7% forte vulnérabilité, 6,6% une vulnérabilité moyenne et 1,7% comme une vulnérabilité faible. Les parties sud et sud-est de la zone d'étude présentaient le plus fort potentiel de pollution ; le potentiel correspondant était plus faible dans la partie nord-ouest.

Enfin en à comparer entre la répartition des nitrates avec la carte DRASTIC pour la validation la méthode DRASTIC, Les résultats ont montré que la méthodes DRASTIC étaient précise et efficace.

Les problèmes liés à la pollution des eaux souterraines constituent actuellement une source d'inquiétude qui requiert un intérêt universel. Ces eaux sont menacées par certaines sources de pollution provenant des activités anthropiques, agricoles, des décharges publiques incontrôlées, les systèmes d'assainissement non contrôlés, les eaux usées et industrielles. La pollution générée par les activités anthropiques atteint des niveaux critiques et présente un danger grave pour la santé publique ce qui s'appelle le risque.

Contribution à l'étude qualitative des eaux souterraines de la plaine d'El taref (Nord-Est Algérien)

Chaoui.W[1]*, Halimi.F[2], Sedrati N[3] et Chaoui.K[4]

1 LR3MI, Université Badji Mokhtar Annaba, Département de Géologie, Faculté des sciences de la terre,*

2 Université Badji Mokhtar Annaba, Département de Géologie, Faculté des sciences de la terre,

3 REDD, Université Badji Mokhtar Annaba, Département de Géologie, Faculté des sciences de la terre,

4 LR3MI, Université Badji Mokhtar Annaba, Département de Mécanique, Faculté des sciences de l'Ingéniorat,

chaoui.widad1@gmail.com

Résumé

Les eaux souterraines représentent une ressource stratégique en Algérie, surtout face à la croissance démographique et économique. Dans la plaine d'El Tarf, ces eaux jouent un rôle crucial pour la potabilisation, l'agriculture et l'industrie. L'analyse chimique permet de caractériser la qualité de ces eaux. Les résultats suggèrent que certaines sources sont adaptées à ces usages, tandis que d'autres présentent des signes de minéralisation ou de dégradation nécessitant une gestion durable.

Cette étude vise à caractériser les eaux souterraines de la plaine d'El Taref (nord-est de l'Algérie) sur le plan hydrochimique et à évaluer leur qualité pour la consommation humaine. Les analyses physico-chimiques révèlent une qualité d'eau variant de bonne à moyenne selon les normes de l'OMS. Les diagrammes de Piper et de Berkalof indiquent un faciès chloruré-sodique dominant, associé à des faciès bicarbonatés sodiques et calciques, traduisant la dissolution de minéraux évaporitiques.

L'analyse thermodynamique, réalisée via le logiciel PHREEQC à 25°C, a permis de simuler les équilibres sel/solution des ions majeurs (Cl^-, SO_4^{2-}, HCO_3^-, Ca^{2+}, Mg^{2+}, Na^+, K^+). Les résultats montrent que tous les échantillons sont en état de sous-saturation vis-à-vis du gypse ($CaSO_4$), indiquant que ce minéral constitue une source probable de Ca^{2+} et SO_4^{2-} ;de même, l'halite (NaCl) est sous-saturée, suggérant que les formations géologiques sont de type gypso-salifère.

Mots clés: *eaux souterraines, plaine d'El-Taref, paramètres physico-chimiques, OMS, Indice de saturation,*

Artificial Intelligence for Water Resources Management: Forecasting, Operations, and Monitoring

El Aachab Yassine[1]* and Kaicer Mohammed[2]

[1,2]Laboratory of Analysis Geometry and Applications, Department of Mathematics, Faculty of Sciences, Ibn Tofail University Kenitra, Morocco

**yassine.elaachab@uit.ac.ma*

Abstract

Artificial intelligence (AI) is reshaping how we predict, operate, and monitor water systems. Globally trained AI models now deliver reliable river-flood forecasts even in ungauged basins, with skill at multiday lead times; these advances are already operationalized in public platforms that provide locally relevant forecasts up to seven days ahead. In parallel, reinforcement learning (RL) is emerging as a practical tool for optimizing sequential decision such as reservoir releases, pumping, and irrigation under multiple, often conflicting objectives. On the monitoring side, open remote-sensing portals (e.g., FAO's WaPOR) enable wide-area, routine estimation of evapotranspiration and water productivity, while modern deep learning methods improve the interpretation of satellite and in-situ signals for water quality and ecosystem health. This article synthesizes high impact use cases, emphasizes good practice (spatiotemporal validation, uncertainty quantification, and physics-informed design), and points to open data and operational systems that make AI deployments reproducible and actionable for agencies and utilities.

Keywords: *water resources management; artificial intelligence; flood forecasting; reservoir operations; irrigation scheduling;*

Assessment of groundwater quality and human health risks in arid and semi-arid regions using WQI and HQ-Nitrate Models: a case study of the Kairouan plain (Tunisia)

Ridha Khammari[1*], Younes Hamed[2], Salem Bouri[3]

1. University of Gabès, Higher Institute of Water Sciences and Techniques of Gabès, Gabès, Tunisia

2.University of Gafsa, Faculty of Sciences of Gafsa, Gafsa, Tunisia

3. Water, Energy and Environment Laboratory (LR3E), National Engineering School, University of Sfax, Sfax, Tunisia

**Correspondence to:* khammariridha1983@gmail.com

Abstract

Groundwater resources, especially deep aquifers, are increasingly vital under climate change conditions, as they provide a reliable source of water during droughts. Their strategic importance is growing in arid and semi-arid regions facing declining surface water availability. Sustainable management of these reserves is crucial to adapt to future water challenges. This study investigates the groundwater quality of the Kairouan plain (Central Tunisia) through the hydrochemical analysis of borehole water samples. It evaluates the suitability of groundwater for both drinking and agricultural uses by applying two composite indices: the Drinking Water Quality Index (DWQI) and the Irrigation Water Quality Index (IWQI), incorporating key physico-chemical parameters. In addition, human health risks associated with nitrate contamination were assessed using the Hazard Quotient (HQ_nitrate) model. The DWQI results show that most water samples fall within the range of 50 to 100, suggesting acceptable quality for human consumption, though continued monitoring is recommended. Regarding irrigation suitability, the analysis based on five key parameters (electrical conductivity, sodium adsorption ratio, sodium, chloride, and bicarbonate) indicates that only 50.4% of samples are classified as suitable, 36.6% as medium suitability, and 13.3% as unsuitable for irrigation. The $HQ_{nitrate}$ model revealed that approximately 10% of the samples exhibit moderate to high risk levels, with children identified as the most vulnerable group. These findings highlight the need for integrated groundwater management strategies and provide valuable insights for policymakers to ensure the sustainable use and protection of groundwater resources in the region.

Keywords: *Groundwater, Water quality index, hydrochemistry, health risks, Central Tunisia.*

Impact of Anthropogenic Activities on Groundwater Quality and Irrigation Suitability in the Seriana Plain, Algeria

Nawel Benouara[1,2], Retima Nadjib[1,2], Boukhari Sofiane[3,4], Hamza Bouchahed[1,2], Essia Boudjebieur[5]

1 Department ofHydraulic, Faculty of Technology, Badji Mokhtar–Annaba University, P.O. Box 12, 23000, Annaba, Algeria

2 Laboratory of Soils and Sustainable Development, Faculty of Science, Badji-Mokhtar Annaba University, P.O.Box 12, 23000 Annaba, Algeria)

3InfraRes Laboratory, University of Souk Ahras, 41000 Souk-Ahras, Algeria

4Department of Civil Engineering, Faculty of Science and Technology, University of Souk Ahras, 41000 Souk-Ahras, Algeria

5Departement of geology,Faculty of Earth Sciences, Geography and Territorial Planning BP 32 Bab Ezzouar, 16111 - ALGER.

**Correspondence to: Nawel Benouara* nawel.benouara@univ-annaba.dz*

Abstract

The Seriana Plain, located in northeastern Algeria, relies heavily on groundwater as its primary water source to meet the region's drinking, irrigation, and industrial needs. This study, conducted throughout 2019, aimed to assess groundwater quality and its suitability for irrigation by collecting and analyzing water samples during both the dry and wet seasons. Physico-chemicalanalyseswereperformedtoexaminekeywaterqualityparameters, including calcium, magnesium, sodium, potassium, bicarbonate, nitrate, chloride, sulfate, pH, and electrical conductivity. The assessment was based on the Irrigation Water Quality Index (IRWQI), along side several additional indices such as Sodium Percentage (Na%), Sodium Adsorption Ratio (SAR), Residual Sodium Bicarbonate (RSBC), Permeability Index (PI), Kelly's Ratio (KR), Magnesium Hazard (MH), and Potential Salinity (PS). To visualize the spatial distribution of groundwater quality, a Geographic Information System (GIS) environment was employed using the Inverse Distance Weighted (IDW) interpolation technique. This enabled the creation of maps illustrating the spatial variability of the irrigation water quality indices cross the study area. The study findings indicate that the degradation of groundwater quality in the region is largely driven by human activities. To ensure the sustainable use of groundwater for agricultural purposes, itis essential to implement urgent measures to treat the water before irrigation use and to develop effective management strategies to protect this vital resource from further pollution.

Keywords: *Groundwater Quality, Irrigation Water Quality Index (IRWQI), GIS Mapping, Hadrochemical Parameters, Seriana Plain.*

Examination of the physical-chemical quality of the water from the Koudiet Medouar barrage – BATNA –Algeria

Retima Nadjib [1]*, Benouara. Nawel [2], Boukhari Sofiane[3] and Bouchahed Hamza [4]

1,3 InfraRes Laboratory, University of Souk Ahras, 41000 Souk-Ahras, Algeria

2,4 Laboratory of Soils and Hydraulic, Faculty of Technology, Badji-Mokhtar Annaba University, P.O. Box 12, 23000 Annaba, Algeria

1, 2,4 Department of Hydraulic, Faculty of Technology, Badji Mokhtar-Annaba University, P.O. Box 12, 23000 Annaba,

3 Department of Civil Engineering, Faculty of Science and Technology, University of Souk Ahras, 41000 Souk-Ahras, Algeria

Nadjib Retima: (E-mail: nadjib.retima@univ-annaba.dz)

Abstract

This study assesses the physicochemical quality of water in the Koudiet Medouar Reservoir, located in the Batna Province of eastern Algeria. A systematic sampling campaign was conducted to measure key parameters, including temperature, pH, electrical conductivity, total suspended solids (TSS), chloride (Cl^-), phosphate (PO_4^{3-}), ammonium (NH_4^+), nitrate (NO_3^-), and organic matter content. The evaluation takes into account both climatic variations and potential anthropogenic influences, such as wastewater inputs. The results demonstrate that the physicochemical integrity and organic matter levels are in compliance with Algerian water quality standards. This adherence is largely due to the lack of direct industrial or domestic effluent discharges in the immediate surroundings, which reduces anthropogenic contamination and helps maintain the reservoir's water quality under present environmental conditions. The findings contribute to the understanding of surface water quality in semi-arid regions and support the need for continued monitoring to preserve water resources.

Keywords *: Quality, Surface water, physico-chemical parameter.*

Enhancing Irrigation Efficiency for Date Palm Cultivation in Arid Environments: A Case Study Using Regulated Drip Systems in the Tozeur Oasis, Tunisia

Latifa Dhaouadi[1,2,*], Aya Ayouni[3], Houda Besser[2], Fatma Wassar[3]

[1]*Regional Research Center For Oasis Agriculture, Deguech Toozeur Tunisia*

[2]*Ermology and combating Desertification Laboratory, Institute of arid regions, Mednine, Tunisia*

[3]*Higher Institute of Sciences and Techniques of Water of Gabes, Gabes, Tunisia*

**Corresponding author: Latifa Dhaouadi*

Abstract

The sustainability of agriculture in Tunisian oasis depends critically on the efficient management of scarce water resources. This study evaluates the performance of regulated drip irrigation systems for *in vitro*-propagated *Phoenix dactylifera L.* grown under the hyper-arid conditions of the Tozeur oasis in southern Tunisia. The research focuses on quantifying soil-water dynamics, optimizing irrigation scheduling, and enhancing water use efficiency (WUE) in young date palm plantations.

Field experiments were conducted in Degeuche, where the soil was characterized as sandy loam with an average bulk density of 1.46 g/cm³, a gypsum content of 14.8%, and low organic matter (<0.6%). Water retention analysis showed a field capacity (θ_fc) of 14.15%, a permanent wilting point (θ_wp) of 7.88%, and an available water content of 6.27%. Saturated hydraulic conductivity (Ks) ranged from 0.34 to 0.92 cm/h, indicating moderate permeability.

Irrigation was applied through pressure-compensating drippers (4 L/h), with daily volumes adjusted to match phenological stages and reference evapotranspiration (ET_0). Soil moisture was continuously monitored using tensiometers and gravimetric methods. Results showed that regulated drip irrigation-maintained root-zone moisture within the optimal range (θ = 10–13%), significantly reducing both deep percolation and surface evaporation. Application efficiency exceeded 90%, and water productivity improved by over 25% compared to traditional irrigation practices in the region. These findings highlight the potential of regulated drip irrigation to optimize WUE, reduce water losses, and enhance the productivity of oasis agriculture under extreme arid conditions.

Keywords: *Date palm, drip irrigation, soil moisture dynamics, water use efficiency, Tunisian oasis*

Assessment of water quality in some Northeastern Algerian dams

Feyrouz Hafid[1*], Badreddine Saadali[1], Hicham Zerrouki[1], Marwa Benslama[1], Chams Abid[1]and Haythem Dinar[2]

1Department of Geology, University of Oum-El-Bouaghi, Algeria

2Centre de Recherche en Aménagement du Territoire (CRAT), Campus Zouaghi Slimane, Route de Ain el Bey, 25000 Constantine, Algérie

**e-mail:fhafid@yahoo.fr*

Abstract

This study aims to evaluate the water quality of seven dams located in eastern Algeria by combining several complementary approaches: the Water Quality Index (WQI), the Organic Pollution Index (OPI), the Specific Pollution Index (SPI), the Nutrient Pollution Index (NPI), and the trophic ratio TN/TP.

The results highlight contrasting levels of pollution depending on the sites. For instance, the Kissir Dam shows good water quality with a WQI of 58.7 and an OPI of 1.25, indicating low pollution, while Hammam Grouz exhibits a WQI of 123.4, an OPI of 2.75, and a TN/TP ratio of approximately 10.9, reflecting severe pollution dominated by phosphorus inputs. Beni Haroun Dam also shows an alarming water quality status (WQI = 115.6; SPI = 2.1; NPI = 1.9).

Overall, three dams (Beni Haroun, Hammam Grouz, Foum El Gherza) are classified in the "polluted to highly polluted" category, whereas the others show low to moderate pollution. These results underline the major influence of domestic effluents (NH_4^+, OM) and agricultural discharges (NO_3^-, PO_4^{3-}) on water quality.

To mitigate the degradation of aquatic ecosystems and reduce the risk of eutrophication, it is essential to install wastewater treatment plants (WWTPs) on the main tributaries feeding the dams, and to strengthen drinking water treatment plants in order to ensure compliance with water quality standards for human consumption.

Keywords: *Water quality, dams, pollution, WWTP, water treatment, Algeria*

Contribution of Electrical Resistivity Tomography to the Understanding of the Hydrogeological Controls of Spring Emergence

Hicham Zerrouki[1*], Feyrouz Hafid[1], Badreddine Saadali[1], Haythem Dinar[2] and Mazouz El Hadi[1]

1Department of Geology, University of Oum-El-Bouaghi, Algeria

2Centre de Recherche en Aménagement du Territoire (CRAT), Campus Zouaghi Slimane, Route de Ain el Bey, 25000 Constantine, Algérie

**e-mail:fhafid@yahoo.fr*

Abstract

The Oum El Bouaghi region, located in northeastern Algeria in the High Constantine Plains, is an internal area belonging to the para-autochthonous domain of the northern Aurès, part of the North Algerian Alpine chain. The region is characterized by a semi-arid climate, with a combination of heat and cold, rugged terrain, and diverse sedimentary geological structures. These factors significantly affect the quality and quantity of surface water and make it difficult to access groundwater at considerable depths.

A 2D electrical imaging survey was conducted to highlight the geological conditions responsible for the emergence of three water springs (Aïn Ratat, Aïn Ledjledj, and Aïn Ras elHamra) located northeast of the Reghis Mountain. Data interpretation revealed that the water from these springs generally emerges from the contact between impermeable, conductive marl formations and resistant sandstone formations, as follows:

- **El-Ratat Spring:** A permeable resistant formation (over 65.6 Ohm.m) in contact with impermeable conductive marl formations (below 52 Ohm.m).
- **Ledjledj Spring:** The presence of marl (13.9 to 22.7 Ohm.m) in contact with resistant formations (ranging from 60 to 90 Ohm.m).
- **Ras el-Hamra Spring:** Contact between Burdigalian sandstone formations (exceeding 1481 Ohm.m) and Cenomanian marl formations (below 2.28 Ohm.m).

Additionally, the presence of faults has facilitated water circulation, leading to the emergence of these springs.

Keywords: *Oum-El-Bouaghi, water springs, 2D electrical imaging, Ratat, Aïn Ledjledj, Aïn Ras elHamra.*

Modelling and optimization of intermittent drying of Strawberries

Houda Hachem[1]*, Jihen Touati[1], Daoued Mihoubi[1]

[1]Laboratory of Wind Energy Control and Waste Energy Recovery, LMEEVED, Research and Technology Centre of Energy, CRTEn, Borj-CedriaTechnopark, B.P No. 95, 2050, Hammam Lif, Tunisia

** Correspondence to: Houda.Hachem@crten.mesrs.tn*

Abstract

Intermittent drying is one of the simplest and most cost-effective techniques to improve the final quality of strawberries while addressing challenges related to their overproduction. Optimizing this drying process is crucial for enhancing energy efficiency and preserving the physicochemical and nutritional properties of the end product. Although strawberry drying has been extensively studied, the application of Response Surface Methodology (RSM) for modeling and optimizing intermittent drying remains limited. This study aims to evaluate the influence of key process parameters on energy consumption, effective moisture diffusivity, and drying time during intermittent drying of strawberries, and to determine optimal operating conditions using RSM. The effects of drying temperature, sample thickness, and intermittence ratio (IR) on moisture removal kinetics, temperature evolution, energy use, and overall drying efficiency were thoroughly investigated. In addition, the evolution of both longitudinal and radial shrinkage during the drying process was analyzed. A Box–Behnken response surface design with three factors at three levels was employed to model the drying process and assess the impact of the independent variables: drying temperature (X_1: 45–75 °C), intermittence ratio (X_2: 0.16–0.5), and sample thickness (X_3: 1–5 mm) on various response variables. These included drying time (Y_1), energy consumption (Y_2), effective moisture diffusivity (Y_3), as well as quality indicators such as sugar content, total polyphenols, and acidity (Y_4, Y_5, Y_6). Results show that drying temperature and sample thickness had the most significant effects on drying time, energy consumption, effective moisture diffusivity and final product quality. Higher drying temperatures significantly reduced the drying time and improved the diffusivity coefficient, butdecreases final product quality. Moderate drying conditions (around 60 °C, medium sample thickness, and IR of 0.33) led to optimal retention of sugar content, total polyphenols, and acidity, highlighting the importance of balancing process efficiency with product preservation.

Keywords: *Strawberry, Energy consumption, intermittent drying, Response surface methodology*

Drying Methods and Quality Preservation in Prickly Pear Fruits

Houda HACHEM[1*], Khaoula KHOUAJA[1], Daoued MIHOUBI[1]

[1]Laboratory of Wind Energy Control and Waste Energy Recovery, LMEEVED, Research and Technology Centre of Energy, CRTEn, Borj-CedriaTechnopark, B.P No. 95, 2050, Hammam Lif, Tunisia

** Correspondence to: Houda.Hachem@crten.mesrs.tn*

Abstract

The fruits of the prickly pear (Opuntia ficus-indica) are seasonal products with varying shades, ranging from yellow to deep red. Their pigments, rich in bioactive compounds, are highly sensitive to thermal processing methods used for preservation, particularly drying. This study aims to evaluate the effect of different drying methods, convective drying, infrared drying, and freeze-drying, on the bioactive and sensory properties of prickly pear fruits harvested in the Mahdia region of Tunisia. Sliced fruits were dried using convective drying at 50, 60, and 70 °C, infrared drying, and freeze-drying at −40 °C and 0.25 mTorr. Several parameters were measured, including total polyphenol content (TPC), sugar content (SC), antioxidant activity (AA) and colorimetric coordinates (L* a* b*). Additionally, the impact of drying techniques on drying kinetics was analyzed, focusing on the temporal evolution of the dimensionless moisture content, drying rate, and moisture diffusion coefficient. Results show that freeze-drying best preserved the nutritional and sensory qualities of the prickly pear, maintaining the highest TPC, antioxidant activity, and most stable color parameters. Infrared drying provided a good compromise between process efficiency and quality retention. In contrast, convective drying at higher temperatures led to significant degradation of bioactive compounds and color deterioration. Drying kinetics revealed that infrared drying achieved faster moisture removal and higher diffusion coefficients than convective drying, while freeze-drying showed the slowest but most protective drying profile. These findings highlight the importance of selecting appropriate drying methods to balance process efficiency with preservation of fruit quality.

Keywords: *prickly pear fruits, antioxidant activity, color, drying*

Predictive modeling of wheat yield under water flooding stress: a decision tree approach

Hoceme DEGAICHIA[1]*, Sara HEZIL[1], Khadidja BOUSSAID[1] and Ahcène HAKEM[1]

[1]*Centre de recherche en Agropastoralisme, CRAPast, Djelfa - Algeria*

[2]*They should be preceded by a numerical superscript corresponding to the same superscript after the name of the author concerned*

[3]*Please ensure that affiliations are as full and complete as possible and include the country*

**Correspondence to: hoceme.degaichia@crapast.dz*

Abstract

This research aims to examine the impact of water flooding on durum wheat yield using a predictive modeling approach based on CHAID analysis. Randomized complete block trials were conducted in two locations, with and without waterflooding, using four durum wheat cultivars (GTA dur, Citra, Simeto, and Boussalem). The assessment of yield loss highlighted significant sensitivity of cultivars to waterflooding, with Simeto showing the highest yield loss (64.33%). The CHAID analysis enabled the identification and prioritization of factors influencing yield, revealing that waterflooding is the most important predictor (71.14%), followed by the average number of tillers per plant (16.74%), cultivar (6.32%), and plant emergence density (5.80%). Beyond merely observing the negative impact, our model allows for predicting yield losses based on various agronomic parameters. The results showed that waterflooding significantly reduces yield (16.89 $q.ha^{-1}$), but tillering and cultivar also play an important role in wheat response to water stress. The study highlights the importance of predictive modeling to anticipate yield losses and guide crop management decisions in flood-prone areas.

Keywords: *precision agriculture, risk management, water stress, Triticum durum*

Electro-driven direct lithium extraction from hydrothermal brines to generate battery-grade lithium hydroxide

Wissem Zaaraoui[1]*, Fateh Drifi[1], Younes Hamed[1], Elimame Elaloui[1], Rihab Hadji[2]

1 L. R. Laboratory of Application of Materials to the Environment, Water and Energy (LR 21ES15), Department of Chemistry, Faculty of Sciences of Gafsa, Sidi Ahmed Zarroug University Campus - 2112 Gafsa, Tunisia*

2Department of Earth Sciences, Institute of Architecture and Earth Sciences, Ferhat Abbas University. Laboratory of Applied Research in Engineering Geology, Geotechnics, Water Sciences, and Environment, Ferhat Abbas University, 19137, Setif, Algeria Algeria.

Abstract

As Li-ion batteries are increasingly being deployed in electric vehicles and grid-level energy storage, the demand for Li is growing rapidly. Extracting lithium from alternative aqueous sources such as hydrothermal brines plays an important role in meeting this demand. Electrochemical intercalation emerges as a promising Li extraction technology due to its ability to offer high selectivity for Li and its avoidance of harsh chemical regenerants. In this work, we design an economically feasible electrochemical process that achieves selective lithium extraction from Salton Sea geothermal brine and purification of lithium chloride using intercalation materials, and conversion to battery grade (>95% purity) lithium hydroxide by bipolar membrane electrodialysis. The results demonstrate the potential of our technology for electro-driven, chemical-free lithium extraction from alternative sources.

Keywords: *Lithium extraction, hydrothermal groundwater*

Assessment of Groundwater Quality and Health Risks in the Regueb Aquifer, Central Tunisia

Rim Missaoui[1,2,3], Younes Hamed[1,3,4], Salem Bouri[5]

[1] *Laboratory for the Application of Materials to the Environment, Water and Energy (LAM3E), Faculty of Sciences of Gafsa, University of Gafsa, Tunisia. Emails:* rimmissaouimissaoui@gmail.com , hamed_younes@yahoo.fr

[2] *Department of Water Sciences, University of Gabes, Higher Institute of the Sciences and Techniques of Waters of Gabes (ISSTEG), Gabès, Tunisia.*

[3] *International Association of Water Resources in the Southern Mediterranean Basin, Gafsa, Tunisia*

[4] *University of Houston, Texas-USA, Department of Earth & Atmospheric Sciences.*

[5] *Water, Energy and Environmental Laboratory (L3E), ENIS, Street Soukra Km 3.5, BP.W: 3038, Sfax, Tunisia. Emails:* salem_bouri@yahoo.fr

**Correspondence to:* rimmissaouimissaoui@gmail.com

Abstract

The intensive agricultural practices in the Regueb region, Central Tunisia, have led to the overexploitation of groundwater resources and a decline in water quality. This study assesses the hydrochemical characteristics, suitability for irrigation and drinking, and associated health risks in the Regueb aquifer. Using a multidisciplinary approach integrating hydrogeological and hydrochemical analyses, water quality indices (IWQI, DWQI, NPI), and human health risk assessment models (HQ), we provide a comprehensive evaluation of groundwater contamination.

The results indicate that 76% of the study area contains water unsuitable for human consumption due to high salinity (TDS) and elevated nitrate concentrations, exceeding the WHO permissible limits. Spatial distribution maps of water quality indices reveal a moderate to high vulnerability of the aquifer, with anthropogenic activities being a significant contributor to contamination. Furthermore, health risk assessments show that nitrate pollution poses a greater risk to children due to their lower body weight and higher water intake rates.

These findings highlight the urgent need for sustainable groundwater management strategies, including pollution mitigation measures, improved irrigation techniques, and long-term monitoring programs. The study serves as a scientific foundation for policy development aimed at protecting water resources in arid and semi-arid regions.

Keywords: *Groundwater quality, Health risk, Nitrate pollution, Water vulnerability, Regueb aquifer, Tunisia*

Hydro-geophysical characterization of aquifers in kef area (northern Tunisia) from 3D gravity inversion and VES

Ramdhane Benassi[1]*and Sofien Al Yahyaoui[2]

[1] *Faculty of Sciences Gafsa, University of Gafsa, Tunisia*

[2]*Research Laboratory Geosystems, Géoressources and Géoenvironnements, University of Gabès» (LR3G), Faculty of Sciences of Gabes, University of Gabes. Tunisia.*

[3] *Georessources Laboratory, Water Research and Technology Center, CERTE, Borj Cedria Ecopark, Soliman, Tunisia.*

**Correspondence to: benassi_ramdhane@yahoo.fr*

Abstract

In the context of increasing water scarcity driven by climate change and rising demand, accurate characterization of groundwater resources is essential for sustainable water management. This study presents a geophysical investigation aimed at delineating aquifer structures in northwestern Tunisia. A 3D inversion of gravity data was employed to image subsurface geological formations and identify major structural features controlling groundwater distribution. The resulting gravity models reveal the spatial arrangement of sedimentary sequences and highlight gravimetric lineaments corresponding to fault zones and formation boundaries. To enhance subsurface resolution, gravity data interpretation was integrated with Vertical Electrical Sounding (VES) and Time-Domain Electromagnetic (TDEM) methods. The integration of these geophysical datasets allows for a more comprehensive characterization of the hydrogeological framework, improving the delineation of aquifer extents, depths, and connectivity. The combined geophysical approach not only refines the understanding of the regional groundwater system but also provides a valuable tool for groundwater exploration and sustainable management. The findings underscore the importance of multi-method geophysical investigations in arid and semi-arid regions, where data scarcity and complex geology often hinder effective groundwater assessment.

Keywords: *geophysical inversion, aquifer, VES, TDEM,* northwestern Tunisia

Study of the coastal ecohydrology of the Ghar El Melh lagoon, Gulf of Tunis, Mediterranean, for sustainable water management

Chaima KACHBOURA *[1], Oula AMROUNI[1] and Luis CHICHARO[2]

1Marine Laboratory, National Institute of Marine Sciences and Technologies (INSTM), University of Carthage, Tunisia

2University of Algarve, Faro (UALG) (Portugal)

Correspondence to:chaima.kachboura@etudiant-fst.utm.tn

Abstract

The Ghar El Melh (GEM) lagoon has been recognized since 2022 as the first coastal ecohydrology demonstration site, designated by UNESCO in Africa and the Mediterranean. Renowned for its ecological and socio-economic value. Meanwhile, this wetland faces multiple environmental issues, shaped by both natural and human factors. This research aims to analyze the interactions within marine ecosystems, including sediments and associated macrophytes, and to understand how water quality influences them. Within this framework, this study adopts a multidisciplinary approach to explore the GEM coastal lagoonin the Gulf of Tunis, Tunisia, for sustainable water resources management. The methodology used relies on sedimentological analysis, geochemical characterization, and the identification of bioindicator species of pollution. The granulometric results reveal heterogeneous sediment distribution in the lagoon. Indeed, the Sidi Ali El Mekki (SAM) sebkha is characterized by medium sand, well-sorted with a unimodal mode (Mo=0.38mm). While the GEM lagoon is dominated by the muddy fraction (D50 <0.063mm) in 91% of cases. The sand particle size is found in the El Boughaz channel at 9%. The silt–clay fraction is rich in carbonates, likely due to shell accumulation. Cadmium levels in submarine sediments range from 0.047 to 0.068ppm. Flora identification shows the occurrence of *Ulva rigida* and *Chaetomorpha linum* at station GEM1, near the harbor, as well as the halophyte *Sarcocornia fruticosa* along the lagoon's landward edges. This ecohydrological approach offers a holistic perspective through lagoon bioindicators and water quality to assess the wetland's response to ecological stressors.

Keywords: *Sustainable water resources management, coastal ecohydrology, sediments, Ulva rigida, Chaetomorpha linum.*

Predictive Modeling and Spatial Analysis of Irrigation Water Quality in the Tozeur Oasis Region: An ANN-Based Approach

Fatma BEN BRAHIM 1,2; Zouhour MOUSSAOUI 1,3; Salem BOURI 1,4

[1]*Water, Energy and Environment Laboratory (LR3E), National School of the Engineers, B.P.W.3038 Sfax, Tunisia*

2Department of Earth Sciences, Faculty of Sciences of Gabes, University of Gabes, Tunisia

3University of Gabes, Higher Institute of Water Sciences and Techniques of Gabès (ISSTEG)

4Department of Earth Sciences, Faculty of Sciences of Sfax, University of Sfax, Tunisia

**Correspondence to: bfatma27@yahoo.fr*

Abstract

This study focuses on the predictive modeling and spatial analysis of irrigation water quality in the Tozeur oasis region using an artificial neural network (ANN) approach. Key water-quality parameters such as the Sodium Adsorption Ratio (SAR), Electrical Conductivity (EC), Kelly's Ratio (KR), Sodium content (% Na), Soluble Sodium Percentage (SSP), Permeability Index (PI), and Magnesium Hazard (MH), and pH were analyzed to evaluate spatial variability and assess agricultural suitability.

By applying artificial neural networks (ANNs), the study provides an enhanced understanding of water quality dynamics in this arid region, offering valuable insights for sustainable water management. Spatial mapping reveals that most sampled waters have low-to-medium irrigation quality. Areas such as Degache, Tamegza, and Hazoua exhibit the poorest water quality, while waters from central Tozeur and Nefta are suitable for restricted irrigation under proper drainage.

An optimized ANN model was developed to estimate the Irrigation Water Quality Index (IWQI)using IBM SPSS and multilayer perceptron feed-forward mechanism. The model achieved RMSE values of 0.09 and 0.07 for the training and testing datasets, respectively, indicating strong predictive accuracy. It also assist spolicymakers in developing sustainable irrigation strategies and provides researchers with valuable tools for predicting water quality and conducting spatial analysis.

Keywords*: IWQI; Salinity hazard; Sodium risk; Multilayer Perceptron ; Sustainable irrigation; Artificial Neural Networks ; Arid region water management*

Synthesis and characterization of a novelorganic-inorganic composite for Congo Red dye removal

Fatma Ounis, Nesrine Kamoun and Hamza ELFIL

Laboratory Desalination and Natural Water Valorization, Center of Water Researches and Technologies (CERTE), Soliman 8020, Tunisia

Abstract

Water resource pollution by dyes, resulting from effluent discharges due to various intensive industrial activities, presents a persistent environmental and human health problem. So far, various physical and chemical treatment methods have been reviewed for the removal of dyes, such as biological degradation, ion exchange, chemical precipitation, reverse osmosis, adsorption, coagulation, flocculation, etc. Among them, adsorption is considered to be the most efficient due to its high removal efficiency, easy operation, cost-effectiveness, and recyclability of the adsorbents.

Considering this, the present work focused on removing Congo Red from water using an organic–inorganic adsorbent. This adsorbent was prepared by incorporation of iron oxide into the cellulosic framework of cresson seeds powder using the co-precipitation method. The morphology and structure of the prepared material were examined using N_2 physisorption, FTIR spectroscopy, pH_{PZC} and XRD. The effects of several critical factors, such as initial dye concentration, solution pH, temperature, contact time, and adsorbent dose on the dye adsorption performance are also optimized in batch mode. The obtained results showed an excellent removal capability of this adsorbent for CongoRed, which reaches 96 %.

Keywords: *Adsorption; Congo Red; Water treatment; Bio-adsorbent*

Innovative bio-material for efficient methylene blue removal from aqueous solution

Emna Melliti*, Nesrine Kamoun, Fatma Ounis, Hamza Elfil

[a)] *Laboratory of Desalination and Nature Water Valorization, Center of Water Researches and Technologies (CERTE), B.P. 273, Soliman 8020, Tunisia.*

**Corresponding author e-mail:emna.melliti@certe.rnrt.tn*

Abstract

Besides in the rapid growth of the world population, industrialization, unplanned urbanization, agricultural activities as well as the excessive use of chemicals have contributed to environmental pollution. Wastes produced by human activities have resulted in high volumes of contaminated water which threatens human health and other living organisms. Discharge of colored substances into water bodies not only can aesthetically cause issues but also itis harmful to biological organisms and ecology. Therefore, this work deals with the activation and characterization of a green natural adsorbent, black cumin seeds, and its application for adsorption of Methylene blue dye from aqueous solution.

Treated bio-material was activated with Sodium Hydroxide and characterized using Fourier transform Infrared (FT-IR), X-ray diffraction (XRD), scanning electron microscopy techniques. Batch experiments were performed with varying adsorbent dose (0.005 - 0.04g. L^{-1}), pH of the solutions(2 - 10), contact time (15 - 120min), concentration (10 - 220 mg. L^{-1}) and agitation at 300 rpm. Langmuir, Freundlich isotherm models were used to determine the adsorption capacity.

Results of the study indicated that this activated bio-adsorbent allows can ensure a total removal efficiency of 98% for 10 minutes, while using a low mass of bio adsorbent (0.02 g). This biomaterial maintains high performance in a wide pH range. The adsorption process exhibited a maximum adsorption capacity of 41.19 mg. g^{-1} at ambient temperature.

Key words: *Water treatment; Adsorption; Methylene bleu; Black cumin*

Study of the sedimentary archives of the Ghar El Melh lagoon in the context of climate change over the last two centuries

Ons JDAY [3], Oula AMROUNI [1],& Abderraouf HZAMI [1] Yoann COPARD [2]

[1] *National Institute of Marine Sciences and Technologies, Laboratory of Marine Environment, University of Carthage*

[2] *UMR CNRS 6143 ''Continental and Coastal Morphodynamics", Department of Earth Sciences and Environment, University of Rouen-Normandy, 76821 Mont-Saint-Aignan Cedex, France*

[3]*Tunis Faculty of Sciences, Tunis-El Manar University, 2092 Tunis, Tunisia*

**Correspondence:oula.amrouni@instm.rnrt.tn*

Abstract

Recent sedimentary and Carbon storage changes at the Ghar El Melh lagoon (Gulf of Tunis) are investigated using a multiproxy approach of sediment cores completed by Rock Eval pyrolysis analysis. The aim of this study is to focus on understanding the biogeochemical interactions between sediments, organic matter, and plant communities, which promote blue carbon sequestration and strengthen their role in climate change mitigation. The methodology is based on the multi-proxy analysis of a sediment core (GEM22-01) sampled in July 2022. Granulometric analysis indicated that lagoon sediments are composed by 78% silty facies and 22% sandy facies. The geochemical study showed heterogeneous Total Organic Carbon (TOC) content from 1.22 to 4.00 wt%. %. The high levels are likely related to the aquatic primary productivity of the lagoon. Four sedimentary units were identified, within an evolution of grain-size from a sandy (Units 1, 2)to a silty deposit. This latter is enriched with organic matter (OM)content. Geochemical characterization of the high-resolution deposits (1cm) shows the vertical variation of the distribution of TOC content, with the highest levels found in the finest particle sizes (Unit 4). However, the lowest TOC content, ranging from 1.22 to 2.60% is found in Unit 2, an indicator of organic decomposition of the sedimentary column under geochemical conditions of the water/sediment interface. This sedimentary study reveals the hydrodynamic environmental changes of the lagoon deposit during the last decades, probably due to the Medjerda river course changes, human activities, and climate change stressors.

Keywords: *Ghar El Melh lagoon, climate change, sedimentary archive, organic matter, paleoenvironment*

Geophysical approach for the identification of the structure of the neritic limestone aquifer of Hammam Bradaa (average Seybouse) N.E. Algerian

Abdelhamid Khedidja[1*], Rahma Khadri[2], Mohammed Khelifa[3]

[1]Laboratory of mobilization and management of water resources (LMGRE). Department of Geology - Institute of Earth Sciences, University of BATNA 2, Batna, Algeria. Mail : khedi73@yahoo.fr

[2]Laboratory of mobilization and management of water resources (LMGRE). Department of Geology - Institute of Earth Sciences, University of BATNA 2,Batna, Algeria.

[3]Laboratory of mobilization and management of water resources (LMGRE). Department of Geology - Institute of Earth Sciences, University of BATNA 2, Batna, Algeria.

Corresponding author: Khedidja Abdelhamid

Mail : khedi73@yahoo.fr

Abstract

The neritic aquifer which extends between Hammam Bradaa and El Fedjoudj because of its faulted structure and in places karstified, its power and its lateral extension represent a strategic resource for the region, the waters are used for water supply drinking water in neighboring towns: Heliopolis, Guelaat Bousbaa, Nechmaya and El Fedjoudj as well as part of the wilaya of Annaba. These neritic limestones outcrop at Djebel Debagh and Bouzitoune.

In order to better know the potential of this aquifer, it is essential to identify its geometry and its structure by analyzing the geological data, mechanical drilling data and the analysis of geophysical data by the electrical prospecting campaign. The main results indicate that the study area has identified two important aquifer formations: a formation in the Mio-Plio-Quaternary alluvium consisting of clays, marls, gravel and sand; the second is a deep carbonated aquifer composed of fissured and karstified neritic limestone of the Cretaceous age of variable depth oscillating between 50m and 350m.

The originality of the study consists in demonstrating that the study area is characterized by the presence of thick, cracked and karstified carbonate formations that are intensively tectonized and have significant aquifer potential.

The correlation of the geological data with the geophysical data made it possible to conclude that the study area presents a sedimentary basin limited by faults of a preferential orientation South-West, North-East, forming a strongly fractured unit, thus constituting the horsts and grabens. The significant water potential reservoir formed by essentially carbonated geological formations very cracked with the presence of Karstic forms represented by resistant horizons.

Keywords: *Hammam Bradaa, geometry, electrical prospecting, neritic limestone.*

Morphodynamic study of the Coastal dune After the setting-up of windbreakers: A Case of Ghar El Melh, Tunisia

Zahra SALLEMI [1,2], Oula AMROUNI [2], Abderraouf HZAMI[2], Essam HEGGY[3]

[1] *Faculty of Sciences ofTunis, University Tunis El Manar, 2092 Tunis, Tunisia*

[2] *National Institute of Marine Sciences and Technologies, Laboratory of Marine Environment, University ofCarthage*

[3] *University of Southern California, Viterbi School of Engineering, Dept. ofElectrical Engineering &Electrophysics, 3737 Watt Way, Powell Hall of Engineering, Office 502, Los Angeles, California, 90089-1112, USA*

*Correspondence:zahrasallemii@gmail.com

Abstract

The aim of this study is to determine the sedimentological and morphological state of the eroding sandy beach of Ghar El Melh, Gulf of Tunis, Tunisia, after the setting up of windbreakers management in 2022, to evaluate the effectiveness in mitigating marine erosion. The sediment sampling and topography measurements based on the LiDAR surveys were carried out in May and September 2025 respectively. Topometric datasets processing using Cloud Compare were combined with photogrammetry surveys occurred from 2022–2024. A total of 26 sediment samples were collected over three main sectors: 1-the managed coastal dunes (S1) ,2-The managed and non-monitored dunes (S2) in “Coco” beaches and 3- the non-managed dunes (S3) in Sidi Ali El Mekki beach. The Grain-size indexes analyses (Mz, σ, Sk, Ku, modality) reveal textural variability. Sedimentological results shows that the S1 site is dominated by medium (~70%) and fine (~30%) sandy distribution (Ø>0.063 mm), well-sorted, unimodal, with fine-skewed distributions and leptokurtic curves, reflecting a grain-size sorting both by marine-swash processes and aeolian transport of the trapped sediment by the eco-friendly management. However, S2 and S3 sites shows coarser sediments components within an average of 45–75% coarse fractions, poorly sorted and coarse-skewed tails, reflecting heterogenous sources (lagoonal, alluvial and anthropogenic) winnowed by high energy conditions. Digital Surface Model (DSM) and High-Resolution topographic measurements show maximum dune height accretion of 35 ± 0.1 cm/year in the S1 site. Findings indicate that sandy accretions observed after implementing the Nature-Based Solution management confirm that dune restoration helps safeguard the coastal system against marine erosion and sea-level rise.

Keywords: *Coastal Dune, sediment, LIDAR, Windbreaker, Ghar El Melh, Mediterranean*.

Clay-Based Barrier Systems for Sustainable Management of Phosphogypsum

Ines Benaoun[1,2]*, Aidi Marzouki[3,4], Arif Ismail[5] and Noureddine Hamdi[1,2]

[1] Higher Institute of the Sciences and Techniques of Waters of Gabes, University of Gabes, 6072 Zrig Gabès, Tunisia

[2] Laboratory of Composite Materials and Clay Minerals, National Center for Research in Materials Science, Borj Cedria (CNRSM), B.P. 73-8020 Soliman, Tunisia

[3] Higher Institute of Technological Studies of Rades, BP 172, 2098 Radès Medina, Tunisia

[4] Laboratory of Civil Engineering, University of Tunis El Manar, National Engineering School of Tunis, B.P. 37 Le Belvédère, 1002 Tunis, Tunisia

5 Earth scope consulting, Setif, Algeria.

**Corresponding author, Email:inesbeaoun@gmail.com*

Abstract

Phosphogypsum, a by-product of the phosphate fertilizer industry, represents a significant environmental concern due to its large volumes and chemical composition, which often contain radioactive elements and heavy metals. One of the major challenges associated with its storage is the infiltration of leachates into groundwater, leading to adverse impacts on water quality.

To better understand these risks and propose suitable management solutions, laboratory experiments were conducted to characterize the influence of phosphogypsum on the geotechnical behavior of different clays, focusing on parameters such as compressibility, swelling pressure, permeability, and shear strength, both under natural conditions and after acid leaching (phosphoric solution). These experimental results provided the basis for a numerical study aimed at evaluating the potential of these clay soils as a sealing barrier in phosphogypsum storage sites. The investigation focused on two clay types: the smectitic clay of the Aleg Formation (AG) and the clay of the El Haria Formation (EH) from Jebel Haidoudi, Gabès. The study combined laboratory tests with numerical modeling based on Eurocode 7 and Plaxis 2D. Numerical analyses estimated maximum allowable deposit heights of 38.5 m for AG soil and 57.2 m for EH soil. Bearing capacity verification according to Eurocode 7 confirmed sufficient soil strength, with values exceeding 1 MPa for AG and 2 MPa for EH. Furthermore, Plaxis 2D simulations revealed that most of the settlements occur within the phosphogypsum deposit itself. Overall, the EH clay demonstrated superior stability and load-bearing capacity, whereas AG clay remains viable under appropriate monitoring conditions.

Keywords: *Clays; Heavy Metals; Landfill Site; Phosphogypsum.*

Low-cost ceramic membranes: Manufacturing methods, and application in wastewater treatment

Abir Taher[*1,2], Kawther Yahia[1,2], Assia Ben Amor[1,2], Miguel A. Rodriguez[3], Noureddine Hamdi[1,2]*

1- Higher Institute of Water Sciences and Techniques of Gabes, University of Gabes, Zrig 6072, Gabes, Tunisia

2- Laboratory of Composite Materials and Clay Minerals, National Center of Research in Materials Sciences (CNRSM), B.P.73–8020. Soliman, Tunisia

3- Institute of Ceramics and Glass (ICV), CSIC, Kelsen 5, Cantoblanco, 28049 Madrid, Spain

**: Corresponding author, Email: abirtaherlf3sa@gmail.com*

Abstract

The research focused on the preparation of different types of membrane studies, and the influence of inorganic precursor types on the stability, morphology, and porous texture of the inorganic matrix.

This work aims to prepare low-cost ceramic membranes to be used in a filtration process. The manufacturing of low-cost ceramic flat membranes via dry pressing and extrusion, using low-cost material, especially, natural Illite clay from Tataouine (South Tunisia), calcite, and dolomite from Gabes (South Tunisia), and organic waste collected from the seawater station of a power generation center (North Tunisia) as a pore-forming agent.

This study began with the characterization of the raw material to choose the best condition for membrane preparation. After the characterization, the ceramic supports were sintered at 950 °C, 1000 °C, and 1050 °C for 2 hours to obtain flat ceramic membranes of 25 mm in diameter. Critical parameters for the membrane performance such as porosity, density, mechanical strength, gas permeability, and water flux, were determined.

The best results were for the support made of 50% clay, 10% dolomite, 10% calcite, and 30% organic waste sintered at 1000 °C with a porosity of 37% and a diametrical compression strength of 3.1 MPa. It showed a gas permeability of about 2624 L h^{-1} m^{-2} bar^{-1} at 1.4 bars and a water flux of 1010 L h^{-1} m^{-2} at a pressure of 0.9 bar. Three membranes were effectively tested to remove the fat in a solution containing 10% milk.

Keywords: *Ceramic membranes; clay; dolomite; calcite; mechanical strength*

Textile dye adsorption by natural perlite

Beloufa Nabil[1], Fethallah Nourelhouda[1], Otmane Cherif Abdulillah[1], Hachemaoui Anouar[1], Bekheira samir[1], Abess Malika[1]

[1]*Institut hydrométéorologique de Formation et de Recherche (I.H.F.R), Oran Algeria.*

Abstract

In today's world of industrial progress, pollution is a major concern, especially water pollution. Considered a real danger to mankind, this article looks at the treatment of water contaminated by textile dyes, which has become a danger to humans and the environment. As an example, we have chosen the green dye FB (anionic type) which is found in the rejects of a textile factory ENADITEX in the industrial zone of the wilaya of ORAN - ALGERIA, this dye is among the most used in the textile industry. The method adopted for dye removal is adsorption by natural perlite. The Experimental results showed that adsorption of the green dye FB on the porous solid studied: natural perlite, gave a removal rate of 87.51% for 60 minutes. The adsorption isotherms of the adsorbent/adsorbate systems studied are satisfactorily described by the two mathematical models Freundlich and Temkin. All the results obtained show that the adsorption kinetics of the green dye FB by the solid material is well described by the second-order model. The adsorption reaction is a physisorption, as the thermodynamic study demonstrated.

Keywords: *adsorption, green dye FB, perlite, Adsorption Isotherm, Thermodynamic study.*

Flood Risk on National Road N°6 in Sedjrara (western Algeria) under Climate Change.

Hachemaoui Anouar[1], Abess Malika[1], Beloufa Nabil[1], Fethallah Nourelhouda[1], Otmane Cherif Abdulillah[1]

[1]*Institut hydrométéorologique de Formation et de Recherche (I.H.F.R), Oran Algeria.*

Abstract

Climate change is intensifying the frequency and magnitude of extreme hydrological events, significantly increasing flood risk — particularly in vulnerable semi-arid regions. This study assesses the projected evolution of flood hazard along National Road N°6 in the commune of Sedjrara (Mascara Province, Algeria), an area recurrently impacted by flash floods. Moving beyond large-scale climate assessments, this work delivers a localized, integrated analysis by coupling statistically downscaled climate projections with hydrological and hydraulic modeling to enhance flood risk evaluation under future climate conditions.

Historical precipitation records from multiple meteorological stations were rigorously quality-controlled and gap-filled to ensure data integrity. Statistical downscaling techniques were applied to refine outputs from an ensemble of Global Climate Models (GCMs) under various Representative Concentration Pathway (RCP) scenarios. Extreme rainfall events were statistically characterized using the Gumbel distribution to derive design storms for multiple return periods (e.g., 10-, 50-, 100-year events). These rainfall inputs were then transformed into runoff hydrographs using the SCS Unit Hydrograph method implemented in HEC-HMS. The resulting discharge hydrographs served as boundary conditions for 2D hydraulic simulations in HEC-RAS, enabling high-resolution mapping of flood extents and depths along the RN6 corridor.

Results indicate a consistent and substantial increase in peak discharges by mid- and late-century with the most pronounced rises occurring for long return periods. Simulated inundation maps reveal a significant spatial expansion of flood-prone zones, exposing critical infrastructure, agricultural assets, and residential areas to heightened risk. These findings highlight the escalating vulnerability of the Sedjrara region under climate change and underscore the urgency of proactive adaptation strategies.

This integrated modeling framework combining downscaled climate data, hydrologic simulation, and 2D hydraulic modeling offers a robust, transferable methodology for anticipating future flood hazards at the local scale. Updating engineering design standards, land-use planning regulations, and emergency response protocols is imperative to build resilience against increasingly extreme and unpredictable flood events.

Keywords: climate change; statistical downscaling; Gumbel distribution; SCS; HEC-HMS; HEC-RAS

Création d'une Base de données spatiales et d'une application WEB Mapping à partir des données du levé topographique par Drone d'une carrière de Calcaire dans la Colline du Mormont (Suisse).

Radhia Ben Harb

Résumé

La technologie drone permet l'acquisition fiable, rapide et précise de nuages de points en 3D géoréférencées. Cette technique permet de déterminer la hauteur du terrain même en présence d'une végétation peu dense. Les traitements appliqués au nuage de points drone sont avant tout une classification que nous voulons la plus automatique possible compte tenu du volume de données à traiter.

L'objectif principal de ce projet est de mettre en place une méthodologie de travail pour générer un modèle stéréoscopique, Orthophoto et la classification automatique pour la modélisation 3D d'un terrain. Ensuite une édition manuelle a été effectuée sur le nuage de points qui a été classé pour la génération du MNT et des Orthophotos. La conception d'une base de données spatiale a été décrit les composantes de la carrière pour les présenter par la suite dans une application Webmapping.

Mots clés: Drone, classification, nuage de points, MNT, Modèle 3D, WebMapping

Phytoremediation efficiency of *Arundo donax* roots for cadmium and lead removal: Insights from response surface methodology

Boussaid Khadidja*[1], Deghaichia Hossem[1], Lafri Imene[1]

[1]*Research Center Agro-Pastoralism (CRAPast)- Djelfa, Algeria*

**Correspondence tokhadidja.boussaid@crapast.dz*

Abstract

Heavy metal contamination of water, particularly by cadmium (Cd) and lead (Pb), poses serious risks to environmental and human health. Phytoremediation using tolerant plants with extensive root systems offers a sustainable solution to mitigate this issue. This study investigated the potential of *Arundo donax* for Cd and Pb removal from aqueous solutions under controlled conditions for 30 days. The Response Surface Methodology (RSM) was employed to evaluate and optimize the effects of exposure time, initial concentration, and plant biomass on metal removal efficiency. Results showed significant reductions in waterborne Cd (up to 78%) and Pb (71%). Metal accumulation was predominantly observed in the root system, with bioaccumulation factors exceeding 1 and low translocation to aerial parts, confirming a phytostabilization mechanism. RSM analysis validated the statistical significance of all tested variables ($p < 0.05$), and predictive models demonstrated high accuracy ($R^2 > 0.95$). These findings highlight *A. donax* as a promising species for low-cost, root-based phytoremediation of Cd- and Pb-contaminated waters, with strong potential for integration into constructed wetland systems.

Keywords: *phytoremediation,* Arundo donax*, cadmium, lead, roots, response surface methodology*

Hydrogeochemical characteristics of groundwater in the Hassi Ameur area (North-West part of Algeria)

Mohammed Khelifa[1*], Abdelhamid Khedidja[1], Hamidi Mansour [2]

University of Batna 2, Laboratory of mobilization and resources management, Batna, Algeria

University of Oran 2, Laboratory of Georesources, Environment and Natural Hazards, Oran, Algeria.

** Correspondingauthor:med.khelifa@univ-batna2.dz*

Abstract

The groundwater aquifers in the Hassi Amer region, which are part of the Asti-Calabre complex, form a vast unconfined aquifer. However, the rise of new industrial activities in 1973 has complicated the situation, potentially leading to various types of contamination. The physicochemical characterisation of the aquifer water shows that it is generally highly mineralised. This mineralisation is largely controlled by sodium, magnesium, sulfates, and chlorides. The water in the study area is typically characterised by a sodium chloride composition, and in some cases, by calcium or magnesium as well. The study of saturation indices provided deeper insight into the equilibrium state of the aquifer water with respect to the main carbonate and sulfate minerals. The water is slightly oversaturated with calcite, aragonite, and dolomite, and undersaturated with gypsum and anhydrite. The aquifer water in the study area is poorly suited for irrigation and may pose a risk of soil alkalinisation. This water is classified as unfit for human consumption and is generally characterised by a high degree of hardness.

Keywords: *Hydrogeology, geological, aquifer, mineralization, Hassi Ameur.*

Statistical analysis of Groundwater quality in Teleghma plain (North-East Algeria)

Mouna Dekakra, Khedidja Abdelhamid

1Laboratory of mobilization and management of water resources (LMGRE). Department of Geology - Institute of Earth Sciences, University of BATNA 2, Batna, Algeria. Mail : khedi73@yahoo.fr

2Laboratory of mobilization and management of water resources (LMGRE). Department of Geology - Institute of Earth Sciences, University of BATNA 2,Batna, Algeria. Mail: mouna.dekakra.geo@gmail.com

Corresponding author: Khedidja Abdelhamid

Mail : khedi73@yahoo.fr

Abstract

Groundwater quality assessment in agricultural regions requires robust analytical tools to disentangle the combined effects of natural hydrogeochemical processes and anthropogenic pressures. In the Teleghma plain (North-East Algeria), where groundwater is the main source for agricultural use, intensive farming practices have raised concerns about nitrate enrichment. To better understand the factors controlling groundwater chemistry, a statistical approach was adopted, complementing conventional hydrogeological and hydrochemical investigations. A dataset of 23 groundwater samples was subjected to multivariate statistical analyses, including Principal Component Analysis (PCA) and Hierarchical Cluster Analysis (HCA). PCA was used to reduce the dimensionality of the dataset and identify the dominant variables explaining groundwater composition. HCA allowed the classification of samples into homogeneous groups, highlighting spatial and chemical similarities. The PCA results revealed that two main components explained more than 64 % of the total variance. The first component reflected natural geochemical controls, such as mineral, dissolution and water–rock interaction, while the second component was strongly associated with anthropogenic inputs, mainly agricultural fertilizers leading to nitrate accumulation. HCA supported these findings by distinguishing three main groundwater clusters: (1) low-mineralized waters with limited human impact, (2) moderately impacted waters where natural and anthropogenic influences overlap, and (3) highly polluted waters characterized by elevated nitrate concentrations, often exceeding the WHO guideline of 50 mg/L.

Keywords: *Statistics, PCA, HCA, Water quality*.

Statistical refinement of Lanthanum recovery in nitrate medium by nanofiltration process

Feriel Ghitri, Nasreddine Belkhouche*, Nacera Benyahia, Zyneb Sefrou and Meryem Mesli

Laboratory of Separation and Purification Technologies (LTSP N°38)

Faculty of Sciences - University Abou Bekr Belkaid of Tlemcen

Bp119- 13000 Tlemcen- Algeria

** Email : nbelkhouche@yahoo.fr*

Abstract

The nanofiltration experiments of lanthanum recovery in nitrate medium by using the nanofiltration pilot were carried out. The experimental data were treated by using experimental designs namely the basic 3^3 factorial design and the industrial designs asBox-Behnken and Taguchi. The data treatment was achieved by using statistical tools (Fisher and Student) for the understanding between accuracy and precisely in the results obtained experimentally. Also, to determine the controllable (signal) and uncontrollable (noise) experimental factors which influence the nanofiltration process and to predict the optimum conditions of lanthanum recovery with the best response. In fact, the statistical refinement showed that the Box-behnken model is the most appropriate model to describe our experimental results of lanthanum recovery by the nanofiltration process. Thus, the reduced cubic Box-Behnken model gave a predicted optimum retention (98.55%) with adesirability of 100% close to that obtained experimentally (98.44%) taking into account transmembrane pressure, metal ion concentration and counter-ion concentration as the most tree experimental factors. Modeling by basic3^3factorial designs showed that the maximum retention expected is 98.74%. This result is close to that found experimentally (100%) considering the experimental deviation (±1.15), obtained in the absence of the counter-ion. Whereas, Taguchi's design showed that the used model (L_4) is significant and that there is no chance that model occurring due to noise (low F-value). However the error variance due to uncontrollable factors was 1.24% < 5% of risk but the percentage of error contribution (11.61%) was greater than 5% (admissible risk). This shows that the model chosen (L_4) will not enable us to describe our experimental results accurately and precisely.

Keywords : *Nanofiltration, La(III), Modeling, Basic design3^3, Box-Behnken, Taguchi*

Groundwater resources: challenges and future opportunities in Northwestern Tunisia

Yosra Ayadi1, Kaouther Ncibi1, Malika Abbes2, Younes Hamed1

[1]*University of Gafsa, Faculty of Sciences of Gafsa, Department of Earth Sciences, Gafsa, Tunisia*

[2]*Hydrometeorological Institute for Training and Research (IHFR), Oran, Algeria*

Abstract:

Ensuring the sustainability and security of groundwater resources requires identification of region-specific challenges and solutions to accommodate water needs in diverse sectors, including ecosystems in Northern Tunisia. They are related to extensive variations in natural conditions (e.g. geology, geomorphology and hydrology), human interventions, and political, cultural and socio-economic realities that need to be considered in working towards sustainable development. To achieve this goal, it is important to understand social transformations and societal drivers, as well as management and governance challenges which hinder effective groundwater management and access. Unlocking the future opportunities of groundwater require to integrate the existing knowledge and emerging tools and techniques to explore the unknown resources, and device governance strategies to improve livelihoods and health, build more resilient water futures, and move towards long-term sustainable and equitable groundwater use.

The physico-chemical behaviour of groundwater are largely influenced by the hydraulic and chemical properties of the aquifers in which it is stored (carbonate/dolomite/alluvial…), as well as human interferences such urban and irrigation activities. Groundwater is invisible, its vertical and horizontal flow in porous aquifers is often extremely slow, recharge rates are uncertain, long residence times and discharge processes typically taking place over timescales of several years to millennia. Flow through fractured, crystalline or karstic media is highly unpredictable and influenced by bedrock geology and discontinuity pathways, as demonstrated by studies in Jendouba and Beja (NW Tunisia), in this study. The current reliance of global food production by irrigation through non-renewable groundwater could constitute a threat to global food security in the mid to long term.

Keywords: *Groundwater quality, management and governance challenges, NW Tunisia*

AI integration in groundwater quality ranking and sustainability

Soumaya Hajji*, Nabila Allouche, Emna Bougharriou and Salem Bouri

Laboratory of «Water-Energy and Environment» B.P 3038, E.N.I-Sfax,Tunisia

Soumaya.Hajji@fss.usf.tn

Abstract

Accurate and efficient ranking of groundwater quality is critical for sustainable resource management and public health protection. Traditional methods, often reliant on expert-driven index calculations, can be time-consuming, subjective, and struggle with complex, non-linear relationships within water quality datasets. This study proposes a novel framework that integrates Artificial Intelligence (AI) to automate and enhance the groundwater quality ranking process. We developed a methodology that combines the Groundwater Quality Index (GQI) with an unsupervised AI technique, the Self-Organizing Map (SOM), to cluster and rank sampling wells based on hydrochemical data. The model was trained and tested on a comprehensive dataset comprising ten key parameters (e.g., pH, nitrate, chloride, heavy metals) from over 60 wells in a semi-arid region. The results demonstrate that the AI-integrated approach successfully generated a robust and spatially explicit ranking of groundwater quality, effectively identifying clusters of wells with similar hydrochemical characteristics. The SOM clustering provided deeper insights into the dominant pollution factors influencing each rank category, surpassing the interpretative limitations of a single index value. The major implication of this research is that AI integration offers a powerful, data-driven tool for environmental scientists and policymakers, enabling more rapid, objective, and nuanced groundwater quality assessments. This can significantly improve monitoring efficiency and inform targeted remediation strategies.

Keywords: *groundwater quality ranking, Artificial Intelligence, SOM, semi-arid region, remediation startegies.*

Integrating WQI and Fuzzy Logic in GIS for Groundwater Irrigation Suitability: Case Study of the Souassi Aquifer, Tunisia

Ghada Nasri*, Fatma Benbrahim and Salem Bouri

University of Sfax, Water-Energy and environment Laboratory B.P3038 ENISfax-Tunisia.

**Correspondence to: nasrighada93@gmail.com.*

Abstract

Nowadays, groundwater is an essential resource in many countries due to the shortage of surface water, particularly in arid and semi-arid zones. Therefore, monitoring the quality of this resource is crucial since it is widely used in several fields. The aim of the present study is to assess and evaluate groundwater quality for irrigation in the Souassi aquifer using the Water Quality Index (WQI) and the Fuzzy logic method integrated with GIS functions. According to the analytical results, the calculated WQI values range between 14 and 60 for irrigation purposes. The generated Fuzzy spatial maps indicate that the "desirable" and "acceptable" groundwater quality classes are located in the central and southern parts of the study area, whereas the "undesirable" quality is mainly observed in the northern sectors, due to intensive agricultural activities and over-exploitation of the aquifer. Furthermore, the Fuzzy membership levels represented in GIS-based maps show a high correlation ($r = 0.79$) with the WQI-assessed values for irrigation suitability. Grouping analyses also confirm these spatial patterns, showing that anthropogenic pressures generally coincide with the unsuitable zones for irrigation. The findings of this research contribute to a better understanding of groundwater sustainability and provide support to decision-makers in planning water management strategies and resource protection.

Keywords: *Groundwater quality, Irrigation suitability, Water Quality Index (WQI), Fuzzy logic, Souassi aquifer (Tunisia)*

Chlorination Performance Assessment in Drinking Water Distribution Systems

Sirine Sallemi, Emna Melliti* and Hamza Elfil

**Corresponding Author: emna.melliti@certe.rnrt.tn*

Laboratory Desalination and Natural Water Valorization, Center of Water Researches and Technologies (CERTE), Soliman 8020, Tunisia

Abstract

Water disinfection for human consumption is the essential step for drinking water treatment process. This process significantly reduces the spread of various waterborne infectious diseases, thereby making an important contribution to the protection of human health. Chlorination is the most widely applied technique, which has led to considerable progress in terms of public health worldwide. This is attributed to its effectiveness, low cost, as well as its monitoring and prolonged residual effect up to the points of consumption. Although chlorination is a highly effective method for disinfecting water, chlorine generates disinfection by-products (DBPs) that are both genotoxic and cytotoxic. These by-products are formed through the interaction of chlorine with dissolved natural organic matter present in the raw water. Therefore, the main of this study is to evaluate and optimize the effectiveness of drinking water disinfection processes across different regions of Tunisia. UV-Visible spectrometry was employed as the analytical method for monitoring chloride levels. The study also examined the influence of various parameters, including pH and organic matter, on the chlorination process.

The results revealed significant regional variations in disinfection efficiency. In Soliman, daily monitoring indicated irregular variations, even within a single day. This work showed a significant impact of pH and organic matter on the effectiveness of water disinfection.

Keywords: *Drinking water; Disinfection; Chlorination; Disinfection by-products*

Impacts of water quality and irrigation frequency on soil characteristics

Rabah ATTAB[1], Imane KAMASSI[2], Souad BENDAOUD[2] and Sofiane SAGGAI*[1,3]

[1] Laboratory of Water and Environment Engineering, Kasdi Merbah University, Ouargla, Algeria

[2] Department of Civil Engineering and Hydraulic, Kasdi Merbah University, Ouargla, Algeria

[3]Saharan Area Laboratory for Modernization and Development of Agriculture (SALAMALab), Higher School of Saharan Agriculture – El Oued, PB 90 Chouhada, El Oued 39011, Algeria

**Correspondence to: saggai.sofiane@esas-eloued.dz*

Abstract

Water is a crucial factor affecting soil properties, particularly in arid regions where salinity and irrigation management strongly influence soil quality and agricultural productivity. This study investigated the combined effects of water quality and irrigation frequency on the physicochemical characteristics of sandy soils in Ouargla, Algeria. Three types of water were tested: treated wastewater from a purification station, tap water, and distilled water supplemented with salt. Twenty-seven plastic containers were filled with sandy soil and divided into three groups, each irrigated with one water type at different frequencies: once daily (T1), twice daily (T2), and three times daily (T3).

Water samples were analyzed before and after irrigation for pH and electrical conductivity (EC), while soil samples were evaluated weekly for the same parameters. Results indicated that soil properties varied significantly with both water quality and irrigation frequency. In general, irrigation contributed to a reduction in soil EC, while soil pH remained alkaline and relatively stable across treatments. The treated wastewater proved to be the most suitable water source for sandy soils, maintaining favorable soil properties compared to tap water and saline distilled water. Its EC ranged between 1054 and 3698 µS/cm in the first week and between 760 and 804 µS/cm in the second week, while soil pH values remained within 7.06–8.04.

These findings highlight the potential of treated wastewater as an alternative irrigation source in desert regions, as it can preserve soil quality under different irrigation regimes. Proper management of water type and irrigation frequency is therefore essential to sustain soil fertility and agricultural development in arid environments.

Keywords: *water quality, irrigation frequency, soil characteristics, electrical conductivity, pH*

The impacts of climate change on human health: an alarming fact

ABDERRAHMANE Djoher1 , Ait Habouche-Mihoub Ouahiba1

1Faculty of economics, Management and Business sciences. University of Mohamed BENAHMED Oran2. Algeria. Mail: djoher.abderrahmane@gmail.com LARAFIT Laboratory. CEDIMES-France.

Summary

In recent years, climate change has impacted on health in many ways, including deaths and illness from increasingly frequent extreme weather events such as heat waves, storms and floods, disruption of food systems, increases in zoonoses, food-borne, water-borne and vector borne diseases, and mental health problems. The aim of this work is to shed light on climate change, its impacts and consequences on human health. In addition, current climate change compromises many of the social determinants of good human health, such as livelihoods equality and access to healthcare and social support structures, and so on.

Keywords: *climate change, human health, health crises, environmental crises, epidemics, heatwave.*

Cartographie de l'humidité du sol dans le bassin versant d'Oued Khelouia (Nord-Ouest Algérien) à partir des images satellitaires Aster et Landsat

NEHAL Laounia[1,2], Semari khadidja [2], HAMIMED Abderrahmane[1]

[1] Laboratoire de Recherche sur les Systèmes Biologiques et la Géomatique (LRSBG*), Université Mustapha Stambouli de Mascara, Algérie ;*

[2] *Département d'Hydraulique, Faculté des Sciences et de la Technologie, Université Mustapha Stambouli de Mascara, Mascara, Algérie;*

l.nehal@univ-mascara.dz, hamimed@univ-mascara.dz

Résumé

L'humidité du sol est largement reconnue comme une variable clé dans de nombreuses études environnementales en relation avec la météorologie, l'hydrologie et l'agriculture. Dans cette étude, la précision de la méthode du triangle (qui exploitent les dimensions d'un triangle résultant de la corrélation entre les indices de végétation et la température de surface) a été évaluée pour l'estimation de l'humidité du sol à partir d'une image satellitaire Aster, une image Lansdat ETM+ et deux images OLI/TIRS, acquises durant les mois février, mars et avril 2019. L'expérimentation a été menée durant la même période dans le bassin versant d'oued Khelouia, d'une superficie de 79,8 km^2, situé dans le nord-ouest de l'Algérie. L'analyse était basée sur des mesures in-situ de l'humidité du sol de 14 points à travers le bassin versant, répétées sur les 4 jours relatifs aux acquisitions des données satellitaires utilisées. Les mesures au sol des deux premiers jours ont été utilisées pour former le modèle, tandis que celles du troisième et quatrième jour ont été utilisées pour la validation. Une régression polynomiale second degré a été établie entre, d'une part, l'humidité du sol (mesurée in-situ) et, d'autre part, l'indice de végétation NDVI et la température de surface du sol (obtenues à partir des capteurs satellitaires utilisés). Les résultats obtenus avec le polynôme second degré de la méthode du triangle montre un ajustement satisfaisant entre les valeurs mesurées et celles estimées par le modèle, avec des coefficients de détermination (R^2) égaux à 0,67 et 0,63 pour respectivement la calibration et la validation du modèle, et des erreurs quadratiques moyennes (RMSE) égales à 5,6 et 6,2 mm pour respectivement la calibration et la validation du modèle.

Mots clés : *humidité du sol, concept du triangle, NDVI, température de surface, Algérie*

Intégration des variables géomorphologiques et topographiques dans un Système d'Information Géographique pour la caractérisation de la pluviométrie annuelle dans le bassin versant de la Macta

NEHAL Laounia[1,2], BOUREGBA Naouel[1], HAMIMED Abderrahmane[1]

[1] Laboratoire de Recherche sur les Systèmes Biologiques et la Géomatique (LRSBG*), Université Mustapha Stambouli de Mascara, Algérie ;*

[2] *Département d'Hydraulique, Faculté des Sciences et de la Technologie, Université Mustapha Stambouli de Mascara, Mascara, Algérie;*

l.nehal@univ-mascara.dz, hamimed@univ-mascara.dz

Résumé

La connaissance de distribution spatiale des précipitations à l'échelle du territoire est une condition principale pour la gestion des ressources hydriques. La variabilité des apports sous forme de pluie affecte de nombreuses activités en Algérie, en particulier, la production agricole, l'industrie et l'alimentation en eau potable. L'estimation des précipitations moyennes à l'échelle d'un bassin versant est le travail préalable à toute étude des relations pluie-débit. Le calcul des autres termes du bilan hydrologique (ruissèlement, évapotranspiration et infiltration) dépend de la précision de l'estimation des précipitations. Les données obtenues uniquement à partir des stations pluviométriques ne sont pas toujours suffisantes car la distribution spatiale des précipitations est le plus souvent liée à la topographie (altitude et aspect), aux paramètres morphométriques de l'environnement et à la position sur les surfaces continentales (distance à la mer). A cet effet, les méthodes classiques d'interpolation entre stations, qui ne prennent pas en compte les effets orographiques, ne conviennent pas aux régions où le terrain est accidenté. Avec le développement actuel des techniques de télédétection et des SIG, il est devenu possible de produire des cartes morphométriques et topographiques qui peuvent être utilisées comme variables explicatives dans l'interpolation des précipitations. La méthode présentée dans ce travail repose sur la régression linéaire multiple (RLM) pour interpoler les précipitations dans le bassin versant de la Macta d'une superficie de 14390 km². Un modèle linéaire multiple est déterminé par la RLM en prenant en considération, d'une part, les précipitations annuelles (Pm) mesurées dans 42 stations pluviométriques en tant que variable dépendante et, d'autre part comme variables explicatives, la longitude (L) de la station et sa distance de par rapport à la mer (D), ainsi que les variables dérivées du MNT, à savoir l'altitude (Z) et l'exposition (E). Le coefficient de corrélation multiple (r) obtenu est significatif (de l'ordre de 0.82), ce qui signifie que la quasi-totalité de l'information globale est expliquée par le modèle. Les résidus entre les valeurs mesurées et celles estimées par le modèle sont interpolés par les techniques de krigeage. L'application de ce modèle linéaire sur les quatre variables explicatives et leurs intégrations dans SIG a permis de dresser une première carte de pluviométrie annuelle (tenant en compte la variabilité géomorphologique du milieu). Celle-ci est additionnée à la carte des résidus obtenue par Krigeage pour avoir la carte finale de pluviométrie à l'échelle du bassin versant de la Macta. En conclusion, la distribution spatiale de la pluviométrie dans le BV de la Macta montre que les pluies augmentent avec l'altitude. Elles diminuent plus qu'on s'éloigne du littoral. Les versants exposés au Nord et à l'Ouest sont plus arrosés par rapport aux autres versants.

Mots clés *: Pluviométrie annelle, Cartographie, SIG, variables topographiques, Morphométrie, Macta.*

Study of the temporal variation of water quality in the lakes of Touggourt region

Oumelkheir Bachi[1], Ahmed Bentria[2], Asma Thabet[2] and Sofiane Saggai[3]*

[1] Laboratory of biodiversity and applications of biotechnology in agriculture, Echahid Hamma Lakhdar University, El-Oued, Algeria

[2] Department of Civil Engineering and Hydraulic, Kasdi Merbah University, Ouargla, Algeria

[3]Saharan Area Laboratory for Modernization and Development of Agriculture (SALAMA Lab), Higher School of Saharan Agriculture – El Oued, PB 90 Chouhada, El Oued 39011, Algeria

**Correspondence to: saggai.sofiane@esas-eloued.dz*

Abstract

The Saharan region of Touggourt, located in the Oued Righ valley, contains several lacustrine ecosystems that play a vital ecological and socio-economic role in local hydrology. However, these wetlands are increasingly threatened by anthropogenic pressures and climatic constraints, leading to a progressive degradation of water quality. This study aims to analyze the temporal variation of the physical-chemical characteristics of water in four representative lakes: Mégarine 1, Mégarine 2, Témacine, and Merdjaja. Monthly sampling was conducted during the 2017–2018 hydrological year. Parameters including temperature, pH, electrical conductivity, dissolved oxygen, salinity, nitrites, phosphates, ammonium, and total organic carbon were measured using standardized analytical methods. Results revealed a pronounced temporal variability of water quality linked to climatic fluctuations and anthropogenic discharges. The pH values were slightly alkaline (7.8–8.5), and the electrical conductivity exceeded 45 mS/cm in certain lakes, indicating strong mineralization. High concentrations of nutrients (phosphate up to 0.76 mg/L and ammonium around 7.6 mg/L) highlighted the influence of agricultural and domestic inputs. The strong correlation between salinity and temperature during summer confirmed the impact of evaporation on ionic enrichment. Overall, the results demonstrate that the water quality of the lakes in the Touggourt region is under significant environmental stress. Sustainable management and continuous monitoring are therefore essential to preserve these fragile Saharan aquatic ecosystems, which serve as both ecological refuges and socio-economic resources for local populations.

Keywords: *Touggourt, lake water quality, temporal variation, salinity, eutrophication*

Foraminifer distribution in the Barremian-Albian organic-rich series of the Sidi Medien reference section (Zaghouan Area, NE Tunisia): Depositional setting and regional correlations

Abdallah El Khazri[1*], and Mabrouk Boughdiri[1]

[1]*Faculty of Sciences of Bizerte, Earth Science Department, 7021 Jerzouna, TUNISIA.*

**Correspondence to: ElKhazriabdallah@yahoo.fr.*

Abstract

This study integrates total organic carbon (TOC) weight percentage and spatio-temporal analyses of foraminifers to evaluate oxygen deficiency and their adaptive strategies. A multidisciplinary approach implies lithological data, microfacies analyses, micropaleontology, sedimentological data, and organic matter content. The main results include a three-phase model:

Predating OAE 1a: The Barremian sequence exhibits alternating marly limestones. The marls bear planktonic foraminifers with globular chambers. Foraminifers with radially elongated chambers appear, alongside those with globularones. Benthonic foraminifers of larger sizes are also present, associated with some agglutinated forms. Lithologically, this interval displays a notable change at the top, marked by the emergence of calcareous beds (platelets) with well stratified marl-calcareous intercalations.

During OAE 1a: The upper part of the Lower Aptian is characterized by marls, interbedded marl-limestones, and grey-black flaky limestones with low organic matter content. Planktonic foraminifers with elongated chambers become more prevalent. The microfacies reveal organic matter presence, oxidation traces, sections of planktonic elongated foraminifera, and occasionally radiolarian sections of various shapes. Three significant events are associated with mild oxygen deficiency in the upper part of the Lower Aptian: (1) the first appearance of *Leupoldinacabri* and its abundance in certain localities; (2) the occurrence of organic-poor deposits; and (3) radiolarian blooms in some areas. The anoxic event OAE-1a is diachronous and extend sasfaras North-West Tunisia.

Postdating OAE 1a: The upper Aptian is characterized by marly sedimentation with rare limestone beds that bear globular planktonic foraminifers; abundant larger benthonic foraminifers and agglutinated forms being noted. Planktonic foraminifers with elongated chambers disappear, giving way to forms with globular chambers that increase in diversity and abundance, indicating a return to a generally oxygenated environment on a regional scale. The increase in size of benthonic foraminifers associated with keeled forms confirms a return to normal oxygenated marine paleoenvironments.

The distribution of planktonic foraminifers and their adaptive strategies in response to oxygen deficiency are correlated with similar findings from other regions within the same stratigraphic interval in Tunisia and elsewhere in the Tethyan realm.

Keywords: *Anoxic events 1a-1b, planktonic foraminifera, oxygen deficiency, adaptive strategy, N Tunisia.*

Upper Tithonian-Berriasian calpionellid biozonation and regional correlations of the Oued Soubella reference section in NE Algeria

Ichrak Cherif[1], Abdallah El Khazri[1], Rachid Touansa[2], Houaida Sallouhi[1], Fouad jaiz[2], Mabrouk Boughdiri[1,*]

[1]*Faculty of Sciences of Bizerte, Earth Science Department,7021 Jerzouna,Tunisia.*

[2]*Institute of Earth and Universe Sciences, University Mustapha Ben Boulaïd Batna 2,05078 Algeria.*

**Corresponding author.*mab_boughdiri@yahoo.fr

Abstract

This presentation aims to update the biostratigraphy of the Upper Tithonian-Berriasian series of the Oued Soubella key section in NE Algeria on the basis of a high resolution biozonation, using calpionellids as precise biomarkers. All the calpionellid zones and subzones are identified in two sections of the area, one of them (Boutaleb section) being described here for the first time. In both sections, the genus *Chitinoidella* is mentioned and the accompanying and/or relaying hyaline calpionellid species are illustrated here for the first time.

Long-distance correlations of the study sections with recently well-dated series from NE Algeria lead us to consider the Oued Soubella area's geodynamic setting as part of a pelagic resistant block's southern edge. This extends from the Algerian Kabylia foreland of Northern Constantine to the Babors paleogeographic domain.

In this same line, SE-NW correlations with coeval well-dated sections from Northern Tunisia allow us to consider the study sections as part of the Northern Tunisia 'Dorsal' edge, progressively open to the Tethyan influences via the 'Tunisian Trough'.

A synthesis from both correlations transects, in Algeria and Tunisia, provide a basis from which to propose a regional geodynamic model.

Keywords: *Jurassic-Cretaceous boundary, Calpionellids, Biozonation, Correlations, Geodynamic context.*

Qualité des eaux souterraines et leur utilisation en irrigation dans la wilaya de Souk-Ahras, en utilisant un SIG et un indice de qualité de l'eau d'irrigation

Rouaibia F[1], Bourouga M [2].

[1] *Laboratoire de gestion maintenance et réhabilitation des infrastructures urbaines,*

Université Mohamed Cherif Messaadia Souk Ahras, mail : faridrouaibia@gmail.com

Abstract :

This study developed an Irrigation Water Quality Index (IWQI) combined with Geographic Information System (GIS) zoning maps to assess the quality of groundwater resources intended for irrigation in the eastern part of Souk-Ahras Province, Algeria. The computed IWQI values range from 17.57 to 89.33, indicating that 20% of the samples fall under the category of severe restrictions, where groundwater can only be used for salt-tolerant crops. Additionally, 28% of the wells are subject to high restrictions, 36% to moderate restrictions, 12% to low restrictions, and only 4% are categorized as having no restrictions for irrigation purposes.

These findings were further supported by the USSL classification diagram, which highlighted a pronounced variability in groundwater quality with respect to its suitability for irrigation. Specifically, 20% of the samples, primarily located in the northern and northwestern parts of the study area, are considered to be of good quality for irrigation. The majority of the water samples (64%) are deemed acceptable, while 16% are classified as poor quality and require prior treatment before agricultural use.

A cross-analysis of several physico-chemical parameters such as the Sodium Adsorption Ratio (SAR), Electrical Conductivity (EC), Sodium Percentage (%Na), Chloride concentration, and Permeability Index (PI) allowed for the identification of potential soil degradation risks associated with current irrigation practices. The GIS-based IWQI zoning map provides an accurate spatial representation of groundwater quality, serving as a valuable decision-making tool for identifying critical “red zones” prone to overexploitation, and for guiding sustainable groundwater management strategies. Furthermore, these GIS maps can support recommendations for crop types best suited to the local soil conditions and water quality within the study area.

Keywords: *Index water quality irrigation. Physico-chemical analysis. Groundwater quality. GIS*

Water resources management under impact of users pressures in sfax aquifer using the weap model

Nabila Allouche [1] , Soumaya Hajji [1,2], Emna Boughariou [1,3] and Salem Bouri [1,4]

[1] *Water, Energy and Environment Laboratory (LR3E), National School of the Engineers,B.p.w.3038 Sfax, Tunisia.*

**Correspondence to: Nabila.allouche@gmail.com*

Abstract:

The sixth Sustainable Development Goal (SDG6) aims to ensure sustainable water and sanitation management for all. This study focuses on management scenarios for the Sfax shallow groundwater in eastern Tunisia, an area marked by population growth, agriculture, and industrial activity. These factors, combined with overexploitation and arid climate conditions, have degraded water quality and aquifer reserves. Using the WEAP model, the study assesses climate change impacts on water supply, demand, and socioeconomic consequences under various scenarios.

By 2040, rising demand due to population and economic growth could exceed 200 million cubic meters (MCM), leading to severe water stress. For the water use pressure scenario, there is a severe decrease in water reserves from 25MCM to 3MCM in 2040. However, implementing artificial recharge could increase reserves to 39 MCM. So, this stress could be avoided if we apply the artificial recharge like a policy for water management and may establish a state of balance of supply and demand water.

Keywords: *Sfax shallow groundwater; SDG6, WEAP; artificial recharge; water management*

Intelligence artificielle et changement climatique : modélisation, prévision et aide à la décision pour l'adaptation et l'atténuation

Otmane Cherif Abdulillah[1], Beloufa Nabil[1], Fethallah Nourelhouda[1], Hachemaoui Anouar[1], Abbes Malika[1]

[1]Hydrometeorological Institute for Training and Research (IHFR) , Ibnou Rochd,.Bp 7019, Oran, Algeria.

Abstract

Le changement climatique constitue l'un des défis scientifiques et sociétaux majeurs du XXIe siècle, caractérisé par une augmentation de la fréquence et de l'intensité des événements climatiques extrêmes, une variabilité accrue des précipitations et des perturbations profondes des systèmes hydrologiques et atmosphériques. Face aux limites des approches statistiques et déterministes classiques, l'intelligence artificielle (IA) s'impose comme un outil puissant pour améliorer la modélisation, la prévision et l'analyse des phénomènes climatiques complexes. Ce travail propose une synthèse des principales approches basées sur l'IA — incluant les réseaux de neurones artificiels, les modèles d'apprentissage profond (LSTM, CNN), les méthodes d'ensemble et l'apprentissage hybride — appliquées à l'analyse et à la prévision des variables climatiques telles que les précipitations, la température et la circulation atmosphérique. Une attention particulière est accordée au traitement des données climatiques imparfaites, notamment la complétion des séries temporelles avec des lacunes, ainsi qu'à la prévision à moyen et long terme dans un contexte de non-stationnarité climatique. L'étude met en évidence le potentiel de l'IA pour renforcer les systèmes d'alerte précoce, améliorer la gestion des ressources en eau et soutenir la prise de décision stratégique en matière d'adaptation et d'atténuation du changement climatique, en particulier dans les régions vulnérables. Toutefois, les défis liés à l'interprétabilité des modèles, à la disponibilité des données et à la robustesse des prédictions sont également discutés. Les résultats soulignent l'importance d'une intégration cohérente entre modèles physiques et méthodes d'intelligence artificielle afin de développer une intelligence climatique fiable et opérationnelle.

Keywords : *Intelligence artificielle ; Changement climatique ; Modélisation climatique ; Aide à la décision. Artificial Intelligence; Climate Change; Climate Modeling; Decision Support Systems*