

Third International Congress ISEE GEOMATICS 2023

TIMELINE GEOMATICS! ARTIFICIAL INTELLIGENCE ROLE & CLIMATE CHANGE IMPACT

<https://2023.isee-geomatrics.com>

30th October – 1st November 2023
Hammamet, TUNISIA

Proceeding

CONGRESS CHAIRS:

Noamen REBAI (ATG, ENIT/Université Tunis El Manar)
Mohamed MASTER (Université Mohamed V de Rabat)

**Third EDITION OF INTERNATIONAL CONGRESS
I SEE GEOMATICS 2023
30thOctober – 1st November
Hammamet, TUNISIA**

QUICK VIEW OF THE CONGRESS

Organization:

The Tunisian Association of Geomatics (ATG) is delighted to announce the third International Congress of I SEE GEOMATICS 2023, in collaboration with the Geotechnics Engineering and Georisk Laboratory (LRIGG) at ENIT, the University of Tunis El Manar (UTM), and the High School of Engineering of Tunis (ENIT). This event is scheduled to take place from October 30th to November 1st, 2023, in the beautiful setting of Hammamet, Tunisia.

In cooperation with:

University of Tunis El Manar (UTM), ENIT, RME Laboratory (FST), LGR Laboratory (CERTe), Sahara and Sahel Observatory (OSS), LACEEDE laboratory, CNCT, OTC, beWireless, CRITAL Laboratory, and Topo+ company.

Featuring internationally distinguished keynote speakers:

Michel Kasser (Switzerland), Yacine Bouroubi (Canada), Michel Boko (Benin), Faouzi Ghorbel (Tunisia), Pierre Grussenmeyer (France), Mohamed Mastere (Morocco).

Aim and Objectives :

The GEOMATICS 2023 conference aims to bring together researchers, research scholars, experts, and policymakers to share their research and experiences, and to discuss recent advancements in Geomatics methods and applications related to social and cultural heritage, city planning, georisk assessment, energy management, georesources, and emerging Geomatics industry surveys. The conference will encompass various aspects of modeling with intelligent systems applications, categorized into three primary topics. This colloquium will provide a platform for discussing the outcomes of research in digital web mapping and its fundamental applications. It will also offer the opportunity for a national and international expert debate.

Our main objectives include highlighting the importance of partnerships between public, private, and non-governmental organizations, as well as fostering new research on AI methods and applications, with a keen consideration of the implications of climate change. Furthermore, we will facilitate the dissemination of Copernicus Geospatial data to the broader public via "OPEN DATA".

Topics

I. Geomatics And AI.

1. Smart solutions for sustainable water, soil and air management
2. Geospatial data for Sustainable Development of agricultural resources.
3. Assessment Approaches for land use, land cover (Agrogeomatic)

4. Monitoring environment and climate changes indicators
5. Natural Resources and Environment management

II. Spatiotemporal Monitoring And 3d Mapping

1. Real Time monitoring and embedded system
2. 3D Survey and Mapping
3. Geodesign and Urban 3D
4. Solar land Modelling
5. Building Information Modelling for Sustainable Development

III. HERITAGE AGAINST CLIMATE CHANGE

1. Augmented reality for heritage simulation
2. Climate change Impact on heritage
3. Digital photogrammetry and rebuilding the monument
4. Revisited Tourism
5. WEB-GIS applications

Keynotes:

✓Michel Kasser

Geomatic Industry Survey

✓Mohamed Mastere

Les risques naturels à l'ère du changement climatique

✓Faouzi Ghorbel

Towards explainability of recent Machine Learning algorithms

✓Yacine Bouroubi

Artificial Intelligence and Big EO data applications: case studies

Workshop sessions: Monday, 30th October

Workshop 1 : Artificial Intelligence role in Geomatics

Workshops 2&3 : Climate change and modelling Geospatial

Workshop 4 : Geospatial data and sustainable development

Workshop 5 : LiDAR 3D mapping and survey

Conference Venue

The I SEE GEOMATICS 2023 will take place in Hammamet, a coastal city located in the Northeast of Tunisia. The town is very famous for its fordless white sandy beach and tourist resort. At the city center stand the old Medina and the historic fort of Hammamet.

About I SEE GEOMATICS 2019

The I SEE GEOMATICS 2019, organized from March 25th to 27th, 2019, was a highly successful scientific event. Approximately 80 scientists from seven countries (Algeria, France, Germany, Morocco, Benin, Niger, and Tunisia) delivered 56 oral presentations and presented 24 posters to

share their knowledge and research on recent advances in Geomatics and its applications for human development.

Language

Official languages: French and English without simultaneous translation.

Publication in Special

Papers presented and accepted by the scientific committee will be published in the proceedings of the colloquium. The conference's objective is to compile a series of high-quality thematic collections in special issues of renowned scientific journals (RIG) after the conference.

Proceeding Presidents

Chairman: Prof. Noamen REBAI (ATG, ENIT/Université Tunis El Manar)

Co-Chairman: Prof. Mohamed MASTERE (Université Mohamed V de Rabat)

Chairs Science Program: Dr. Raja Chairi (CERTE), Dr. Boutheina Farhat (FST), Dr. Sonia Gannouni (CERTE), Dr. Zouhour Yahyaoui (ENIT)

General Secretary: Abdelaziz Sbei (FST)

Treasurers: Rakia Chalouati, Rihem Majdoub El Fehri

Organization committee

Dr. Rihem Majdoub El Fehri,
Rihab Riahi, Ines Smaani,
Riadh El Mokh,
Dr. Raja Chairi,
Dr. Boutheina Farhat,
Prof. Salwa Saidi,
Dr. Sonia Gannouni,
Béchir Sfaxi,
Cyrine Belhaj,
Rania Chrigui,
Rakia Chalouati,
Seif Mrabet,
Adel Jelji,
Nabil Doghri,
Abderraouf Abidi,
Hichem Trabelsi,
Mohamed Chalbi,
Houda Hammami,

Scientific Committee

Tunisia : Prof. Faouzi Ghorbel (ENSI), Prof. Imed Riadh El Farah (MSE), Prof. Fakher Kharrat (ENAU), Prof. Nabil Belkhatra, DR. Mustapha Mimouni, Exp. Hamda Foughali (OSS), Pro. Abdelsalem El Ghali (FSB), Prof. Noamen Rebai, Prof .Hamdi Essaieb, Prof. Hamid Amiri, Dr. Hatem Kanfoudi, Exp. Mohamed Chelbi, Dr. Rihem Mejdoub Fehri, DR .Rihab Riahi, Dr. Sllimens Sedrette, Dr. Chaieb Ali, Dr. Adel Fridhi, Dr. Abdelkader Moussi (ENIT), Prof. Ammar Mleyah, Dr. Sonia Gannouni, Prof. Raja Chairi, (CERTE), Prof Taoufik Hermassi (INGREF), Prof. Nesrine Zoghalmi (IPEIEM), Prof. Adnen Bourehla, DR Mourad El Koundi (ESM), Prof. Moncef Zairi, DR. Mohamed Sarbeji (ENIS), Prof. Mohamed Ben chalbi, Prof. Fadhila Darragi, Prof. Salwa Saidi, Prof Abdelaziz Sebei, Dr. Bouthaina Farhat, Dr Tarek Sboui, Dr Sabiha Sleime, DR Nadia Trabelsi, Prop. Feyda Srarfi, DR Noamen Baccari (FST), Dr Hichem trabelsi, DR Achour Hamadi (ISPT), Dr Bilel Soussi, DR. Yahyaoui Zouhour, (ISET Nabeul), DR Ezzine Ahmed(CNCT), Exp. Hamdi Kacem (GMES Africa), Exp Zouheir Fatnassi (OTC), Exp. Nazih Ouerghi (US Aid), Exp. Bechir Sfaxi (Topo+)

Morocco: Prof. Mastere Mohamed (Université Mohamed V de Rabat), Prof. Moumen Aniss (National school of Applied Sciences, Ibn Tofail University Kentra), Prof. Imane Sebari, Prof. Karima Sebari (IAV) Hassan III Rabat), Prof El Bouhaddoui Mohamed (ENSVR) , Dr Nezha Mejjad(CNESTEN)

Algeria: Prof Sebhi Salim, Prof.Souidi Zahira (Université deMascara), Hadji Rihab, Prof. Larbi Jabri (Université Beji Mokhtar Annaba), Dr. Rabah Zennir (Faculté Sciences université Beji Mokhtar Annaba)

Sultanate Oman: Prof. Rifaat Abdalla (Sultan Qaboos University)

Benin: Prof. Michel Boko, Prof. Vincent Orèkan, Prof. Eric Tchibozo

Social Program

A social program is scheduled by November 1, 2023 to visit:

Training Session: 2 -4 November 2023

Immediately after the conferences, the ATG with the collaboration of the Tunis El Mana University assumes the AI role in GEOMATICS training to students/researches/Professionals, in the congress I SEE GEOMATICS context. Offering to participants the possibility to get involved in new skills and experience Early-career scientist will also have the opportunity to attend some useful keynotes in GEOMATICS given by Experts in different topics in GEOMATIC.

FOREWORD



The Tunisian Association of Geomatics with its volunteer members, academics and professionals, also with its public and private partners, organize international scientific meetings, moreover develop Geomatics projects. These projects have a cartographic connotation with a spatio-temporal analysis and modeling of natural phenomena reporting Socioeconomic and Environmental indicators. The congress in its third version "ISEE GEOMATICS 2023", which will be held in Hammamet from 30 October to 1 November 2023, is the result of collaboration with Moroccan Association of Young Geomaticists. This collaboration, born in 2013, has been developed to create the Federation of Geomatics Associations in Africa and in the Euro-Mediterranean area (FAGAEM).

Your presence at this event is an honor to us. Our most sincere thanks go to Michel KASSER, who illuminates and honors with his presence the ISEE GEOMATICS congress in its third edition.

We chose Hammamet for the organization of this congress to preserve equity between the regions. We would like to thank all the participants who believed in our congress project; their encouragement, their support for our approach, their appreciable scientific contributions, as well as their motivation to be present among us and coming from afar is an honor for us. The three days will focus on the dynamization of Geomatics and the development of research in this discipline. Similarly, it concerns the development of the Spatio-temporal analysis approach in the cartographic modeling, visualization and diffusion of information. The papers that are discussed will enrich the discussion around the theme of the contribution of cartography to Local and Regional Sustainable Development. In addition, the communications dealt with various issues related to the development of Geomatics and cartographic databases in order to valorize natural resources and enhancement instruments.

Discussions, conclusions and recommendations resulting from this congress will lead to a forward-looking geomatics cluster in order to:

- Reinforce coordination and transversality of different GIS users
- Strengthening links and linkages with various partners
- Promote tools to leverage information in terms of quality, update it and improve its circulation among different users.
- Develop quality control and mapping updating approaches

Once again, we thank all the Tunisian participants, our African colleagues (Benin, Nigeria, Algeria, Morocco), Europeans (France, Switzerland, Finland) and Canadians who have honored us with their presence and their contribution. All the work and the exhibition of the know-how of the professionals have enriched in a very significant way the congress ISEE GEOMATICS 2023. We are honored to have with us representatives of the public sector such as ONM, CNCT, ARRUE, CPG, CERTE, University Tunis El Manar, ENIT, FST, IPEIEM, private sector representatives such as SCET-Tunisia, expert geometers offices (Topo+, TopoGIS), Be-wireless design office; international bodies: Terrasolid, GISICA, OSS. We are also indebted to the organizers of the congress, to the members of the scientific committee, to the presidents of the sessions and to the various sponsors without whom this project would not have been born. Noamen REBAI

President of the International Congress
«ISEE GEOMATICS 2023»



PREAMBULE



L'Association Tunisienne de Géomatique avec ses membres bénévoles, issus de milieux universitaires et professionnels, et ses partenaires public et privé, organisent des rencontres scientifiques à l'échelle internationale et développent des projets en géomatique. Ces projets sont à connotation cartographique avec une analyse et une modélisation spatio-temporelle des phénomènes naturels à référence spatiale relevant des indicateurs Socio-Economiques et Environnementaux. Le congrès en sa troisième version « ISEE GEOMATICS 2023 » qui aura lieu du 30 Octobre au 1 Novembre 2023 à Hammamet est le fruit d'une collaboration avec l'Association Marocaine des Jeunes Géomaticiens. Cette collaboration, née en 2013, s'est développée en vue de la création de la Fédération des Associations de Géomatique en Afrique et dans l'espace Euro-méditerranéen (FAGAEM). Votre présence lors de cet événement est pour nous un honneur.

Nos remerciements les plus sincères sont dirigés à Monsieur Michel KASSER, qui illumine et honore par sa présence le congrès « ISEE GEOMATICS » dans sa troisième édition. Nous avons choisi Hammamet pour l'organisation de ce congrès afin de préserver une équité entre les régions. Nous tenons à ce propos à remercier tous les participants qui ont cru en notre projet de congrès ; leurs encouragements, leur appui pour notre démarche, leurs contributions scientifiques appréciables. Ainsi que leur motivation pour être présents parmi nous et venant de loin est un honneur pour nous. Les trois journées ont pour thèmes la dynamisation de la géomatique et le développement de la recherche dans cette discipline. De même, il s'agit du développement de l'approche analyse spatio-temporelle dans la modélisation cartographique, visualisation et diffusion de l'information. Les communications qui sont abordées permettent d'enrichir la discussion autour de la thématique de l'apport de la cartographie au Développement Durable Local et Régional. Par ailleurs, les communications ont permis de traiter diverses questions liées au développement de la Géomatique et des bases de données cartographiques afin de valoriser les ressources naturelles et les instruments de mise en valeur. Les discussions, les conclusions et les recommandations issues de ce congrès vont permettre de dégager un pôle géomatique prospectif en vue de :

- renforcer la coordination et la transversalité des différents utilisateurs des SIG
- renforcer les liens et rapprochements avec les divers partenaires
- promouvoir des outils pour valoriser l'information en termes de qualité, la mettre à jour et améliorer sa circulation entre les différents usagers.
- développer des approches de contrôle qualité et de mise à jour cartographique.

Encore une fois, nous réitérons notre remerciement à tous les participants Tunisiens, nos collègues Africains (Bénin, Nigeria, Algérie, Maroc), Européens (France, Suisse, Finlande) et Canadiens qui nous ont honorés par leur présence et par leur contribution. Tous les travaux et l'exposition du savoir-faire des professionnels ont enrichi d'une manière très significative le congrès ISEE GEOMATICS 2023. Nous avons l'honneur de voir présents parmi nous les représentants du secteur public tels ONM, CNCT, ARRU, CPG, CERTE, Université Tunis El Manar, ENIT, FST, IPEIEM, les représentants du secteur privé tels SCET-Tunisie, les bureaux de Géomètres experts (Topo+, TopoGIS), le bureau d'études Be-wireless; les organismes internationaux: Terrasolid, GISICA, OSS. Nous sommes aussi redevables aux organisateurs du congrès, aux membres du comité scientifique, aux présidents des sessions et aux différents sponsors sans qui ce projet n'aurait pas vu le jour.

Noamen REBAI

Président du congrès international « ISEE GEOMATICS 2023 »

CONTENT OF THE PROGRAM

Monday, 30th October 2023, DAY 1

Plenary Sessions

AUTOBIOGRAPHY MICHEL KASSER

Keynote 1 : Geomatic Industry Survey

15

Michel Kasser

AUTOBIOGRAPHY MOHAMAED MASTERE

Keynote 2 : Les Risques Naturels À L'ère Du Changement Climatique

17

Mohamed Mastere

AUTOBIOGRAPHY FAOUZI GHORBEL

Keynote 3 : Towards explainability of recent Machine Learning algorithms

19

Faouzi Ghorbel

AUTOBIOGRAPHY YACINE BOUROUBI

Keynote 4 : Artificial Intelligence and Big EO data applications : case studies

21

Yacine Bouroubi

Workshop sessions

Workshop 1: Application of machine learning algorithms on Google Earth Engine

23

Coordinator: Yacine BOUROUBI, Aniss MOUMEN

Workshops 2 & 3: Climate Change and Modelling Geospatial

24

Coordinator: Mohamed MASTERE, Taoufik HERMASSI

Workshop 4: Geospatial Data and Sustainable Development

25

Coordinator: Hammadi Achour, Sonia GANNOUNI, Ahmed Toujani

Workshop 5: LiDAR 3D Mapping and Survey

26

Coordinator: Michel KASSER, Béchir SFAXI

Tuesday, 31th October 2023, DAY 2: SESSION 1

Smart solutions for a sustainable environment

ORAL COMMUNICATIONS

Chairs : Yacine BOUROUBI & Michel KASSER

The contribution of Artificial Intelligence and the Platform Google Earth Engine in the Management of Water Resources of the Plain of Sminja, Zaghouan

28

Amina Missaoui, Salwa Saidi, Mustapha Mimouni

Evaluation of an existing map archive for the purpose of implementing a prediction and warning system against UVs using deep learning

29

Oussama Jraifi, Ahmed koutous, Hacheem Saadaoui, Moha El-Ayachi

Forecasting the seawater intrusion progress: Model conception (MASC2050), case of the Monastir aquifer system

30

Rihem Mejdoub El Fehri, Noamen Rebai

Predicting Spatially Explicit Composite Burn Index (CBI) from Different Spectral Indices Derived from Sentinel 2A: A Case of Study in Tunisia

31

Mouna Amroussia, Olga Viedma, Hammadi Achour, Chaabane Abbas

Diachronic study of coastline behavior using remote sensing remote sensing, Case study: Korba beach

32

Noamen Rebai, Rihem Mejdoub El Fehri, Zouhour Yahyaoui, Riadh El Mokh, Sonia Gannouni

High-Resolution Pleiades Satellite Imagery and Ground Topographic Validation for Advanced Remote Sensing in Tracking Evolution of the Eastern Coastline of Tunisia	33
Zouhour Yahyaoui, Noamen Rebai, Sonia Gannouni, Olivier Fouché, Henri Robai, Christophe Mahuzier	

Chairs : Mohamed MASTERE & Raja CHAIRI

A Comparative Assessment of Image Classification Algorithm in a Semi-Arid Region Using Landsat8 OLI_TIRS	34
Imen Hentati, Emna Medhioub	
Estimation of changes in land cover, using the Semiautomatic Classification (SCP-QGIS) of Landsat images: Case of Tessa Catchment, northern Tunisia	35
Noamen Baccari, Salwa Saidi, Abdelaziz Sebei, Taoufik Hermassi, Anis Ghattassi, Abir Oueslati	
Accuracy Assessment of Water Indices for Shoreline Extraction Based on Multi-Spectral Data: A Case Study of Mahdia-Bekalta Coast, Tunisia	36
Emna Medhioub, Imen Hentati	
Assessment of remote sensing accuracy in predicting soil salinity distribution using statistical and geostatistical approaches: A case study in the Gafsa region, Tunisia	37
Ibtissem Triki, Nadia Trabelsi, Leila Kharboub, Imen Hentati, Zoheira Ibn Ali	
Advanced Geoprocessing Techniques for accurate LULC mapping using Confusion matrix identification approach: Case of Mornag City, Tunisia	38
Anis Ghattassi, Salwa Saidi	
Study of the potential of PRISMA hyperspectral images for mapping and mineralogical exploration in Zaghouan area	39
Sarrah Hichri, Mourad El Koundi, Nouha Ben Yahia, Wafa Talhaoui	

POSTER PRESENTATIONS

Chairs: Zouhour YAHYAUI & Boutheina FARHAT

Remote sensing imageries data processing for the monitoring of Olive Mill Wastewater disposal sites using medium resolution satellite (Sentinel-2) for multiple case studies: Tunisia and Greece	41
Wissal Issaoui, Dimitrios D. Alexakis, Imen Hamdi Nasr, Athanasios V. Argyriou, Evangelos Alevizos, Nikos Papadopoulos, Ahmed Ezzine, Mohamed Hédi Inoubli	
Study and monitoring of coastal geomorphological changes using drones and DGPS in the Langue de Barbarie (Saint-Louis, Senegal).	42
Kader BA, Papa Sagne, Abdoulaye Ndour, Djibril Tine	
Intelligent solutions for sustainable biomass production from microalgae	43
Khadija EL moustaqim, Jamal Mabrouki, Driss Hmouni	
Accuracy assessment of ML, SVM, and RT machine learning methods for efficient land cover mapping in the Manouba region, NE Tunisia.	44
Nadia Trabelsi, Ibtissem Triki, Imen Hentati, Nizar Rachdi	
Use of ASTER image for lithological discrimination of Fom Tataouin area, Southern Tunisia (Gypsum of Mestaoua)	45
Jamel Seddik, Nouha Ben Yahia, Wafa Talhaoui	
Air quality monitoring using Sentinel 5P images	46
Islem Neffati	
Use of ASTER imagery in the study and mapping of calcium carbonates in the Jebel Kebar region, Sidi Bouzid.	47
Skander Nsiri, Mourad El Koundi, Nouha Ben Yahia, Wafa Talhaoui	
Assessing Coastal Aquifer quality in Ghar el Melh: Impacts of Climate 2 Changes and Human Activities	48
Nadia Khazri, Essam Heggy, Hsami Abderraouf, Imen Rais, Oula Amrouni	
A statistical physics approach to understanding the adsorption of methylene blue on cobalt oxide nanoparticles	49
Younes Dehmani, Ali Dehbi, Dison S. P. Franco, Hind Omari, Jordana Georgin, Adil Lammini, Younes Brahmi, Kaoutar Elazhari, Mohammed Messaoudi, Najib Dahbi, Youssera Bengamra, Taibi Lamhasni, Awad A. Alrashdi, Abdalaziz Abdallaoui	

Tuesday, 31th October 2023, DAY 2: SESSION 2

Geospatial data and environmental Management

ORAL COMMUNICATIONS

Chairs : Abelaziz SEBEI & Salwa SAIDI

- Contribution of remote sensing to the study of land degradation in the Medjerda watershed.** 51
Ahmed Ezzine, Taoufik Hermassi, Emna Kochlef, Mourad Salhi
- Characterization of the spatial variability of soil salinity in different areas along the Great Green Wall in the Trarza Wilaya, Southwest Mauritania, using geostatistics and kriging.** 52
Mohamed Mahmoud Abidine, Nessiba Itawel Oumrou, Lemane Mohamed Cheikh, Ahmedou Soulé, Ahmedou Vadel
- Identification of the main factors acting on seawater intrusion by multivariate statistical analysis of the Monastir aquifer, Tunisia** 53
Rihem Mejdoub El Fehri, Boutheina Farhat, Noamen Rebai
- Impact of Urban Evolution on Water Resources: Case of the Essijoumi Watershed** 54
Sabrine Ammar, Salwa Saidi, Abdelaziz Sebai
- Hydrospatial Modeling - New Term and Old Ingredients** 55
Rifaat Abdalla
- Managing Uncertainty and Imprecision in Spatio-Temporal Database Queries for Flood Events** 56
Manel Chehibi, Ahlem Ferchichi, Imed Riadh Farah
- Estimation of Forage Biomass through Remote Sensing: Case of Pastoral Resources in Heterogeneous Mediterranean Environment** 57
Jacem Ben Hamden, Imad Shaqura, Fabien Stark, Jean-Baptiste Féret
- Machine learning for water data management : bibliometric study** 58
MOUMEN Aniss, MEJJAD Nezha, EL ANSARI Rachid, EL BOUHADDIQUI Mohamed

Chairs : Rifaat ABDALLA & Ahmed EZZINE

- Urban City Planning through Photogrammetric Processes: The Case of La Marsa, Tunis** 59
Yeslem Ahmed Oumar, Noamen Baccari, Seifallah Mrabet, Abdelaziz Sebei
- BIM Modeling and Advanced Spatial Analysis for Constructions: Case of Building S+GF+2+C in Île-de-France.** 60
Ali Chaieb, Imed Mazouzi
- Advancing a Conceptual Framework for Optimizing the Placement of Pumped Energy Transfer Stations through Multi-Criteria Analysis: A Case Study in Tabarka, Tunisia** 61
Mohamed Ayet Allah Bilel Soussi, Noamen Rebai, Chamseddine Zaki
- Agricultural Sector in Cap-Bon and Collaboration Opportunities.** 62
Hatem Ben thamer

POSTER PRESENTATIONS

Chairs: Raja Chairi & Mohamed MASTERE

- Enrichment of Remote Sensing Ontology based on linked Domain Ontologies and Textual Corpora** 64
Sourour Ouerghi, Mohamed Farah, Fethi Ghazouani
- Assessment of remote sensing accuracy in predicting soil salinity distribution using statistical and geostatistical approaches: A case study in the Gafsa region, Tunisia** 65
Ibtissem Triki , Nadia Trabelsi , Leila Kharbout, Imen Hentati, Zoheira Ibn Ali
- Vulnerability of Mornag groundwater to pollution** 66
Abdelaziz Sebei, Boutheina Farhat, Noamen Baccari, Imen Mezrioui, Salwa Saidi
- Estimation of Salinity in a Brackish Area Based on the Assessment of the Spatial and Temporal Distribution of Halophytic Vegetation (Salicornia) Case of Sebket Halk El Menjel (Sousse).** 67
Sonia Gannouni, Rihab Riahi , Noamen Rebai
- The influence of irrigation with treated wastewater on the soils of the irrigated perimeter of Cebelat Ben Ammar-Borj Touil-Ariana (Tunisia)** 68
Ines Smaani, Sonia Gannouni, Salma Boussen, Noamen Rebai
- The contribution of the Geographic Information System and remote sensing to the management of crop irrigation water in the Governorate of Bizerte** 69
Salwa Saidi, Houyem Jouini, Anis Ghattasi
- Water quality assessment and identification of polluted areas, as well as water conservation measures in the Melian watershed** 70
Ranya Chrigui, Boutheina Farhat, Cyrine Belhadj, Ahmed Achour, Noamen Rebai

Wednesday, 1st November 2023, DAY 3: SESSION 3

Climate change and GIS

ORAL COMMUNICATIONS

Chairs: Mohamed MASTERE & Taoufik HERMASSI

- Assessing the Impact of Climate Change on Lake Ichkeul's Functioning: A 1D Hydrodynamic Model-Based Quantitative Analysis** 72
Cyrine Belhadj, Noamen Rebai, Béchir Bejaoui
- Research in the impact of climate change on unitary sanitation network functioning. case study area of Souk Ahras Downtown, Algeria** 73
Abdelkrim Guebail
- Interaction between Climate Change and Environmental Risk. Case Study: Watershed of the Middle Valley of the Mejerda (Tunisia)** 74
Rihab Riahi, Abdessatar Hatira, Slimane Baccouche, Nakouri Amor, Noamen Rebai
- Large-scale climate indices, climate and environmental extremes, The Saharan Oscillation Index (SaOI): a new climate index for the north Africa** 75
Younes Tebbaai, Kenza Khamsi, Mohamed Khalis
- From the Monitoring of changes in Surface states to the Calculation of environmental resilience indices: the case of a region in southern Tunisia (Jeffara)** 76
Aziza Ghram Messedi, Sonia Gannouni
- Climate resilience and adaptive capacity in small and medium sized enterprises a standardized step by step approach** 77
Youssef Jaouhari, Laila Stour, Ali Agoumi
- Inferring meteorological information at different scales from several sources of data** 78
Didier Josselin, Matthieu Vignal, Nicolas Viaux, Delphine Blanke, Céline Lacaux
- The Relationship between Economic Growth and Energy Consumption Disaggregated by Sector: The Case of Morocco** 79
Fatima Zahraa Tatou, Abdellah Yousfi, Tawfiq Rahaoui

Chairs: Anis MOUMEN & Sonia GANNOUNI

- Hybrid model for evaluation of the Effects of Climate Change on vegetation forecasting: Mediterranean region** 80
Manel Rhif, Ali Ben Abbes, Imed Riadh Farah
- End-To-End Framework for natural disaster management : Application to drought** 81
Hanen Balti, Ali Ben Abbes, Imed Riadh Farah
- Variational AutoEncoder model for Desertification Detection using multispectral satellite images** 82
Farah Chouikhi, Ali Ben Abbes, Imed Riadh Farah
- Water Erosion Assessment Using MEDALUS Model in Jendouba Governorate** 83
Taoufik Hermassi, Ahmed Ezzine, Fathia Jarray, Emna Kochlef
- Flood Risk Mapping around the Ouémé-Zou Confluence and the Contact Line between Sedimentary and Crystalline in Benin.** 84
Éric Alain Mahugnon Tchibozo

POSTER PRESENTATIONS

Chairs: Anis MOUMEN & Salwa SAIDI

- Lineament mapping and analysis using optical and radar satellite data: Case of neogene formations in the Jemmal-Zeramdine locality, Tunisia** 86
Hentati Imen, Sebai Nadhir, Mhamdi Bouthaina, Trabelsi Nadia, Triki Ibtissem
- Wetland carbon storage and climate change : Geochemistry of organic fluxes to the Gulf of Tunis** 87
Raja Chairi, Noursene Mahmoud, Hajer Saidi, Arbia Triki
- A Comprehensive GIS-Based Approach for Mapping Groundwater Potential Zones in a Semi-Arid Mediterranean Coastal Aquifer** 88
Bouthaina Farhat, Rihem Mejdoub El Fehri, Meryem Laouissi, Ranya Chrigui, Noamen Rebai
- Study of the Spatial and Temporal Variability of Soil Structural Stability in a Watershed of the Middle Mejerda Valley (Tunisia) Using Cartography and Geographic Information Systems (GIS).** 89
Rihab Riahi, Abdessatar Hatira, Noamen Rebai, Bousnina H
- FePO₄ Strengite nanocomposite: Synthesis, characterization and properties as an Electro-Fenton catalyst** 90
Loubna Rachidi, Ghizlan Kaichouh, Miloud El Karbane, Hind Chakchak, Kacem El Kacemi, Aicha Guessous

Sequential pattern mining approach for forest loss survey: Case study of Kroumirie, Northwestern Tunisia 91

Ahmed Toujani, Zied Gassmi, Hammadi Achour, Wahbi Jawadi

Underwater Forests: An Ecological Future 92

Boutaina Aidouni, M. Wahbi, H. Nhhah, M. Maatouk

Development of a Mobile GIS Application for Monitoring the Evolution of Marine Intrusion, Aquifer of the El Haouaria Plain, Nabeul 93

Rihem Mejdoub El Fehri, Noamen Rebai, Hatem Ben thamer

Monday, 30th October 2023, DAY 1

Plenary Sessions

AUTOBIOGRAPHY MICHEL KASSER



Dr. Michel Kasser is a French and Swiss geodesist and geomatician. Specialized in geodesy, geographic sciences and in particular technological developments in these fields, he is director of the National School of Geographical Sciences (ENSG) of the National Geographic Institute. He chaired the French Association of Topography. From 2004 to 2008, he was Executive Director of the Space Geodesy Research Group (GRGS).

Graduate of the Ecole polytechnique of Paris (1972-1975) and the national School of the geographical sciences (ENSG) (1975-1977). He was appointed professor of universities in 1991. He teaches topometry at the ESGT, then the propagation of electromagnetic waves in the atmosphere at ENSTA, ESGT, ESTP and ENSG, and geodesy in different masters. Distinctions: Knight in the Order of Academic Palms, Verdaguer Award from the Academy of Sciences (2001), first winner of the Grand Prix de l'Instrumentation géographique de l'AFI3G (1989) and winner of the 1969 General Competition (in Geography).

AUTOBIOGRAPHY MOHAMED MASTERE



Mohamed MASTERE is a Professor of Higher Education at the Mohamed V University of Rabat, where he is Director of the University Risk Observatory, Morocco. He obtained his PhD (Philosophy High Degree) from the European University of Brittany in 2011 and his HDR (Habilitation to Supervise Research) in 2016 at the University Mohammed V of Rabat. His research focuses on the use of spatial remote sensing and geographic information systems for the study and assessment of hazards and risks for the promotion of territorial resilience, in relation to urban planning and development. He is the author of about twenty internationally peer-reviewed publications and has edited several books for renowned scientific journals. Mohamed MASTERE worked as an expert for many international organizations such as the World bank and the OCDE. is also Associate Professor at the University of Caen Normandy, France and the International University of Rabat, Morocco. He is leading many internationally scientific research projects.

KEYNOTE 2 : LES RISQUES NATURELS À L'ÈRE DU CHANGEMENT CLIMATIQUE

Mohamed Mastere

Département de géomorphologie et Géomatique, Institut Scientifique – Université Mohammed V de
Rabat.

mohamed.mastere@is.um5.ac.ma

À l'ère du changement climatique, la question des risques naturels revêt une importance croissante en raison de la fréquence et de l'intensité accrues des événements météorologiques extrêmes. Les risques naturels, tels que les tempêtes, les inondations, les sécheresses et les glissements de terrain, ont un impact considérable sur les communautés, les économies et l'environnement. Cette situation a conduit les scientifiques, les responsables politiques et les acteurs de la société civile à intensifier leurs efforts pour comprendre ces risques, renforcer la résilience des populations et mettre en place des mesures d'adaptation appropriées.

1. **Augmentation de la fréquence et de l'intensité des événements météorologiques extrêmes :** Les effets du changement climatique ont été associés à une augmentation de la fréquence et de l'intensité des phénomènes météorologiques extrêmes tels que les tempêtes, les inondations, les sécheresses et les incendies de forêt. Ces événements mettent en péril la sécurité alimentaire, l'accès à l'eau potable, l'habitat humain et la biodiversité, ce qui a des conséquences dévastatrices pour les communautés touchées.
2. **Impact sur les communautés et les économies :** Les risques naturels liés au changement climatique ont un impact disproportionné sur les communautés les plus vulnérables, notamment les populations à faible revenu, les régions côtières et les pays en développement. Ces événements peuvent entraîner des pertes humaines, des dommages matériels considérables, une déstabilisation économique et des déplacements massifs de populations, ce qui accroît les inégalités et fragilise les systèmes de soutien social.
3. **La nécessité de renforcer la résilience :** Face à cette réalité, les gouvernements, les organisations internationales et les communautés locales sont de plus en plus engagés dans le renforcement de la résilience face aux risques naturels. Cela implique des investissements dans des infrastructures adaptées, des systèmes d'alerte précoce, des programmes d'assurance et des plans d'urgence pour atténuer les conséquences des événements climatiques extrêmes.
4. **L'importance de l'adaptation et de l'atténuation :** Pour réduire les risques naturels à long terme, il est essentiel de combiner des stratégies d'adaptation et d'atténuation du changement climatique. Cela nécessite des politiques favorisant la réduction des émissions de gaz à effet de serre, la protection des écosystèmes naturels et la promotion de pratiques durables dans les secteurs clés tels que l'agriculture, la construction et la gestion des ressources en eau.
5. **La nécessité d'une action internationale coordonnée :** Étant donné que les risques naturels transcendent les frontières nationales, une coopération internationale accrue est nécessaire pour partager les connaissances, les technologies et les ressources afin de faire face aux conséquences du changement climatique. Les accords mondiaux tels que l'Accord de Paris sur le climat et les objectifs de développement durable des Nations unies jouent un rôle crucial dans la coordination des efforts mondiaux visant à réduire les risques liés aux catastrophes naturelles.

En somme, la question des risques naturels à l'ère du changement climatique appelle à une action proactive et concertée à l'échelle mondiale pour atténuer les impacts dévastateurs sur les populations, les économies et les écosystèmes. Cela nécessite des politiques ambitieuses, une sensibilisation accrue, des investissements judicieux et une collaboration internationale renforcée pour garantir un avenir plus résilient et durable pour les générations futures.

KEYNOTE 3 : TOWARDS EXPLAINABILITY OF RECENT MACHINE LEARNING ALGORITHMS

Faouzi Ghorbel

GRIFT-CRISTAL Laboratory
ENSI-University of Manouba
faouzi.ghorbel@gmail.com

The last decade has been marked by unprecedented enthusiasm for the development of artificial intelligence systems. Scientific and technological issues aimed their integration into various high-tech applications of a large number of human activity, have recently concerned several innovative proposals. Increasingly complex neural network architectures integrate and add additional functionalities such as convolution blocks (CNN), maximum a posteriori classification rules (Soft-Max), Lie group convolution (GCNN) and so on ... which are based on well-established theories as the signal processing field, the probability calculus, the theory of invariants, the statistics on Riemannian Manifolds and Lie group theory.

On the other hand, a systematic use of different theories of mathematical statistics is made for the realization of learning, testing and evaluation. We can cite the parametric and nonparametric distribution estimation, the re-sampling theory and the statistical pattern recognition, the representativeness of data learning, the definition of metrics for comparison and so on...

Recently and as part of this movement, the idea of explainability of these algorithm systems has become a challenge. This is mainly explained by the need for normalization and standardization of these algorithms. The notions of robustness and stability then became the main properties required for these systems. Invariance with respect to certain geometric transformations, especially when it comes to studying visual data, has also become a sought-after property. Data augmentation methods seem to become one of the solutions for improving stabilization. Data augmentation using the shape mixing approach (Morphing) seems to be promising.

So in this presentation, we intend to succinctly describe the theories and foundations necessary to address the question of explainability of Machine Learning algorithms. We will limit ourselves here to classification and dimension reduction algorithms.

AUTOBIOGRAPHY YACINE BOUROUBI



Mohamed Yacine Bouroubi is an engineer in electrical engineering from the Polytechnic School of Algiers and a doctor in physical geography (remote sensing) from the University of Montreal. He worked on the evaluation of the solar field from 1998 to 2003 at the CDER in Algiers and since 2003 has been working as a remote sensing specialist at the CRDH, Quebec, Canada. Current searches Using drones and deep learning for automated pest detection in agriculture. He has book chapter “Les corrections radiométriques des images multispectrales : et leur importance pour la fiabilité des applications de la télédétection”, more than 24 research papers in international journals and research papers in international/national conference proceedings in his credit . Dr. Mohamed Yacine Bouroubi has given many keynote speeches in his research area, particularly in The domains of the treatment of the digital images applied to various themes of the sciences geomatics , other areas of expertise include radiometric and atmospheric corrections of multispectral optical images; the application of polarimetry and SAR interferometry; signal processing and modeling; advanced statistics; the solar energy field.

Tuesday, 31th October 2023, DAY 2

SESSION 1

**Smart solutions for a sustainable
environment**

ORAL COMMUNICATIONS

D2-A Chairs : *Yacine BOUROUBI & Michel KASSER*

D2-B Chairs : *Mohamed MASTERE & Raja CHAIRI*



The contribution of Artificial Intelligence and the Platform Google Earth Engine in the Management of Water Resources of the Plain of Sminja, Zaghuan

Amina Missaoui¹, Saloua Saidi¹, Moustapha Mimouni²

¹University of Tunis El Manar, Faculty of Science of Tunis, Tunisia.

²Observatory of Sahel and Sahara, Tunisia

amina.missaoui@etudiant-fst.utm.tn

Abstract

Estimating groundwater exploitation remains a serious problem in arid and semi-arid countries such as Tunisia. In the last years, the northern part of Zaghuan governorate knowing an increase in water demand due to the overexploitation of water resources, in particular the groundwater resources, climate change...therefore the intensification of irrigated areas. In this context, realizing piezometric maps based on available piezometric measurements dating from 1998-2019 shows that the flow is mainly heading from the South towards the center and the North-East of the aquifer. Thus, in the center and in the North. The aquifer is drained mainly by Oued Meliane and Oued Melah in the North. The drop in the piezometric level due to the overexploitation, reached 238,37 m in 2019. Agricultural Remote Sensing makes it possible to monitor the spatial distribution of irrigated perimeters by calculating the NDVI vegetation Index using Landsat 5, Landsat 7, Landsat 8 and Landsat 9 collections. The irrigated perimeters are becoming more and more limited in the governorate of Bir Mcherga, during 1985, 2000, 2020, 2022 and mainly the drop of the piezometric level and the decrease of annual rainfall explain this phenomenon. In the context of decision-making, the Power BI platform allows to develop the conceptual data model that links the fact table with its dimensions according by well-defined cardinalities and visualize diagrams and Dashboards in an interactive and relevant way. The application of Power BI showed a proportional variation in the drawdown of the watertable according to the annual rainfall. The groundwater of Sminja is an overexploited aquifer. The decrease in the volume of precipitation worsens the groundwater situation, which requires decision-makers to take adequate measures to protect groundwater resources.

Keywords: Vegetation Indexes, Remote Sensing, Artificial Intelligence, Google Earth Engine, Groundwater, Sminja, Overexploitation.



Evaluation of an existing map archive for the purpose of implementing a prediction and warning system against UVs using deep learning

Oussama Jraifi¹, Ahmed Koutous², Hacheem Saadaoui³, Moha El-Ayachi¹

¹ Department of Geodesy and surveying, Institute of agronomy and Veterinary Medicine, Rabat, Morocco

² Department of Rural engineering, Institute of agronomy and Veterinary Medicine, Rabat, Morocco

³ Energy Park, University Mohammed 6 Polytechnic, BenGuerrir, Morocco

oussama.jraifi@gmail.com

Abstract

The UV Index was established by the World Health Organization as a measure of sun safety. Therefore, the prediction of this index is essential in order to anticipate periods of intense value over the day and alert those concerned. Several approaches have been adopted and are mainly focused on the physical dimension of UV radiation (distance between a certain location and the sun) or even hybrids combining physical and empirical dimensions (zenith angle, meteorological conditions). The development of a method for mapping the UV index from satellite images in 2012 has enabled the production of large-scale UV maps. At the same time, the remarkable progress in deep learning and more precisely in recurrent neural networks (RNN) now makes it possible to carry out the prediction based solely on the time series from the history of values, thus freeing itself multiple complex factors related to UV irradiation. Our study aims to establish a workflow that exploits UV maps for future prediction and alert.

The followed method consists of a series of steps to achieve the desired objective. First, we decoded the maps to extract information at the pixel level. Then, time series were created by combining the data from the maps available in the archive. The next step is related to the georeferencing and the intersection of the UV maps with the cities' layer for the identification of the pixels corresponding to each city. Then, three RNN-based prediction algorithms under TensorFlow were applied.

The results show that the accuracy of the values of the index predicted by the approach adopted are greater than the tolerance recommended by the World Meteorological Organization.

An alert system is set up to notify the users concerned while respecting the precision threshold recommended by the World Health Organization

Keywords: UV index, Health, Deep Learning, Prediction, Recurrent Neural Networks, TensorFlow



Forecasting the seawater intrusion progress: Model conception (MASC2050), case of the Monastir aquifer system

Mejdoub El Fehri Rihem¹, Rebai Noamen¹

¹National Engineering School of Tunis, University of Tunis El Manar, Tunisia.

rihem.majdoubfehri@fst.utm.tn

Abstract

The coastal aquifer system in Monastir faces various sources of salinization, with seawater intrusion being the most significant. Excessive groundwater extraction, primarily for agricultural purposes, has led to a considerable increase in saltwater and seawater intrusion in the Monastir water table. Given the considerable extent of seawater intrusion in the study area, it is crucial to develop a new predictive model for its evolution. To address this challenge, the Monastir Aquifer System Coast 2050 (MASC2050) model, based on artificial intelligence techniques, specifically Artificial Neural Networks (ANN) and linear autoregressive (AR), has been developed to estimate and control seawater intrusion in this coastal aquifer. MASC2050 is designed to forecast conditions in the year 2050 by utilizing climate model predictions. The study's results project a continued increase in seawater intrusion over time, with this phenomenon closely linked to groundwater withdrawal rates. The AR forecasts, based on climatic conditions and exploitation patterns like to those observed in 2008, suggest an expansion of the salt front. This study highlights the reliability of the AR model in predicting marine intrusion hazards, making it as a useful tool for the development of an accurate and optimized simulation methodology to manage seawater intrusion in coastal aquifers on a regional scale.

Keywords: Seawater intrusion, Artificial Neural Networks (ANN), Linear autoregressive (AR), Monastir aquifer, Tunisia



Predicting Spatially Explicit Composite Burn Index (CBI) from Different Spectral Indices Derived from Sentinel 2A: A Case of Study in Tunisia

Mouna Amroussia¹, Olga Viedma², Hammadi Achour¹ and Chaabane Abbes¹

¹ Institut Sylvo-Pastoral de Tabarka, Université de Jendouba, Tabarka 8110, Tunisie

² Department of Environmental Sciences, University of Castilla-La Mancha, Avd. Carlos III, s/n., 45071 Toledo, Spain
corresponding-author- amroussiam@gmail.com

Abstract

Fire severity, which quantifies the degree of organic matter consumption, is an important component of the fire regime. High-severity fires have major ecological implications, affecting carbon uptake, storage and emissions, soil nutrients, and plant regeneration, among other ecosystem services. Accordingly, spatially explicit maps of the fire severity are required to develop improved tools to manage and restore the most damaged areas. The aim of this study is to develop spatially explicit maps of the field-based fire severity (composite burn index—CBI) from different spectral indices derived from Sentinel 2A images and using several regression models. The study areas are two recent large fires that occurred in Tunisia in the summer of 2021. We employed different spectral severity indices derived from the normalized burn ratio (NBR): differenced NBR (dNBR), relative differenced NBR (RdNBR), and relativized burn Ratio (RBR). In addition, we calculated the burned area index for Sentinel 2 (BAIS2) and the thermal anomaly index (TAI). Different tree decision models (i.e., the recursive partitioning regression method [RPART], bagging regression trees [Bagging], and boosted regression trees [BRT]), as well as a generalized additive model [GAM]), were applied to predict the CBI. The main results indicated that RBR, followed by dNBR, were the most important spectral severity indices for predicting the field-based CBI. Moreover, BRT was the best regression model, explaining 92% of the CBI variance using the training set of points and 88% when using the validation set. These results suggested the adequacy of RBR index derived from Sentinel 2A for assessing and mapping forest fire severity in Mediterranean forests. These spatially explicit maps of field-based CBI could help improve post-fire recovery and restoration efforts.

Keywords: biomass consumption; fire severity; Sentinel 2A; RBR; regression trees.



A diachronic study of coastline behavior using remote sensing, Case study: Korba Coast

Rebai Noamen¹, Mejdoub El Fehri Rihem¹, Yahyaoui Zouhour¹, El Mokh Riadh¹, Gannouni Sonia²

¹ National Engineering School of Tunis, University of Tunis El Manar, Tunisia.

²Water Research and Technologies Center (CERTe), Technopark of Borj Cedria, Tunisia

noamen.rebai@enit.utm.tn

Abstract

This study aimed to conduct a quantitative analysis of the spatiotemporal evolution of the Korba coastline over a period of around 18 years. To assess the spatial variation of the coastline we utilized LANDSAT 5 and 7, as well as Sentinel 2A imagery. Our research focused tracking shifts in the Korba shoreline and the broader eastern coastline of Cap Bon from 2004 to 2022. During this period, our image processing was based on the uniformity of conditions, specifically focusing on spring tides. As a result, we selected images during the spring tide period based on their availability. The selected images underwent radiometric and geometric corrections. For LANDSAT images, we utilized a normalized differential water index (NDWI) to differentiate between water and soil characteristics. For Sentinel 2A images, we used a histogram-based pixel classification and image-based visual interpretation to delineate the coastlines. Net changes in shoreline position were calculated and statistically validated using DSAS software. Our analysis and interpretation essentially relied on Earth Observation Point Reference (EPR) techniques. The results indicated that the shoreline within the study area experienced both regression and transgression in four morphological sectors, with an average rate of centimeters depending on the specific sector. In the next phase of our study, we plan to conduct a diachronic comparison of shoreline spatial variation using several methods. This comparison will involve assessing the difference between the coastline obtained through conventional topographic surveys in 2004 and the data obtained from Landsat 7 imagery. The advantage of this significant comparison lies in the fact that we have essentially the same spring tide period of for both topographic surveys and remote sensing data. The results obtained revealed a slight and reasonable difference, as supported by the statistical data. This finding is consistent with the initial hypothesis we aimed to prove, indicating that the validity of coastline monitoring through high-resolution remote sensing is maintained, provided that image acquisition coincides with the same tidal period.

Keywords: Korba coastline, High water, spatiotemporal evolution, DSAS, EPR



High-Resolution Pleiades Satellite Imagery and Ground Topographic Validation for Advanced Remote Sensing in Tracking Evolution of the Eastern Coastline of Tunisia

Zouhour Yahyaoui¹, Noamen Rebai¹, Sonia Gannouni², Olivier Fouché^{3,4}, Henri Robain⁴, Christophe Mahuzier⁴

¹ University of Tunis El Manar, Tunisia.

² Center of Water Researchs and Technologies of Borj Cedria, Tunisia

³ School of Survey and Topographers (ESGT) / National Conservatory of Arts and Crafts (Le Cnam).

⁴ Institute of Ecology and Environmental Sciences (IEES Paris) / IRD, Soil & Critical Zone Department.

yahyaouizouhour80@gmail.com

Abstract

Monitoring and analyzing the shoreline's evolution is paramount for understanding coastal changes, their environmental impacts, and socio-economic implications. In this study, we explore an innovative approach using advanced remote sensing techniques and Pleiades satellite imagery* to track the evolution of the shoreline along the eastern coast of Tunisia. The results provide unparalleled details of coastal features and enable precise analysis of changes over approximately 10 years. Employing advanced image processing techniques, particularly object analysis, we develop map models to monitor diachronic variations in the shoreline. Validation is conducted through field topographic surveys, considered as a reference to assess the accuracy of the remote sensing treatment. This cross-validation ensures the reliability and precision of the information extracted from satellite images. The findings of this research offer valuable insights into coastal changes along the eastern coast of Tunisia. They contribute to understanding ongoing coastal geodynamic processes, sustainability, management, and future development planning. By integrating advanced remote sensing data with field topographic validation. This study provides a solution to assess accuracy, whether at a small or large scale, for monitoring and analyzing shoreline evolution in a dynamic coastal context, thanks to the high resolution of Pleiades imagery.

Key Words: Coastline, remote sensing, High-resolution Pleiades satellite imagery, Topographic validation, Eastern coast of Tunisia.

* Project for DINAMIS proposed by: Christophe MAHUZIER, IRD/IEES-Paris scientist, in collaboration with: Professor Noamen REBAI (ENIT), Olivier FOUCHÉ (IEES-Paris and Cnam), Henri ROBAIN (IRD, IEES-Paris)



A Comparative Assessment of Image Classification Algorithm in a Semi-Arid Region Using Landsat8 OLI_TIRS

Imen Hentati^{1,2}, Emna Medhioub^{1,2}

¹Gafsa University, 2112 Gafsa, Tunisia

²University of Sfax, 3038 Sfax, Tunisia
imenhentati@yahoo.fr

Abstract

Land use/land cover (LULC) mapping is used as input for a variety of scientific tasks as a hydrological modeling, use planning and groundwater vulnerability assessment. In this context, this study aims to produce the most accurate LULC map, for the central coast in Tunisia (Mahdia-Bekalta coast). Landsat 8OLI_TIRS dataset was used to classify the LULC features. The objective of this study is to evaluate classifier accuracy. In fact, the reliability of LULC maps derived from remote sensing data depends on a precise classification. Two different algorithms have been applied for this purpose, the Support Vector Machine (SVM) and the Maximum likelihood Classification (MLC). The level of classification accuracy has been measured through different parameters such as confusion matrix, kappa coefficient and ROC curve. For the classification accuracy assessment, random sampling has been established. The overall accuracy and kappa coefficient statistics provide better results for the SVM classifier than for MLC. The results were checked using the receptor operation characteristics (ROC) curves. The area below the ROC curve (AUC) is used to assess the classifier's performance for the classification of each land class. Indeed, the higher this zone (AUC) is, the more precise the performance. Following the validation process, the SVM method is considered more appropriate than the MLC method for extraction of LULC maps.

Keywords: LULC, MLC, SVM, Accuracy assessment, ROC, Kappa coefficient.



Estimation of changes in land cover, using the Semiautomatic Classification (SCP-QGIS) of Landsat images: Case of Tessa Catchment, northern Tunisia

Noamen Baccari¹, Salwa Saidi¹, Abdelaziz Sebei¹, Taoufik Hermassi²,
Anis Ghattassi², Abir Oueslati¹

¹University of Tunis El Manar, 2092 Tunis El Manar (UTM), Tunisia.

²University of Sfax, Tunisia.

³I.N.R.G.R.E.F.

noamen.baccari@fst.utm.tn

Abstract.

This study aims to highlight the changes in land cover in the Wadi Tessa watershed, northern Tunisia and to contribute to the monitoring of anthropogenic and natural activities. An approach based on remote sensing, geographic information system (GIS) and statistical calculations, was used. Statistical calculations make it possible to evaluate the performance of the Landsat image classification method, using the calculation of producer accuracy, user accuracy, global accuracy and kappa coefficient. The originality of this approach lies in the fact that it was founded on the unprecedented plugin of the supervised semi-automatic classification (SCP) of the QGIS software. This supervised semi-automatic classification based on the "Maximum Likelihood-Algorithm" model makes it possible to create an automatic workflow and facilitate the detection and mapping of land cover change. Based on the classification results for the LANDSAT 5 TM image of the year 1990, the global accuracy obtained is 88.24% and a Kappa value of 0.8, while for the LANDSAT 8 OLI image of the year 2020, the global accuracy obtained is 99.4 % and a Kappa value of 0.99. These values are very satisfactory for land cover analyses. The spatial and statistical analysis of the results show that over the last thirty years, the vegetation cover and land use have changed considerably. Indeed, this period (1990-2020) experienced an annual rate of increase estimated at 1.7% for forests, 4% for Scrublands and 0.4% for annual crops, while an annual regression rate estimated 4.6% for bare soil and 1.6% for rangelands. This study revealed that semi-automated classification (SCP) is an accurate tool to quantify, map and analyze changes over time in land cover.

Keywords: Land cover change, Tessa watershed, LANDSAT, GIS, Remote sensing, (SCP- QGIS), Confusion matrix, Global accuracy.



Accuracy Assessment of Water Indices for Shoreline Extraction Based on Multi-Spectral Data: A Case Study of Mahdia-Bekalta Coast, Tunisia

Emna Medhioub^{1,2} and Imen Hentati^{1,2}

¹University of Gafsa, 2112 Gafsa Tunisia

²University of Sfax, 3038 Sfax, Tunisia
emna.medhioub@enis.tn

Abstract

The coastal areas, which are densely populated and support economic activity, are facing changes in sea levels and significant impacts from erosion and accretion caused by climate change and human actions. Shoreline assessment plays a crucial role in understanding coastal dynamics, erosion processes, and monitoring environmental changes along coastal regions. Hence, this research focuses on the shoreline extraction along the central Sahel coast (Mahdia-Bekalta coast) in Tunisia which presents a dynamic zone due to its geomorphological and lithological nature. Remote sensing techniques, particularly the use of Multispectral satellite data, have proven to be valuable tools for shoreline monitoring coupled with appropriate indices. This study aims to investigate the application of three widely used spectral indices, the Normalized Difference Water Index (NDWI), the Modified Normalized Difference Water Index (MNDWI) and the Automated Water Extraction Index (AWEI) for shoreline extraction. These indices are derived from two sets of multispectral satellite data: Sentinel 2 and Landsat8 with a spatial resolution of 20m and 30m, respectively. Those three spectral Indices are specifically designed to detect water bodies using visible and InfraRed bands. Validation and accuracy assessment of the shoreline boundaries extracted from indices were conducted using ground truth data, obtained from field observations of the shoreline position defined with GNSS during the corresponding high tide periods of the satellite data. The results demonstrate the successful delineation of the shoreline by the three indices, enabling to distinguish limitation between water bodies and continental pixels. Shoreline boundaries extracted from NDWI index calculated from Sentinel2 data exhibited a high correlation with GNSS especially in the north zone of the study area. This study highlights the suitability of spectral indices for shoreline extraction based on satellite data enabling to shoreline evolution monitoring. The findings of this study provide valuable insights to enhance the sustainability of coastal areas, through the identification of vulnerable areas, monitoring of coastal erosion or accretion rates, and evaluation of coastal protection measures.

Keywords: Water indices assessment, NDWI, MNDWI, AWEI, Shoreline, multispectral satellite data, GNSS, Mahdia-Bekalta coast, Tunisia.



Assessment of remote sensing accuracy in predicting soil salinity distribution using statistical and geostatistical approaches: A case study in the Gafsa region, Tunisia.

Ibtissem Triki^{1,2}, Nadia Trabelsi¹, Leila Kharbout¹, Imen Hentati¹, Zoheira Ibn Ali¹

¹University of Sfax, Tunisia

²University of Gafsa, 3029 Sfax, Tunisia

triki_ibtissem@yahoo.fr

Abstract.

In southwestern Tunisia's Aguila irrigated area in Gafsa, factors such as low rainfall, high evaporation, and increased use of treated wastewater for irrigation contribute to soil salinization. This threatens soil quality, posing an environmental challenge with implications for agriculture and food security.

This study compares two methods for mapping soil salinity ordinary kriging using sampled soil data and remote sensing data from Sentinel-2 imagery. The goal is to determine the effectiveness of remote sensing in predicting salinity patterns and its potential integration into predictive models.

The first salinity map was constructed through ordinary kriging using 24 sampled soil data points. The second map was developed by utilizing bands and indices of soil salinity extracted from the Sentinel-2 satellite imagery.

Initially, a principal component analysis (PCA) was conducted to identify the most influential bands and indices for predicting soil salinity. Subsequently, a linear regression model was formulated, integrating relevant bands and indices correlated with soil salinity as explanatory variables.

The results of the principal component analysis (PCA) revealed that the first principal component (PC1) aligns with visible bands and their related salinity indices. Meanwhile, the second principal component (PC2) displayed robust connections with SWIR bands and exhibited a moderate correlation ($R^2 = 0.52$) with electrical conductivity (EC), implying its viability as a predictive factor for soil salinity. The outcomes of the linear regression model indicate that the most effective empirical relation is established using PC2, B7, B8 and B1. This model regression approach explains around 55% of the variance in forecasted soil salinity values and upholds a minimal root mean square error (RMSE = 0.8 dS/m).

The resulting salinity map exhibited a striking similarity to the one interpolated using sampled soil data, thereby emphasizing the effectiveness of remote sensing in visualizing spatial salinity distribution.

Keyword Soil salinity, Sentinel-2 satellite, Spectral indices, PCA, Regression Analysis, ordinary kriging.



Advanced Geoprocessing Techniques for accurate LULC mapping using Confusion matrix identification approach Case of Mornag City, Tunisia

Anis Ghattassi¹ and Salwa Saidi¹

¹ Faculty of Sciences of Tunis, Tunis El-Manar University, Tunisia
anisghattassi7@gmail.com

Abstract

This study presents a detailed application of supervised classification using Google Earth Engine (GEE) for LULC mapping in Mornag City, located in the governorate of Ben Arous, Northeastern of Tunisia. The study utilizes a multispectral satellite data and ground truth data to classify the LULC into various classes, including vegetation, urban areas, water bodies, and bare soil. The classification accuracy is evaluated using the kappa accuracy and confusion matrix method.

This research aims to demonstrate the effectiveness of GEE as a powerful tool for geoprocessing large-scale remotely sensed datasets and generating accurate land cover maps. The kappa accuracy and confusion matrix methods are used to evaluate the classification accuracy and identify areas for improvement. The results indicate a high overall accuracy of the classification, with interesting kappa values for most classes.

An advanced discussion of the potential applications of the generated Landcover classes' monitoring, including environmental monitoring, land use planning, and natural resource management is made. So, results highlight the importance of accurate land cover mapping for sustainable development and presents a practical approach for achieving this using GEE.

Ultimately, this study provides valuable insights into the use of supervised classification especially by using kappa accuracy confusion matrix method in Google Earth Engine for LULC dynamics tracking in the context of Mornag City.

The findings are expected to contribute to the improvement of natural resources management practices' state in the region and beyond.

Keywords: GEE, multispectral satellite, LULC, Mornag City, confusion matrix



Study of the potential of PRISMA hyperspectral images for mapping and mineralogical exploration in Zaghouan area

Sarra HICHRI¹, Mourad El KOUNDI¹, Nouha Ben YAHIA², Wafa TALHAOU²

¹ Borj El Amri Aviation School (BAAS)

² National Center of Cartography and Remote Sensing “CNCT”
sattahichri@gmail.com

Abstract.

This study was conducted in the Zaghouan region, including the Bir'Mchergua area and part of Zaghouan town, to explore the potential of PRISMA hyperspectral data for mapping and identifying the sources of valuable minerals. The data used in this study included PRISMA hyperspectral imagery, two geological maps and field data. These data were processed using ENVI image processing software and geographic data processing tools. The methodological approach adopted was to collect hyperspectral image data, pre-process them and use image analysis algorithms to extract information about the minerals present in the study area and to produce an accurate mineralogical map of the zone. The unsupervised classification results using ISODATA and K-means provided an approximate approach to the number and nature of classes and grouped similar data without prior knowledge of their nature. The two supervised classifications "SAM and SVM" showed the presence of limestone and clay. The SFF classification showed the presence of smectite, kaolinite and illite. This study revealed a predominance of clay lithology in the study area, with a significant abundance of smectite and kaolinite. The results obtained were presented in a mineralogical map, providing a visual representation of the spatial distribution of minerals and enhancing the understanding of the geology of the region. This study has explored the potential of PRISMA hyperspectral imaging to detect and map minerals, which could have significant applications in mineralogical exploration.

Keywords: PRISMA hyperspectral data, Zaghouan, Mineralogical mapping, ISODATA, SAM, SVM.

Tuesday, 31th October 2023, DAY 2

SESSION 1

**Smart solutions for a sustainable
environment**

POSTER PRESENTATIONS

Chairs: Zouhour YAHYAOUÏ & Boutheina FARHAT



Remote sensing imageries data processing for the monitoring of Olive Mill Wastewater disposal sites using medium resolution satellite (Sentinel-2) for multiple case studies: Tunisia and Greece

Wissal ISSAOUI^{1,2}, Dimitrios D. ALEXAKIS³, Imen HAMDI NASR^{1,2}, Athanasios V. ARGYRIOU³, Evangelos ALEVIZOS³, Nikos PAPADOPOULOS³, Ahmed EZZINE⁴, and Mohamed Hédi INOUBLI²

¹Carthage University, Tunisia.

²University of El Manar, Tunis 2092, Tunisia

³Institute for Mediterranean Studies, Foundation for Research and Technology-Hellas (FORTH), 74100 Rethymno, Greece

⁴National Center of Mapping and Remote Sensing, Tunisia

³Springer Publishing, 69121 Heidelberg, Germany

wilala27972172@gmail.com

Abstract.

The manufacturing of olive oil, which contributes significantly to the Mediterranean region's global fame, produces a lot of olive mill wastewater (OMW), which pollutes the land and aquatic ecosystems close to the disposal sites. OMW is made up of both inorganic particles and organic materials with significant phenolic component contents. The purpose of this study is to evaluate the efficiency of satellite image analysis methods using a medium spatial resolution satellite (Sentinel-2, 10*10 m), in order to locate Olive Mill Wastewater (OMW) disposal sites in both the Sidi Bouzid region, Tunisia and the larger Rethymno region, on the island of Crete, Greece. The places were documented by gathering the OMW's spectral signatures at various times. In order to assess how well different spectral vegetation indices (VIs), such the Normalized Difference Vegetation Index (NDVI), can identify OMW disposal regions, the study incorporates their use. Additionally, a variety of image-processing techniques, such as image fusion, false-color composites (FCC), and principal component analysis (PCA), were used on satellite pictures to enhance the monitoring of OMW ponds. In order to help with the overall strategy for accurately detecting the sites, various classification techniques, including the ISODATA, maximum likelihood (ML), and the Support Vector Machine (SVM), were applied to satellite imageries data of both case studies. Comparing the outcomes of several methods, it was determined how well Sentinel-2 images could identify and track OMW disposal sites in various morphological settings; a mountainous morphology (Greek case study) and a flat terrain morphology (Tunisian case study).

Keywords: Remote sensing; olive mill wastewater (OMW); Sentinel-2, spectral signature; indices; classification



Coastal Geomorphological Change Study and Monitoring using Drone and DGPS in the Langue de Barbarie (Saint Louis, Senegal)

Kader BA^{1,2}, Papa SAGNE¹, Abdoulaye NDOUR¹, and Djibril TINE³

¹ University Cheikh Anta Diop, Dakar 5005, Senegal

² Laboratory of Applied Remote Sensing, Dakar 5396, Senegal

³ Topogeny Cité Sidak, Dakar 17000, Senegal

kader.ba@ucad.edu.sn,

Abstract: This work contributes to the study of coastal erosion on the beaches of Guet Ndar and the spit north of the mouth of the Langue de Barbarie. Data were collected using the Dji Phantom drone and the DGPS E300 pro. The captured images were processed into an orthomosaic using photogrammetric post-processing software (Pix4D Mapper). High-resolution data (2.5 cm) were utilized to generate maps, a Digital Terrain Model (DTM), an Orthophoto, contour lines, a 3D Model, and a point cloud (X, Y, Z), all georeferenced in the Senegal geodetic system. Analysis of these results allows the determination of erosion, accumulation, or stability zones along the Langue de Barbarie coastline, their topography, and the estimation of the rate of evolution. The observed changes in these areas are generally attributed to dynamic marine factors, but anthropogenic influence, notably the opening of the drainage canal to prevent flooding, accelerates the process. These findings can assist policymakers in making informed decisions to combat coastal erosion and flooding.

Keywords:

Langue de Barbarie, photogrammetry, erosion, topography, beach profiles.



Intelligent solutions for sustainable biomass production from microalgae

Khadija EL moustaqim¹, Jamal Mabrouki², Driss Hmouni¹

¹Ibn Tofaïl University, Kenitra 14000, Morocco

²Mohammed V University in Rabat, Rabat 10106, Morocco
elmoustaqim.khadija@gmail.com

Abstract.

The transition to the production of sustainable and green energy, such as algal biofuels, has required the prioritization of scaling technologies to improve the overall technological economy of the process. The world today is facing many challenges, such as climate and global change, where we are facing the needs of people who are related to energy and raw materials, and at the same time, we need to keep a more secure border for our world. The focus is now on developing and adopting digitization and automation technologies in the algae sector to meet the desired production scale and optimize operating parameters. It was also discussed how future technologies, such as the Internet of Things (IoT) application to automation and smart agriculture, can significantly improve commercial algal production. Biomanufacturing is advancing in parallel to the fourth industrial revolution that focuses on the production of big data using smart software, artificial intelligence, innovative modelling, robotics, three-dimensional (3D) printing, and the Internet of Things (IoT). However, microalgae culture, which requires accurate monitoring, control, and prediction of microalgae biomass growth, has not yet been integrated into IoT and AI technology as it is still in its infancy. This work focuses on the microalgae-based biofuel production process and IoT implementation toward the future of smart agriculture.

Keywords: Smart System, Microalgae, Internet of Things (IoT), Biofuels, Agriculture.



Accuracy assessment of ML, SVM, and RT machine learning methods for efficient land cover mapping in the Manouba region, NE Tunisia.

Nadia Trabelsi ¹, Ibtissem Triki¹, Imen Hentati ¹ and Nizar Rachdi ², Moncef Zairi¹

¹Ecole Nationale d'Ingénieurs de Sfax, Sfax, Tunisia;

² Geoengine, Geomatics and Geosciences Engineering, Rue du lac de Constance,
Tunis, Tunisia

nadia.trabels@yahoo.fr

Abstract.

Land cover mapping and assessment are fundamental aspects of remote sensing data application. Therefore, selecting an appropriate classifier approach is crucial for accurate land cover classification. In this study, the performance of machine learning classification algorithms was compared using Landsat 9 images of the Manounba government (Tunisia). Three different classification methods were applied : Maximum Likelihood Classification (MLC), Support Vector Machine (SVM), and Random Trees (RT). The classification aimed to identify five land use classes: urban, agriculture, bare soil, water and forest. A qualitative assessment was conducted using Overall Accuracy (OA) and the Kappa coefficient, derived from a confusion matrix. The results of the land cover classification demonstrated a high level of accuracy. The SVM method exhibited the best performance, with an overall accuracy of 93% and a kappa accuracy of 0.9. The MLC method is the second-best classifier with an overall accuracy of 92% and a kappa accuracy of 0.88. The Random Trees method yielded the lowest accuracy among the three approaches, with an overall accuracy of 91% and a kappa accuracy of 0.87. This comparative study contributed to a better understanding of the classification process by evaluating various algorithms for land cover mapping. It provided valuable insights into the relative performance of different classifiers.

Keywords : LULC, machine learning, algorithms, SVM, MLC, RT



Use of ASTER image for lithological discrimination of Fom Tataouin area, Southern Tunisia (Gypsum of Mestaoua)

Jamel SEDDIK ¹, Nouha Ben YAHIA¹, Wafa TALHAOUI¹

¹ National Center of Cartography and Remote Sensing “CNCT”
jamelseddik1986@gmail.com

Abstract

This study focuses on the application of remote sensing data for lithological discrimination in the Tataouine area of southern Tunisia, with particular emphasis on the gypsum of Mestaoua. It highlights the relevance of remote sensing data due to their spatial, spectral and radiometric characteristics, which are crucial for accurate lithological mapping and mineral exploration. The research is part of the REMINT project led by the National Centre for Cartography and Remote Sensing. Lithological identification and delineation between outcropping formations is done by combining several methods of supervised and unsupervised classification using spectral features and other techniques such as Principal Component Analysis (PCA), Independent Component Analysis (ICA), Minimum Noise Fraction (MNF), band ratios, spectral indices and spectral profiles. The lineaments were extracted from the DEM of the study area. The results of these methods were compared with existing geological maps to demonstrate their effectiveness in mapping lithological units. The accuracy of the model is variable compared to the outcropping geological layer. The maximum precision for the Mestaoua Gypsum Formation is 93% and the minimum for the Rehach Dolomites is 63%. This classification is based on the difference between the spectral profiles of the outcropping layers. The same layer can have different spectral profiles due to the impurities of the layer caused by natural factors such as wind, water flow, etc. and its lithology, which explains the variation in precision values. However, the main directions of the lineaments are NE-SW and NW-SE, which is confirmed by the geology of the study area. This study demonstrates the potential of ASTER imagery for the identification and characterization of mineral resources in similar regions.

Keywords: Remote sensing, Geological cartography, ASTER, Fom Tataouine, litho-structural, Gypsum de Mestaoua, MNT.



Air quality monitoring using Sentinel 5P images

Islem Neffati ¹, Rim Katlane ²

¹ Carthage University, Research Laboratory GEOMAG, BP 95 2010, Tunisia

² Manouba University, Research Laboratory GEOMAG, BP 95 2010, Tunisia

neffati.islem@gmail.com

Abstract.

The main objective of the Copernicus Sentinel-5P mission is to perform atmospheric measurements with high spatio-temporal resolution, to be used for air quality, ozone; UV radiation, and climate monitoring; forecasting. Sentinel-5P is focused on air quality and composition-climate interaction with the main data products being O₃, NO₂, SO₂, HCHO, CO, CH₄. This paper provides evidence-based insight into improvement of air quality and environment during pre and post lockdown of the pandemic situation Covid-19. An attempt has been made to visualize the improvement in the air quality using tools like satellite images of atmosphere. Sentinel 5P images are the satellite data used in this work to evaluate the amount of the nitrogen dioxide present in the air in northern Africa before and after COVID-19 crisis. These data were downloaded from space and ESA website (European Space Agency) with NetCDF format. We will use the Basic Envisat Atmospheric Toolbox (BEAT), toolbox under SNAP software to analyze the Sentinel-5p data and run our analysis, and Browse Product. The treatment and the analysis of these data using SNAP software show that a decrease of the rate of these toxic gazes during COVID-19 Crisis. These gazes are related essentially with human activity. Air quality improvements pollution changes due to COVID-19 restrictions have been reported for many urban developments and large metropolitan areas. This study evaluated air pollution changes. NO₂, SO₂, ozone were analyzed in pre-, during, and post-lockdown period (Mars 2020) and also for a comparison purposes in 2019. NO₂ was the pollutant that decreased the most in 2020, coinciding with when the traffic is reduced.

Keywords: Air quality, Remote sensing, Covid-19, Sentinel 5P, Pollution.



Utilization of ASTER Imagery in the Study and Mapping of Calcium Carbonates in Jebel Kebar, Sidi Bouzid

Skander NSIRI¹, Mourad El KOUNDI¹, Nouha BEN YAHIA², Wafa TALHAOU²,

¹ Borj El Amri Aviation School

²National Center for Cartography and Remote Sensing (CNCT)
nsiriska@gmail.com

Abstract: This study is part of the project titled "Mapping and Valorization of Mineral Resources by Remote Sensing," led by the National Center for Cartography and Remote Sensing as part of its research program contract CPR 2019-2024. The objective of the work is to assess the potential of ASTER images in mapping calcium carbonate in arid regions. The chosen study area is the Jebel Kebar region in Central Tunisia. The identification and mapping of calcium carbonate-rich areas in the study zone were suggested by the National Office of Mines, a strategic partner of the project, for planning potential mineral exploitation of this resource. The applied methodology will serve as a basis for similar studies in other regions. An ASTER image at Level 1T was acquired on April 2, 2006. It was downloaded freely from the USGS website. Digital number values were initially converted to radiance values through calibration and then to reflectance using a FLAASH module marketed with ENVI 5.3 software. Three spectral indices, Carbonate Index "CI," Alteration Index "AI," and Quartz Index "QI," were proposed to distinguish calcite from silica, prevalent in this sector (Boudinar formation), based on the absorption peak of calcite produced between 2.33 and 2.45 μm . The colored composition (RGB = CI, AI, QI) facilitated the identification of endmembers used in a supervised classification process using the SAM algorithm. The obtained results are considered valid in the areas mapped by the National Office of Mines at a 1/50,000 scale.

Keywords: ASTER Image, Calcium Carbonate Mapping, Jebel Kebar, RGB, SAM.



Assessing Coastal Aquifer quality in Ghar el Melh: Impacts of Climate Changes and Human Activities

Nadia Khazri^{1,2}, Essam Heggy^{2,3}, Hzami Abderraouf¹, Imen Rais⁴, Oula Amrouni¹

¹University of Carthage, National Institute of Marine Sciences and Technologies, Tunis, Tunisia

²University of Southern California, Viterbi School of Engineering, Los Angeles, CA, USA

³Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA

⁴World Wide fund for nature-North Africa-Freshwater program, Tunisia
nadia.khazri@etudiant-fst.utm.tn

Abstract.

The coastal aquifer of Ghar El Melh region, located in northeastern Tunisia, Mediterranean, faces challenges due to high population density and the increasing threats of storms and Sea Level Rise (SLR). These drivers are likely to lead to future coastal flooding and marine intrusion. This study aims to hydrogeological and Land Use Land Cover-based assessment of the impact of coastal dynamics on the sustainability of coastal aquifers, of the Medjerda plio-quaternary deep aquifer and the Aousja Ghar El Melh phreatic aquifer. Besides, the study aims to identify the water source used by the exclusive Ramli Irrigation Technique (RIT) employed in local agriculture. The methodology involves monthly monitoring of eight piezometers and seven agriculture wells during October 2022 to October 2023. Water quality analysis of the phreatic aquifer includes measuring piezometric levels and conducting in-situ measurements.

Preliminary results indicate that the maximum piezometric level reached 0.4 meters in March 2023, while the minimum level was recorded at -0.2 meters in August 2022. Notably, the piezometer number two reveals a total dissolved solids (TDS) concentration of up to 65.2 g/L. The seasonal monitoring reveals that the RIT is characterized by a thin layer of overlying freshwater on seawater, with the amount of freshwater varying by season. Elevated salinity levels, as indicated by TDS, are predominantly attributed to marine intrusion and the formation of swamps.

The low-water quality shed light on the complex environmental and hydrogeological dynamics of the highly urbanized Ghar El Melh region and underscore the urgent need for sustainable management practices to mitigate the impacts of climate change and human activities on this vulnerable coastal ecosystem.

Keywords: Coastal Aquifer, Ghar El Melh, climate changes, Sustainable development, environment monitoring.



A statistical physics approach to understanding the adsorption of methylene blue on cobalt oxide nanoparticles

Younes Dehmani¹, Ali Dehbi¹, Dison S. P. Franco², Hind Omari¹, Jordana Georgin², Adil Lammini¹, Younes Brahmi³, Kaoutar Elazhari¹, Mohammed Messaoudi¹, Najib Dahbi⁴, Youssera Bengamra¹, Taibi Lamhasni⁵, Awad A. Alrashdi⁶, Abdalaziz Abdallaoui¹

¹Moulay Ismaïl University, Meknes 50070, Morocco

²Universidad de la Costa, CUC, Atlántico, Colombia

³Mohammed VI Polytechnic University (UM6P), Ben Guerir, Morocco

⁴Institut supérieure des professions infirmières et techniques des santé de Meknés

⁵Institut National des Sciences de l'Archéologie et du Patrimoine (INSAP), Rabat-Instituts, Morocco

⁶Umm Al-Qura University, Al-Qunfudah University College, Saudi Arabia

dehmaniy@gmail.com

Abstract.

The article describes the synthesis of cobalt oxide nanoparticles and their application in the adsorption of methylene blue (MB) from solution. The X-ray diffraction patterns show the synthesized cobalt oxide nanoparticles have a crystalline cubic structure. The study of the adsorption of methylene blue onto the cobalt oxide nanoparticles involved determining the contact time and initial concentration for the adsorption of MB on the adsorbent. The kinetics of adsorption were studied using two kinetic models (pseudo-first order and pseudo-second order), and the pseudo-second order model was found to be the most appropriate to describe the behavior of the adsorption. The study indicates that the MLTS (monolayer with the same number of molecules per site) model is the most suitable model for describing the methylene blue and cobalt oxide systems, and the parameter values help to further understand the adsorption process through the steric parameters. Indicating that the methylene blue is horizontally adsorbed onto the surface of the cobalt oxide, which is bonded to two different receptor sites. Regarding the temperature effect, it was found that the adsorption capacity increased; the experimental value ranged from 313.7 to 405.3 mg g⁻¹, while the MLTS predicted 313.32 and 408.16 mg g⁻¹. From the thermodynamic functions, it was found that there was high entropy around 280 mg L⁻¹ concentrations. The Gibbs free energy and the enthalpy of adsorption were found to be negative at all the investigated concentrations and temperatures, indicating that the system is spontaneous and endothermic. The study concluded that the adsorption of methylene blue on cobalt oxide nanoparticles occurs by the formation of a monolayer, where the same number of molecules is adsorbed onto two different sites. The findings provide insights into the adsorption process of methylene blue on cobalt oxide nanoparticles, which can be used for various applications, such as wastewater treatment.

Tuesday, 31th October 2023, DAY 2

SESSION 2

**Geospatial data and environmental
Management**

ORAL COMMUNICATIONS

D2-C Chairs : *Abelaziz SEBEI & Salwa SAIDI*

D2-D Chairs : *Rifaat ABDALLA & Ahmed EZZINE*



Contribution of Remote Sensing to the Study of Land Degradation in the Medjerda Watershed

Ahmed Ezzine¹, Taoufik Hermassi², Emna Kochlef¹, Mourad Salhi¹

¹Center for Cartography and Remote Sensing

²National Institute for Research in Rural Engineering, Water, and Forests
ezzine.ah@gmail.com

Abstract: Land degradation is a process that reduces or destroys the capacity of land for agricultural, plant, animal, and forestry production. It results from human activities or natural phenomena exacerbated by human activities. To characterize and assess this degradation, it is opportune to exploit new techniques based on earth observation data. This study is part of the Research Program Contract of the National Center for Cartography and Remote Sensing (erosion project), funded by the Ministry of Higher Education and Scientific Research. The program aims to develop and apply geospatial techniques to assess and map land degradation in the Medjerda watershed. In this study, mapping and quantification of degradation indicators were carried out using indicator SDG 15.3.1, which describes methods for evaluating and quantifying the proportion of degraded land based on three indicators: land cover, soil productivity, and organic carbon stock in the soil. Empirical erosion models RUSLE and MEDALUS were used in the study area due to their compatibility and adaptation to Tunisian conditions, using the MISLAND platform developed by the Sahel and Sahara Observatory.

Keywords: Land Degradation, MEDALUS, SDG 15.3.1, Remote Sensing



Characterization of the spatial variability of soil salinity in different areas of the Great Green Wall alignment in the Trarza Region, Southwest Mauritania, using geostatistics and kriging.

Mohamed Mahmoud Abidine¹, Nessiba Itawel Oumrou¹, Lemane Mohamed Cheikh¹, Ahmedou Soulé² et Ahmedou Vadel¹

¹ University of Nouakchott, P.O. Box 880, Nouakchott, Mauritania

² Higher Normal School, P.O. Box 990, Nouakchott, Mauritania

abidine108@gmail.com

Abstract: The Great Green Wall (GGW) is a trans-Saharan belt crossing Sahelian countries. In its overall policy, it aims to establish windbreaks, fruit trees, and food crops around cities and villages along its alignment. The objective of this work is to study two essential soil components, Electrical Conductivity (EC), and pH. Subsequently, experimental data will be used to establish extrapolation maps of EC and pH for the studied region (Trarza: R'Kiz, Rosso, and Keur-Macine). The germination of six species is monitored on soil samples collected from the three sites at two different depths (0-15cm and 15-30cm). Our approach involves uniformly and representatively collecting fifty soil samples from each site. EC and pH are measured in the laboratory. The experimental values obtained are modeled using two prediction methods: Ordinary Kriging (OK) and Inverse Distance Weighting (IDW). To validate our results, we followed the germination of six species on soils collected from three sites. The species include three woody plants (*Acacia tortillis*, *Acacia senegal*, *Balanites aegyptiaca*), two cereals (*Sorghum cernum* and *Zea mays*), and a vegetable (*Lycopersicum esculentum*). Our results showed that the soils of R'Kiz and Rosso are less saline than that of Keur-Macine. The soils of Keur-Macine and Rosso are acidic, while that of R'Kiz is basic. The OK method is more valid than IDW. Indeed, the interpolation maps obtained by this method perfectly reflect the experimental data. The soils of R'Kiz and Rosso allow good (80-90%) and/or acceptable (60-70%) germination capacities for the species *A. tortillis*, *A. senegal*, *S. cernum*, and *L. esculentum*. In contrast, the soil of Keur-Macine exhibits low germination rates (7-20%). The species *B. aegyptiaca* and *Z. mays* show germination failure. The low germination capacities recorded in Keur-Macine's soil are linked to a very high degree of salinity. The germination failure observed in *B. aegyptiaca* is likely due to seed dormancy. It appears that the lack of germination noted in *Z. mays* results from low embryo viability.

Keywords: Great Green Wall, Trarza, Soil Conductivity and pH, Extrapolation Map, Germination



Identification of the main factors acting on seawater intrusion by multivariate statistical analysis of the Monastir aquifer, Tunisia

Rihem Mejdoub El Fehri ¹, Boutheina Farhat ², Noamen Rebai ¹

¹Civil Engineering Department , National Engineering School of Tunis, University of Tunis El Manar, Geotechnic and Geohazards , Laboratory (LR14ES03), Tunis, Tunisia.

²Faculty of Sciences of Tunis, Laboratory of Mineral Resources and Environment, University of Tunis El Manar, 2092 Tunis, Tunisia

rihem.majdoubfehri@fst.utm.tn

Abstract

Saltwater intrusion is a leading cause of groundwater quality degradation in numerous coastal aquifers worldwide. However, investigating saltwater intrusion and developing effective groundwater management strategies presents limited alternatives. The prevailing method for assessing saltwater intrusion involves the application of numerical modeling. Nevertheless, this numerical modeling process is complex and data-intensive, demanding intricate calculations due to the extensive data requirements. In areas with limited hydrological monitoring data, such as the coastal Monastir aquifer in Tunisia, the application of numerical models can be hindered by a lack of data certainty. To address this challenge, we have introduced a combined statistical and geochemical assessment technique to accurately delineate the extent of groundwater salinization in the coastal areas of the Monastir aquifer. Hydrogeology and water quality data from thirty-eight groundwater sampling wells were collected. A chloride concentration cross-sectional plot was used to simulate the theoretical mixing between two primary hydrochemical facies groups: $\text{Na}^+ - \text{Cl}^-$ and $\text{Ca}^{2+} + \text{Mg}^{2+} - \text{NO}_3^- + \text{Cl}^-$. This theoretical mixing was simulated, and the results were aligned with observed groundwater data, confirming the prevalence of groundwater salinization attributed to saltwater intrusion. This salinization is evident through elevated concentrations of Total Dissolved Solids (TDS), Cl^- , and Na^+ , stemming from geochemical processes resulting from water-rock interactions. These processes are reflected in the calcium, magnesium, sodium, chloride, and sulfate content, all positively correlated with salinity across water samples. These constituents primarily originate from the dissolution of halite found in the Upper Miocene sediments. Additionally, the presence of SO_4^{2-} and Ca^{2+} suggests that sulfate dissolution further contributes to the increased salinity. The observed data, combined with the mixing models, support the conclusion that groundwater quality declines from north to south. The findings of this study serve as a foundational basis for future hydrogeological research and development within the region.

Keywords: Groundwater, Hydrochemistry, Multivariate statistical analysis, Chloride, Monastir aquifer, Tunisia



Impact of Urban Evolution on Water Resources: Case Study of the Essijoumi Watershed

Sabrine Ammar¹, Salwa Saidi¹, Abdelaziz Sebai¹

¹ University of Tunis El Manar, Tunisia
sabrinel.ammar@gmail.com

Abstract: The main objective of this study is to investigate changes in land use and assess their impact on water resources in the Essijoumi watershed. To achieve this, we utilized diachronic mapping of land cover using freely available Landsat satellite images for various dates (open data). The integration of these data into a GIS platform and their spatialization allowed us to monitor and detect the degree of change in terms of urbanized areas. A subsequent comparison was made between this urban evolution and the hydrological balance for the same dates (choosing the year 2018), using the historical data from CRDA Manouba and previous studies in the same area and context. The application revealed a significant increase in urban surface area (81.5%), especially in the last decade, leading to a decrease in the quantity of infiltrated water and an increase in surface runoff volume—a factor contributing to urban risk, particularly flooding.

Keywords: Essijoumi Watershed, Land Cover, Hydrological Balance, GIS, Remote Sensing.



Hydrospatial Modeling - New Term and Old Ingredients

Rifaat Abdalla

Department of Earth Sciences, College of Sciences, Sultan Qaboos University, Al-Khouth, Oman
rabdalla@squ.edu.om

Abstract.

Hydrospatial modeling is a rapidly developing field that integrates hydrographic surveying, geographic information systems (GIS), and remote sensing to produce detailed models of marine environments. This study aims to explore the integration of these key ingredients in hydrospatial modeling and highlight its significance for marine spatial planning and management. The purpose of this study is to provide an overview of hydrospatial modeling, examine its historical development, and highlight its applications in marine spatial planning.

The methods used in this study involve a comprehensive review of the literature on hydrospatial modeling and its key ingredients. Data collection involved an extensive search of online databases and scientific literature, including journal articles, conference papers, and technical reports. Data processing involved a thorough analysis and synthesis of the data collected to identify key themes and trends.

The results of this study demonstrate the significant contribution that hydrospatial modeling can make to marine spatial planning and management. The integration of GIS, remote sensing, and hydrographic surveying provides a powerful tool for developing accurate and detailed models of the marine environment. These models can be used to identify areas of high conservation value, assess the impacts of human activities on marine ecosystems, and support the sustainable management of marine resources.

Interpretation of the results suggests that hydrospatial modeling is a valuable tool for enhancing our understanding of the marine environment and supporting sustainable development. The integration of GIS, remote sensing, and hydrographic surveying in hydrospatial modeling can provide a comprehensive understanding of the marine environment, which is critical for effective marine spatial planning and management.

In conclusion, this study highlights the significant contribution that hydrospatial modeling can make to marine spatial planning and management. The integration of GIS, remote sensing, and hydrographic surveying in hydrospatial modeling provides a powerful tool for developing accurate and detailed models of the marine environment. These models can be used to support sustainable development and enhance our understanding of the marine environment.

Keywords: GIS, Remote Sensing, Hydrography, Hydrospatial Modeling



Managing Uncertainty and Imprecision in Spatio-Temporal Database Queries for Flood Events

Manel Chehibi ¹, Ahlem Ferchichi ², Imed Riadh Farah ¹

¹ENSI, University of Manouba, Tunisia

²University of Ha'il, Hail, Saudi Arabia

manel.chehibi@ensi-uma.tn

Abstract.

Spatio-temporal databases play a crucial role in managing data related to flood events, encompassing both the period and location where these phenomena occur. However, queries within these databases, especially those related to floods, often involve vague and imprecise criteria related to time and space. This imprecision and uncertainty in flood-related queries pose a challenge for traditional response systems.

In this study, we present an innovative approach to effectively handle spatio-temporal queries concerning flood events, which are frequently characterized by vague, uncertain, and imprecise attributes. The system architecture we propose not only resolves the issues inherent to imprecision and uncertainty in flood queries but also allows users to express their spatial and temporal preferences with great flexibility.

Keywords: Spatio-temporal databases queries, Flood events, Uncertainty, Imprecision, Flexible Query Answering Systems



Estimation of Forage Biomass through Remote Sensing: A Case Study of Pastoral Resources in a Heterogeneous Mediterranean Environment

Jacem Ben Hamden^{1,2}, Imad Shaqura², Fabien Stark², Jean-Baptiste Féret³

¹ University of Carthage, 1082 Tunis, Tunisia

²SELMET, INRAE, CIRAD, l'Institut Agro-Montpellier, University of Montpellier, 34060 Montpellier, France

³TETIS, INRAE, AgroParisTech, CIRAD, CNRS, University of Montpellier, 34093 Montpellier, France

benhamdenjacem@gmail.com

Abstract: Mediterranean landscapes are characterized by heterogeneous mosaic patterns, combining cultivated, natural, and semi-natural spaces. Pastoralism, historically present in these territories, holds significance in addressing ecological transition challenges, contributing to landscape openness, biodiversity preservation, and wildfire prevention. Understanding the forage potential of these diverse and heterogeneous spaces is crucial information to facilitate the reintroduction of pastoral farming but remains challenging at small regional scales. This research aims to develop and test a remote sensing-based method for estimating the pastoral potential of a diversified Mediterranean territory (Massif de La Clape, France). We first characterized different land use types by combining SPOT7 and RPG data. Subsequently, we estimated plant biomass using physical indices, LAI and LMA, obtained through the PROSAIL inversion model on the Sentinel-2 satellite time series from 2019 to 2022. This work produced a detailed land cover map of the study area, including various pastoral surfaces, often insufficiently considered (kappa of 0.92). Furthermore, we generated maps and annual and multi-annual vegetation biomass monitoring diagrams, differentiated by land use type. The results were evaluated by experts and compared to reference data (Rami Pasto), reinforcing the reliability of our method. Spearman correlation matrices were used to explore the relationships between estimated biomasses by land use type and meteorological conditions. Our findings reveal, among other things, that open heathlands show a relatively stable biomass quantity over the years, while closed heathlands exhibit substantial variations over the four studied years. Inter-row spaces in vineyards, on the other hand, reveal a significant amount of biomass that can be grazed by herds during the winter season. In conclusion, this study spatially and temporally characterized the pastoral potential, in terms of available biomass, of a small Mediterranean region. These results are of considerable interest for the sustainable management of natural resources and the future planning of pastoral activities.

Keywords: Pastoralism, Remote Sensing, PROSAIL, Biomass.



Machine learning for water data management : bibliometric study

MOUMEN Aniss¹, MEJJAD Nezha², EL ANSARI Rachid¹, EL BOUHADDIOUI Mohamed³

¹ Ibn Tofail University, Kenitra, Morocco

² National Center for Energy Sciences and Nuclear Techniques, Morocco

³ National School of Mineral Industry, Rabat, Morocco

aniss.oumoumen@uit.ac.ma

Abstract. The abstract Machine learning techniques present an alternative way to estimate, evaluate and predict the evolution of water parameters. Indeed, the decider makers consider all this information to improve the situation of water resources. In this paper, we present a bibliometric study about applications of Machine learning to address issues related to water resources. We have found more than 160 references. To elaborate this literature review we used scientific databases: Scopus, ScienceDirect and IEEE. After applying word cloud requests, we have identified many topics: Water quality, Groundwater, Water Surface, Irrigation, drought. Also, the most recurrent machine learning technics used by researchers in this field are Neural Network, Deep Learning, SVM, Regressions, Xgboost, ELM. To conclude this paper, we present a comparative discussion between machine learning technics according to their metrics to evaluate the quality of those models.

Keywords: Machine learning Algorithm, Water management, Metrics, SLR.



Urban City Planning through Photogrammetric Processes: Case Study of La Marsa, Tunis

Yeslem Ahmed Oumar¹, Noamen Baccari¹, Seifallah Mrabet² Abdelaziz Sebei¹

¹ Faculty of Sciences, Tunis El Manar University

² Aero-Survey Mapping, Cité des Jardins

Yeslemfah@gmail.com

Abstract: The aim of this work is to create a new plan for the city of La Marsa, north of Tunis, at a scale of 1/2000, covering an area of 546 hectares. To meet this challenge of urban cartography, aerial photos taken by an airplane on 15/02/2023 were chosen. The goal was to obtain an accurate two-dimensional (2D) representation of the urban area of La Marsa using photogrammetry as the main method for collecting geospatial data. The methodological approach adopted to achieve our goal is based on a series of photogrammetric data processing steps, including PVA, stereo-preparation, photogrammetric block creation, internal orientation, external orientation, aerial triangulation, point cloud creation, restitution, creation of a mesh (GRID) to create DTM and DSM. For this, orthographic rectification, mosaicking, radiometric and geometric corrections were performed, followed by the assembly of all orthophotos into a single orthoimage using the ERDAS IMAGINE ORIMA2022 program. The result is the creation of an ortho-image and a plan at a scale of 1/2000, with an RMS error of 12 mm, covering the urban area of La Marsa. This ortho-image represents a valuable detailed 2D map of the city. Our research demonstrates the effectiveness of photogrammetry in the context of urban cartography. This method accurately captured the details of the urban area, including buildings, road networks, and green spaces. Moreover, by using high-resolution aerial photos, we succeeded in accomplishing this complex task. Therefore, a city plan for La Marsa was created using photogrammetry and advanced data processing technology. This achievement represents a significant advancement in urban cartography and provides a useful tool for long-term urban planning and management.

Keywords: Photogrammetry, RMS, DTM, Orthophoto, PVA



BIM Modeling and Advanced Spatial Analyses for Construction: Case of Building S+RDC+2+C in Île-de-France

Ali Chaieb^{1,2}, Imed Mazouzi²

¹ National School of Engineers of Tunis, University of Tunis El Manar, Tunisia.

² Higher School of Engineers of Medjez El Bab, University of Jandouba, Tunisia

Abstract: This study aims to model a 3D BIM model of a building located in Île-de-France, comprising a basement, ground floor, 2 floors, and an attic. Advanced spatial analyses were conducted to optimize its design, construction, and operation. Using BIM data and spatial analysis algorithms, this study aims to provide information on the building's performance and identify potential improvement areas. The building modeling and MEP networks were performed using Revit software, while data for analyses included simulations of hydraulic flows, thermal modeling, acoustic simulations, wind simulations, and fire scenario simulations obtained from the building's BIM model. The results of the analyses showed that the building's design could be improved to optimize its performance. Simulations revealed areas for improvement in terms of acoustic insulation, thermal performance, and airflows. Additionally, hydraulic flow simulation identified potential issues with the building's water management system. The findings of this study suggest that BIM and advanced spatial analysis techniques can be used to optimize construction. The use of these techniques can help identify potential issues early in the design and operation process, allowing for more efficient design and construction. In conclusion, this study highlights the importance of using BIM and spatial analysis techniques within the construction industry. By doing so, designers and builders can optimize building performance, reduce risks, and enhance efficiency. This study contributes to existing knowledge about the benefits of BIM and structural analyses and provides insights into their application in a real case study.

Keywords: BIM, Spatial Analysis, 3D Model, Simulation, Buildings.



Advancing a Conceptual Framework for Optimizing the Placement of Pumped Energy Transfer Stations through Multi-Criteria Analysis: A case Study in Tbaraka, Tunisia

Mohamed Ayet Allah Bilel Soussi¹, Noamen Rbai¹, Chamseddine Zaki²

¹National School of Engineering of Tunis, University of Tunis El Manar, Tunisia

²College of Engineering and Technology, American University of the Middle East, Kuwait

`bilel.geomatique@gmail.com`

Abstract.

In today's dynamic renewable energy landscape, encompassing a wide array of sources such as solar, hydropower, and wind energy, we initiated a strategic conceptual study to optimize the placement of a Pumped Energy Transfer Station (PETS) in Tabarka, Tunisia. This endeavor involved creating a high-resolution Digital Terrain Model (DTM) using PIX4D, leveraging imagery captured by a DJI INSPIRE drone within our study area. Subsequently, we employed the Analytic Hierarchy Process (AHP) to meticulously evaluate and rank potential PETS locations based on predefined criteria, categorizing them into exclusion and evaluation criteria. Our approach began by applying exclusion criteria to filter out inappropriate site choices. Next, we utilized AHP to develop a weighted formula for assessing various factors. We conducted four distinct scenarios, adjusting the number of factors and refining the weight distribution in each instance. The resulting average weighting provided a robust foundation for the subsequent phases of our study. We leveraged the specialized framework "Modeling of Application Data with Spatio-temporal features" (MADS), extending its application to introduce a comprehensive conceptual approach for identifying optimal PETS locations across various study areas. We successfully translated the exclusion and evaluation criteria methods into a concrete implementation in the plpgsql programming language. These conceptual insights equip database designers with the tools necessary to address similar site placement challenges, replicating the success of our case study.

Key Words: Tabarka, renewable energy, PETS, Orthophoto, AHP, MADS, Plpgsql.



Agricultural Sector in CAP-BON and Collaboration Opportunities

Ben Thamer Hatem¹

¹ Department of Agricultural Studies and Development, CRDA Nabeul, Tunis, Tunisia.
bt_hatem@yahoo.com

Abstract: The governorate of Nabeul, located at the heart of Tunisia, stands as a central pillar in the national agricultural economy. It contributes over 15% to the country's agricultural production, managing more than 14 different seasons. Among its flagship productions are citrus fruits, accounting for 75% of the national production, vines with 60%, potatoes at 45%, and tomatoes at 35%. However, the governorate of Nabeul faces considerable challenges. One major issue is marine intrusion, a phenomenon that directly threatens the quality of soils and water resources. Added to this are other challenges such as the degradation of natural resources (water, soil), climate change, the structuring of the sector, and the importance of integrating Information and Communication Technologies (ICT) as well as geomatics to modernize and safeguard the agricultural sector. In the face of this reality, the involvement and awareness of stakeholders, including farmers, local organizations, or consumers, are essential. The actions taken today will determine the sustainability and prosperity of agriculture in the region for future generations. In conclusion, the governorate of Nabeul, with its pivotal role in Tunisian agriculture, is at a crucial crossroads. Adopting modern solutions and actively involving stakeholders is key to overcoming current obstacles.

Keywords: Nabeul, soils, water resources, ICT.

Tuesday, 31th October 2023, DAY 2

SESSION 2

**Geospatial data and environmental
Management**

POSTER PRESENTATIONS

Chairs: Raja Chairi & Mohamed MASTERE



Enrichment of Remote Sensing Ontology based on linked Domain Ontologies and Textual Corpora

Sourour Ouerghi¹, Mohamed Farah¹, Fethi Ghazouani²

¹National School of Computer Science, University of La Manouba, Tunisia

²Département de Médecine Nucléaire, Centre Henri Becquerel, Rouen, France
sourourouerghi@gmail.com

Abstract.

Remote sensing (RS) research focuses on the acquisition, representation, and interpretation of satellite scenes. RS helps monitor geographical objects that change over time. Many studies have been carried out in the literature to produce relevant semantic interpretations of RS images, thus extracting relevant knowledge from satellite imaging to study natural phenomena, such as erosion, deforestation, and desertification. Ontologies are the basis for the formal and explicit representation of RS images. Till now, we do not have yet a reference RS ontology to assist us in studying major events that affect the Earth and in detecting and monitoring natural phenomena. Nevertheless, various geographical ontologies exist and can be used as semantic resources to build such reference RS ontology. Also, a wide range of scientific papers deal with RS, thus can also be used to enrich the reference RS ontology. In this paper, we propose a two-step approach to build this ontology starting from the target ontology of Durand et al. First, we reuse several geographical ontologies (called source ontologies) to extend and enrich the ontology of Durand et al. This allowed taking advantage of the conceptual richness of the target ontology and extending it with new concepts from source ontologies. Source ontologies were selected based on their diversity and ability to model various geographical objects. These ontologies such as FTT, Fodomust, Hydrology, FusionTopoCarto and OntoGeo, model a variety of geographical objects at various levels of detail. The second step of the proposed approach involves identifying relevant concepts from textual corpora using syntactical and statistical methods. Also a filtering step is introduced to retain only concepts related to RS. The last step (structuring phase) consists of choosing where the retained concepts are incorporated into the target ontology.

Keywords: remote sensing, geographic ontologies, ontology engineering, textual corpora.



Assessment of remote sensing accuracy in predicting soil salinity distribution using statistical and geostatistical approaches: A case study in the Gafsa region, Tunisia.

Ibtissem Triki^{1,2}, Nadia Trabelsi¹, Leila Kharbout¹, Imen Hentati¹, Zoheira Ibn Ali¹

¹University of Sfax, Tunisia

²University of Gafsa, 3029 Sfax, Tunisia

triki_ibtissem@yahoo.fr

Abstract.

In southwestern Tunisia's Aguila irrigated area in Gafsa, factors such as low rainfall, high evaporation, and increased use of treated wastewater for irrigation contribute to soil salinization. This threatens soil quality, posing an environmental challenge with implications for agriculture and food security.

This study compares two methods for mapping soil salinity ordinary kriging using sampled soil data and remote sensing data from Sentinel-2 imagery. The goal is to determine the effectiveness of remote sensing in predicting salinity patterns and its potential integration into predictive models.

The first salinity map was constructed through ordinary kriging using 24 sampled soil data points. The second map was developed by utilizing bands and indices of soil salinity extracted from the Sentinel-2 satellite imagery.

Initially, a principal component analysis (PCA) was conducted to identify the most influential bands and indices for predicting soil salinity. Subsequently, a linear regression model was formulated, integrating relevant bands and indices correlated with soil salinity as explanatory variables.

The results of the principal component analysis (PCA) revealed that the first principal component (PC1) aligns with visible bands and their related salinity indices. Meanwhile, the second principal component (PC2) displayed robust connections with SWIR bands and exhibited a moderate correlation ($R^2 = 0.52$) with electrical conductivity (EC), implying its viability as a predictive factor for soil salinity. The outcomes of the linear regression model indicate that the most effective empirical relation is established using PC2, B7, B8 and B1. This model regression approach explains around 55% of the variance in forecasted soil salinity values and upholds a minimal root mean square error (RMSE = 0.8 dS/m).

The resulting salinity map exhibited a striking similarity to the one interpolated using sampled soil data, thereby emphasizing the effectiveness of remote sensing in visualizing spatial salinity distribution.

Keyword Soil salinity, Sentinel-2 satellite, Spectral indices, PCA, Regression Analysis, ordinary kriging.



Evaluation Comparative de la vulnérabilité de la Nappe de Mornag : Méthodes DRASTIC Standard vs DRASTIC Pesticides

Abdelaziz Sebei¹, Bouthaina Farhat¹, Noamen Baccari¹, Imen Mezrioui¹, Salwa Saidi²

¹Faculty of Sciences of Tunisia, University of Tunis El manar

²Nationale Engineer school of Sfax, University of Sfax
abdelaziz.sebei@fst.utm.tn

Abstract:

The prospect of global change threatens a hydraulic crisis and land degradation, necessitating the strengthening of adaptive capacities to this foreseeable crisis. This study on the vulnerability of agricultural land in a watershed in the middle valley of Mejerda to climate change is based on a diagnosis of the current and future state of the environment and natural resources to develop the ability to predict soil degradation through erosion caused by interactive changes between land use and climate. This study of the interaction between climate change and environmental risk is based on the development of a study protocol for the vulnerability of agricultural land under the context of global changes by combining location parameters with time parameters. It is a mathematical approach aiming to estimate the risk of physical land degradation and determining factors, thereby identifying adaptation strategies and the threshold rainfall value that can influence and trigger the risk. This approach also takes into account the value at which the slope factor is considered an erosion characteristic. The environmental risk of physical degradation of the studied homogeneous hydrological units in our model is correlated with the vulnerability matrix, which depends on the characteristics of the environment (agronomic, pedological, topographic, and edaphic). Three risk classes were distinguished: units with low slopes cultivated with olive trees have a low risk of degradation (risk = 3 to 4×10^4); units with moderate slopes and land use in cereal cultivation have a medium risk (risk = 4 to 5×10^4); and units with slopes greater than 33% are the most vulnerable (risk > 20×10^4). Six scenarios were studied, and it is observed that if precipitation intensity increased, the risk would triple from 7 to 21×10^4 for Unit 1, the most vulnerable. The assessment of the risk of soil physical degradation due to water erosion requires considering both the hazards of climate change, the exposed issues, and vulnerabilities. Therefore, perspectives must be developed not only in terms of adaptation but also in terms of expected changes related to land and water management practices and the development of resource management capacities.

Keywords: Climate change, vulnerability, degradation, environmental risk, adaptation.



Estimation of Salinity in a Brackish Area Based on the Assessment of the Spatial and Temporal Distribution of Halophytic Vegetation (Salicornia) Case of Sebkhet Halk El Menjel (Sousse)

Sonia Gannouni¹, Rihab Riahi², Noamen Rebai²

¹CERTE, Technopole de Borj Cedria, Tunisia

²National School of Engineering of Tunis, University of Tunis El Manar, Tunisia
gannounisonia2017@gmail.com

Abstract

The increasing salinization of lagoons in arid and semi-arid regions threatens food security and water resource quality. Factors contributing to this salinization include harsh climates, irregular precipitation, and ineffective drainage. Additionally, geological composition influences the concentration of dissolved salts. Within this ecosystem subject to elevated salinity, halophytic vegetation, especially *Salicornia*, emerges as crucial indicators of adaptation to inhospitable conditions. It is in this context that our study is framed, based on the analysis of high-resolution Landsat satellite data (30 meters), focused on evaluating the spatial and temporal distribution of halophytic vegetation, specifically *Salicornia*, whose salinity tolerance does not exceed 5 mg/l, in the region of Sebkhet Halk El Menjel, Sousse, Tunisia. A simple linear regression analysis was used to study the relationship between the NDVI (Normalized Difference Vegetation Index) and soil salinity. The results reveal essential information about the impact of NDVI and soil salinity on vegetation cover. The regression intercept, set at 32.5, represents vegetation cover in conditions where vegetation is virtually absent, with zero values for NDVI and soil salinity. The regression coefficient associated with NDVI, quantified at 22.5, indicates that an increase of one unit of NDVI is linked to a significant increase of 22.5 units of vegetation cover, highlighting the influence of vegetation vigor. Concurrently, the regression coefficient related to soil salinity, set at -3.75, underscores an inverse relationship: a decrease in soil salinity is accompanied by an increase of 3.75 units of vegetation cover.

Keywords: Sebkhet Halk El Menjel, Salinization, Salicornia, NDVI, Linear Regression



The influence of irrigation with treated wastewater on the soils of the irrigated perimeter of Cebelat Ben Ammar-Borj Touil-Ariana (Tunisia)

Ines Smaani¹, Sonia Gannouni², Salma Boussen³, Noamen Rebai¹

¹ University of Tunis El Manar, National School of Engineering of Tunis, Tunisia.

²Water Research and Technologies Center (CERTE), Technopark of Borj Cedria, Tunisia.

³ University of Carthage, Higher Institute of Preparatory Studies in Biology and Geology, Soukra, Tunisia.

ines.smaani@fst.utm.tn

Abstract.

Tunisia has implemented a strategy for the valorization of treated wastewater (TWW), which includes the creation of several irrigated agricultural perimeters. This initiative aims to promote the sustainable use of water resources by reusing treated wastewater for agricultural irrigation. In the context of soil characterization, our study focuses on the spatiotemporal evolution of soils irrigated with discharged wastewater in the Borj Touil irrigated perimeter in the Cébalet Ben Ammar region of Tunisia. Soil samples were collected from plots irrigated with different irrigation durations, and we adopted a methodology based on three approaches. The first approach is remote sensing, which enables the spatial and temporal monitoring of the studied plots through the processing of multi-date satellite images (LANDSAT) (1987, 1992, 1997, 2002, 2007, 2013, 2018, and 2022). The results revealed the absence of saline minerals in the early years of irrigation (1987 to 1992). However, from 1997 onwards, an accumulation of saline minerals such as gypsum, halite, and anhydrite began to appear. This accumulation gradually increased with the irrigation duration. The second approach is in situ spectroscopy, which involves measuring the reflectance of six plots irrigated with TWW using an ASD4 field spectroradiometer. The analysis of soil spectra from the different plots showed the presence of absorption bands of saline minerals, such as gypsum. The third approach is geochemical analysis, which validates the results obtained from the previous two approaches. The main findings of the geochemical analyses include high concentrations of sodium and zinc in the different plots, proportional to the irrigation duration. These elements, through their evolution with irrigation duration, contribute to the salinization problem. The mineralogical characterization of the soils revealed the presence of halite only. In

conclusion, the results obtained from the three approaches are complementary, showing similarities with slight differences. The findings highlight that remote sensing is more effective than the geochemical approach in terms of qualitative analysis, as it allows for clear identification of saline minerals and their positive distribution with the irrigation period.

Keywords: Treated wastewater, Remote sensing, Spectroscopy, Geochemical analyses, Saline minerals and salinity.



The contribution of the Geographic Information System and remote sensing to the management of crop irrigation water in the Governorate of Bizerte

Salwa SAIDI^{1,2}, Houyem JOUINI¹, Anis GHATTASI^{1,2}

¹ Faculty of Sciences of Tunis, University of Tunis El Manar

² ENIS, University of Sfax

salwa.saidi@fst.utm.tn

Abstract.

Constant population growth highlights the critical importance of maintaining sustainable agricultural practices to ensure food security. In this context, the efficient use of irrigation water and the assessment of the real water needs of crops constitute a major advantage for preserving water resources and improving agricultural production in the face of global warming. One of the effective approaches to achieve this objective is based on the integration of Geographic Information System (GIS) and remote sensing using the FAO-56 model in irrigation management. It is in this context that this project takes place which aims to estimate the water needs of crops in the governorate of Bizerte. The application of this approach allowed us to optimize the irrigation water needs of different crops. And by exploiting geospatial data and spectral indices such as NDVI, NDWI and NDMI, agricultural decision-makers can take appropriate measures to optimize irrigation, avoiding excess or deficit of water, while minimizing environmental impacts.

Key words: Climate change, FAO-56 Method, GIS, water needs, spectral indices, water resources management.



Water quality assessment and identification of polluted areas, as well as water conservation measures in the Melian watershed

Ranya Chrigui², Boutheina Farhata¹, Cyrine Belhadj², Ahmed Achour¹, Noamen Rebai²

¹Faculty of Sciences of Tunis, University of Tunis El Manar, 2092 Tunis, Tunisia

²Civil Engineering Department, National Engineering School of Tunis, University of Tunis El Manar, Tunis, Tunisia.

ranyachrigui4@gmail.com

Abstract.

Suitable development requires the efficient management of water resources, both in terms of quantity and quality. The current study seeks to examine water quality and identify polluted regions within the Melian watershed in Zaghuan, Northern Tunisia. To accomplish this, we utilized a combination of field observations, GIS technology for spatial analysis and geostatistical analysis. We collected 20 water samples for this purpose using methodologies that integrated the analysis of chemical and organic characteristics of groundwater. This comprehensive approach revealed a complex interplay of both anthropogenic and natural influences, resulting in a gradual increase in salinity along the water's flow direction. Notably, the presence of organic contaminants, such as polychlorinated biphenyls (PCBs) and Polycyclic aromatic hydrocarbons (HAPs), in the groundwater exceeded the acceptable drinking water standards.

This geochemical study enabled us to identify areas of pollution within the Melian watershed, highlighting locations that exceeded safety standards, thereby posing a risk to humans, human health due to elevated nitrate levels. The identification of these high-risk areas indicates an increase in contamination around the Melian River. The results of the water quality assessment, obtained through the comprehensive Pollution Index (PI) approach, revealed that both the PI calculation and its spatial distribution accurately reflected the water quality levels. Out of the twenty monitoring sections, eight exhibited significant pollution, leading to a 'Poor' classification of water quality in these areas. According to the Groundwater Quality Index (GWQI), approximately 30% of the samples fell within the 'Good' category for drinking water. Furthermore, while this work primarily focuses on the causes and processes of water quality contamination in the Melian watershed, it is evident that further research is required to encompass other contributing factors.

Keywords: Pollution, PCB, HAP, PI, GWQI, geochemistry, Melian watershed, Zaghouan.

Wednesday, 1st November 2023, DAY 3

SESSION 3

Climate change and GIS

ORAL COMMUNICATIONS

D3-E Chairs: *Mohamed MASTERE & Taoufik HERMASSI*

D3-F Chairs : *Anis MOUMEN & Sonia GANNOUNI*



Assessing the Impact of Climate Change on Lake Ichkeul's Functioning: A 1D Hydrodynamic Model-Based Quantitative Analysis

Cyrine Belhadj¹, Noamen Rebai¹, Béchir Bejaoui²

¹University of Tunis el Manar, 1002 Tunis, Tunisia

²National Institute of Marine Sciences and Technologies (INSTM), University of Carthage, Tunis-Tunisia.
cyrine.belhadj@etudiant-enit.utm.tn

Abstract.

This research focuses on quantitatively assessing the impact of climate change on the functioning of Lake Ichkeul, an 8500-hectare (85 km²) ecosystem in northern Tunisia. Utilizing the MOHYB hydrodynamic model, a 1D numerical approach, the study investigates the role of lagoon exchange through the Tinja river, including the influence of tides, in controlling salinity and preventing drought occurrences in the Ichkeul lagoon. The model incorporates relevant environmental parameters, such as water inflow, wind stress, evaporation rates, precipitation, river inputs, water temperature, air temperature, and tidal variations, to simulate the hydrodynamic behavior of the lagoon. The hydrodynamics of Lake Ichkeul are influenced by the inflow of fresh continental water during winter and saltwater inflow from the Bizerte Lake during summer. Additionally, the model considers the impact of tides on controlling the flow of salt into the lagoon. By incorporating these dynamics, the study accurately captures the complex behavior of the lagoon and its response to changing environmental conditions. According to the simulations conducted over a 5-year period, the flow of water across the communication between the Tinja river and the Ichkeul lagoon varies seasonally. The results highlight the importance of tides in controlling the flow of salt into the lagoon. The maximum flow of water exchanged across this communication ranges from -200 mm/d to 200 mm/d, exhibiting variations corresponding to the different seasons. Furthermore, the simulations demonstrate the consequences of the closure of the Tinja canal. After 550 days of closure, the Ichkeul lagoon experienced a total drought, with an average monthly water level decrease of 5.56 cm. These findings underscore the critical significance of maintaining lagoon connectivity through the Tinja river, considering both river input and tidal influence, to control salinity levels and prevent drought events in the Ichkeul lagoon. By analyzing the hydrodynamics of the lagoon and its interaction with the Tinja river, including tidal variations, this research provides valuable insights into the potential impacts of climate change on the functioning of Lake Ichkeul.

Keywords: Ichkeul Lake, MOHYB, 1D hydrodynamic model, Climate change.



RESEARCH IN THE IMPACT OF CLIMATE CHANGE ON UNITARY SANITATION NETWORK FUNCTIONING. CASE STUDY AREA OF SOUK AHRAS DOWNTOWN, ALGERIA

AbdelKrim GUEBAIL¹

¹Laboratory of modeling and socio-economic analysis in water science “MASESE”, University of Souk-Ahras,
Algeria
agebaili@yahoo.fr

Abstract

A sanitation network, in with agreement and among its crucial functions, is to combat water-borne diseases resulting from pollution problems, the most frequent of which are those caused by waste water which undesirably affects our daily environmentally good lives. The aim of this study is to resize a water unitary sanitation network used belonging to the city of Souk Ahras in eastern Algeria. This sanitation network is designed to collect and evacuate waste water from this area. However, we will link our resizing according to Two (02) different project rain series, which distinguishes a current and consequent climate change. This is to detect possible differences between the hydraulic components and observing the difference of the physical behavior of the same network. The main

problem of our present study is that our same sewerage network is well able to respond to two different series of rains caused by climate change.

Keywords: unitary sanitation network; Souk Ahras; two different series of project rain; climate change; the hydraulic components.



Interaction changement climatique-risque environnemental Etude de cas : bassin versant de la moyenne vallée de la Mejerda (Tunisie)

Rihab Riahi¹, Abdessatar Hatira¹, Slimane Baccouche², Nakouri Amor¹, Noamen Rebai¹

¹University Tunis El Manar, Tunisie

²University of Jendouba, Tunisie

riahirihab2@gmail.com

Abstract:

The prospect of global change threatens a hydraulic crisis and land degradation, necessitating the strengthening of adaptive capacities to this foreseeable crisis. This study on the vulnerability of agricultural land in a watershed in the middle valley of Mejerda to climate change is based on a diagnosis of the current and future state of the environment and natural resources to develop the ability to predict soil degradation through erosion caused by interactive changes between land use and climate. This study of the interaction between climate change and environmental risk is based on the development of a study protocol for the vulnerability of agricultural land under the context of global changes by combining location parameters with time parameters. It is a mathematical approach aiming to estimate the risk of physical land degradation and determining factors, thereby identifying adaptation strategies and the threshold rainfall value that can influence and trigger the risk. This approach also takes into account the value at which the slope factor is considered an erosion characteristic. The environmental risk of physical degradation of the studied homogeneous hydrological units in our model is correlated with the vulnerability matrix, which depends on the characteristics of the environment (agronomic, pedological, topographic, and edaphic). Three risk classes were distinguished: units with low slopes cultivated with olive trees have a low risk of degradation (risk = 3 to 4 x 10⁻⁴); units with moderate slopes and land use in cereal cultivation have a medium risk (risk = 4 to 5 x 10⁻⁴); and units with slopes greater than 33% are the most vulnerable (risk > 20 x 10⁻⁴). Six scenarios were studied, and it is observed that if precipitation intensity increased, the risk would

triple from 7 to 21 x 10⁴ for Unit 1, the most vulnerable. The assessment of the risk of soil physical degradation due to water erosion requires considering both the hazards of climate change, the exposed issues, and vulnerabilities. Therefore, perspectives must be developed not only in terms of adaptation but also in terms of expected changes related to land and water management practices and the development of resource management capacities.

Keywords: Climate change, vulnerability, degradation, environmental risk, adaptation.



Large-scale climate indices, climate and environmental extremes, The Saharan Oscillation Index (SaOI): a new climate index for the north Africa

Younes TEBBAAI¹, Kenza KHOMSI^{1,2}, Mohamed KHALIS^{1,3}.

¹ Mohammed VI University of Sciences and Health, Casablanca, Morocco

² Directorate General of Meteorology, Casablanca, Morocco.

³Institute of Health Sciences, Rabat, Morocco

Abstract

The Mediterranean region is highly susceptible to various climate and environmental risks, such as frequent flooding, severe droughts, and extreme rainfall occurrences. The interaction of large-scale atmospheric circulation with the atmosphere and ocean plays a vital role in regulating weather patterns, overall climate conditions, and activities within the region. A Saharan Oscillation Index (SaOI) has been developed as a climate index designed to capture the oscillation dynamics between the Saharan depression and the Azores High in the southern desert area. The objective of this study is to acquire a comprehensive understanding of the Saharan Oscillation Index (SaOI) and evaluate its relationship with the atmospheric circulation and other large-scale climate indices in the Mediterranean region. We calculated the time series of the SaOI index from 1950 to 2021 using its established formulation. To evaluate the relationship with the SaOI index, we computed its annual and seasonal correlations with multiple climate indices (NAOI, MOI, TNA, TSA, AMO, AO, El Niño, and WHP) using the Pearson

correlation coefficient. Furthermore, we developed a linear regression model to quantify the strength of the relationship between these climate indices and SaOI. Our analysis unveiled a moderate positive correlation between the Saharan Oscillation Index (SaOI) and the North Atlantic Oscillation Index (NAOI), Arctic Oscillation (AO), Oceanic Nino index (ONI) and Western Hemisphere Warm Pool (WHP) indices, suggesting interconnected variability in the Mediterranean region. Additionally, we observed weak positive correlations between SaOI and several other climatic indices, namely the WHP, Tropical South Atlantic (TSA), Tropical North Atlantic (TNA), Mediterranean Oscillation Index (MOI), and El Niño. These findings imply a positive relationship and indicate potential influences among these variables. The correlation between the newly developed Saharan Oscillation Index (SaOI) and other prominent indices in the Mediterranean region provides an opportunity to explore potential relationships and interactions among these climatic phenomena. Investigating their correlations can yield valuable insights into their impact on both regional and global weather patterns. These teleconnections often arise from the propagation of atmospheric waves and the transfer of energy and momentum throughout the atmosphere.

Keywords: Large scale, Saharan Oscillation, climates indices, Atmospheric circulation.



From the Monitoring of changes in Surface states to the Calculation of environmental resilience indices: the case of a region in southern Tunisia (Jeffara)

Aziza Ghram Messedi et Sonia Gannouni

ghramaziza@gmail.com

Abstract.

In southern Tunisia in general, and in the Jeffara region in particular, significant changes in land use (both natural and anthropogenic) have been observed for several decades. Given the environmental, economic and social implications of these changes, it is strategically important to develop a method for monitoring the evolution of land use and estimating the potential degradation of surface states. These surface states are studied in a landscape context

characterized by different morpho-pedological forms. To evaluate the extent of degradation and/or improvement of these surface states, monitoring systems for these arid ecosystems should be developed and regularly fed with data taken from the regions under study. These data can be obtained in part from satellite observation systems with high and medium spatial resolution and high temporal repeatability, whose synoptic vision makes them a particularly suitable source of information. This work is thus based on the creation of an exhaustive socio-bio-physical database. This database is made up of cartographic, radiometric and statistical data integrated into a geographic information system (geodatabase_Jeffara). Indicators are selected from this database, then identified, listed and calculated on the basis of data collected from the Jeffara study area. The research work presented here concerns the development of a method for calculating an index of environmental resilience. This method is essentially based on the MOD13Q1 product from the MODIS sensor.

Keywords : Jeffara, land use, surface states, MODIS resilience



Climate resilience and adaptive capacity in small and medium-sized enterprises: a standardized step-by step approach

Youssef Jaouhari¹, Laila Stour¹, Ali Agoumi²

¹Faculty of Sciences and Technologies of Mohammedia, Hassan II University of Casablanca, Mohammedia 28806, Morocco

²Hassania School of Public Works, Casablanca Po Box 8108, Morocco youssef.jaouhari@gmail.com

Abstract.

Climate change (CC) represents new and unprecedented challenges for businesses and is now viewed as a new business imperative. Unlike large multinationals, Small and Medium Enterprises (SMEs) are particularly vulnerable to climatic hazards, and often lack flexibility in the distribution of their risks. To preserve their business and sustainably strengthen their resilience and competitive advantages, SMEs must now systematically integrate adaptation to the impacts of CC in their business strategies and the various links in their value chain. Therefore, it is necessary to provide them with appropriate

methodological tools dedicated to the assessment of their vulnerabilities and risks and the development of CC resilience strategies. Using an optimized approach to Moroccan SMEs, this research work provides a sequential flowchart to characterize and prioritize climate risks, identify potential business opportunities, and develop a coherent strategy to adapt to climate change, integrated with the GHG mitigation process. The development of this flowchart was guided by the results of the evaluation of the implementation of the Climate Expert tool to help analyse climate risks and opportunities- with several Moroccan companies and the benchmark of the instruments for screening and evaluating climate risks relevant to the Moroccan business context. Consequently, three main areas of impact have been identified, covering the company's core operations, the value chain and the external environment. Later, this flowchart will serve as the basis for developing an online tool for managers to assess vulnerability to climate risks at the scale of their companies and to identify and prioritize adaptation measures.

Keywords: Adaptation to Climate Change, Resilience, Small and Medium- Sized Enterprises, Risk Assessment, Climate Risk, Tool.



Inferring meteorological information at different scales from several sources of data

Didier Josselin¹; Matthieu Vignal¹; Nicolas Viaux¹; Delphine Blanke²; Céline Lacaux²

¹ UMR ESPACE, CNRS, Avignon Université, France

² Laboratoire de Mathématiques d'Avignon, Avignon Université, France
didier.josselin@univ-avignon.fr

Abstract.

Understanding the impacts of climate change on varied geographical scales is critical for accurate landscape evolution prediction. To monitor temperature fluctuations, experts employ two primary tools: localized sensors, which, though providing spatially accurate readings, are scattered unevenly across territories, and comprehensive climate models like the ALADIN model, which offer a broader scope but often at a coarser granularity. The integration and interpretation of these datasets present inherent challenges. The primary challenge stems from merging information derived from fundamentally different methodologies. The second challenge emerges from potential inaccuracies that could arise, a concern underscored by issues such as the ecological effect or the Modifiable Areal Unit Problem, both known to skew results. Our study, centered on the Provence Alpes Côte d'Azur region, delves deep into these challenges. Through the amalgamation of temperature readings from

meteorological stations and the ALADIN model, we've observed nuanced temperature variances across several French administrative divisions, including "départements" and "arrondissements". Our innovative "scalogram" tool aids in visually representing these temperature variances. This comparative visual tool starkly illuminates the discrepancies that exist between the ALADIN model's projections and the readings from meteorological stations. Such disparities emphasize the meticulous approach needed when analyzing and employing meteorological data across varied scales. To enhance the accuracy and reliability of our results, we adopted a technique grounded in spatial random permutation. This novel approach seeks not only to amplify the reliability of the data but also to bolster our ability to depict landscapes with greater precision across a multitude of scales. The findings and methodologies presented herein aim to usher in a new era of precision and accuracy in meteorological research, driving more accurate predictions and fostering a deeper understanding of landscape evolution in the face of changing climates.

Keywords: Climate change, Temperature fluctuations, ALADIN model, Scalogram, Spatial random permutation.



The Relationship between Economic Growth and Energy Consumption Disaggregated by Sector: The Case of Morocco

Fatima Zahraa Tatou¹, Abdellah Yousfi¹, Tawfiq Rahaoui¹

¹Faculty of Economic and Social Legal Sciences, Mohammed V University
Rabat, Morocco.

fatimazahraa.tatou@um5s.net.ma

Abstract.

The paper aims to study the relationship between economic growth and energy consumption disaggregated by sector (residential, transportation and industrial) using the case of Morocco.

This study analyzes the relationship between the gross domestic product (GDP) and energy consumption but disaggregated by sector (residential, transport and industrial). And to validate our model we have taken the case of Morocco during the period 1997-2019, in order to draw the impact of each sector on economic growth. To test this causality, a Vector Error Correction Model (VECM) is applied instead of a Vector Autoregressive Model (VAR), using the Johansen cointegration technique.

The results obtained showed that in the long run energy consumption by the transportation and residential sectors has a positive impact on GDP, while that of households has a negative impact. Contrary to what is showed in most of the works that study the global impact of the total energy consumption on the GDP, while each sector can have a different impact on the economic growth.

This study is an original work, showing the results of the relationship between energy consumption and economic growth. Because the purpose of this study is to explore the interrelationships that may exist between economic growth (GDP) and

energy consumption disaggregated by sector (residential, transportation and industrial). Most of the work done by other researcher only concerns energy consumption in a general sense but this consumption includes all the economic sectors that use energy (residential, industry, transport, agriculture...).

Keywords: Energy Consumption, Economic Growth, Sector, Vector Error Correction Model, Cointegration, Johansen Causality



Hybrid model for evaluation of the Effects of Climate Change on vegetation forecasting: Mediterranean region

Manel Rhif ¹, Ali Ben Abbes ¹, Imed Riadh Farah ¹

¹National School of computer sciences, Manouba, Tunisia
manel.rhif@ensi-uma.tn

Abstract.

Climate change has a significant impact on vegetation forecasting, which refers to predicting how plant communities and ecosystems will respond to changing climatic conditions. Recently, the use of deep learning models in forecasting vegetation change based on climatic information offers promising results for improving forecasting performance. These models, which include long-short term memory (LSTM), Gated recurrent unit (GRU), temporal convolution network (TCN), etc. have proved their effectiveness for non-linear time series forecasting. However, these models have limitations for dealing with non-stationary time series and require specific approaches to deal with such data effectively. In this paper, a hybrid method based on wavelet transform and TCN for non-stationary time series forecasting in the Mediterranean area is presented. In a first step, both the vegetation (Normalized Difference Vegetation Index (NDVI)) and climate (Standardized precipitation index (SPI)) time series are decomposed into trend and seasonal components using wavelet transform. Then, each NDVI component is forecasted based on the SPI component using the TCN model. Finally, the forecasted trend and seasonal components are summed to obtain the forecasted NDVI time series. The results show that the proposed

hybrid method has around 83% of pixels with RMSE lower than 0,1 compared to 74%, 72% and 59% of pixels presented in TCN, LSTM, and GRU. Despite the effectiveness of the proposed method, there are still several challenges for non-stationary time series forecasting such as abrupt changes and changing data distribution. A solution to these challenges is the concept of a drift model, which can improve forecast results by adapting to changes in the data.

Keywords: climatic change, Land use Land cover change, Deep learning, Time series forecasting.



End-To-End Framework for natural disaster management: Application to drought

Hanen Balti¹, Ali Ben Abbas¹, Imed Riadh Farah¹

¹National School of Computer Science, University of Manouba, Tunisia

hanen.balti@ensi-uma.tn

Abstract.

Natural disasters have become more frequent in recent years, causing significant harm to social and economic structures globally. The increasing frequency of these disasters highlights the need for continued efforts to reduce their occurrence and impact on society. In this paper, a new decision-making framework for natural disasters based on big earth observation data has been developed. A comprehensive end-to-end framework for natural disaster management can help mitigate the impact of disasters like droughts, which have become more frequent in recent years. Such a framework can help in early detection, forecasting, and monitoring of droughts, as well as enable effective communication and coordination among stakeholders, from policymakers to end-users. The proposed framework consists of four main components: 1) Data Collection: Data are gathered from multiple sources, characterized by their high dimensionality and heterogeneity. 2) Data Loading and Storage: Data are loaded in parallel and stored in a low-latency data warehouse. 3) Data Modeling: A heterogeneous spatio-temporal graph neural network (HSTGNN) for drought forecasting is used to extract the relevant features that take in account the spatiotemporal correlation between heterogeneous 4) Visualization and Decision Making: Results are visualized

using various charts and maps to provide more visibility for decision-makers, assisting them in the decision-making process. This framework enables more accurate and timely decision-making during natural disasters by providing real-time data on weather patterns, soil moisture levels, and other relevant information. Experiments were conducted using heterogeneous data gathered from different types of sensors (meteorological, biophysical, satellites) over China. The results revealed that the model proposed in this paper outperformed baseline methods such as ARIMA, LSTM, CNN-BiLSTM, Bi-LSTM, and GRU.

Keywords: Graph neural network, decision making, big Earth Observation data, natural disasters, forecasting.



Variational AutoEncoder model for Desertification Detection using multispectral satellite images

Farah Chouikhi^{1,2}, Ali Ben Abbes¹, Imed Riadh Farah¹

¹National School of Computer Science, Manouba 2010, Tunisia

² LESOR Institute of Arid Regions Medenine 4119, Tunisia
chouikhi.farah@gmail.com

Abstract.

Using satellite images and deep learning models has allowed the accurate detection of desertification, the process by which land becomes increasingly dry and barren, affecting vegetation and soil fertility. Deep Learning algorithms applied to the satellite images provide a rapid and efficient way to analyze large amounts of data, identifying patterns and trends indicating the degree of desertification. This method has enabled researchers and policymakers to develop targeted interventions and sustainable management plans to mitigate the impact of desertification on the environment and communities relying on these ecosystems. The proposed methodology employed in this study integrates a Variational AutoEncoder (VAE) with the visible spectrum of Landsat images and the NDVI vegetation index. Following the preprocessing of satellite images, the encoder component of the VAE efficiently transforms the input data into a latent space, which captures essential features extracted through a series of convolution layers and is characterized by a mean vector and a standard deviation vector. Subsequently, a supervised classification step is introduced by employing a SoftMax layer within this latent space. This approach yields a robust desertification risk map, combining the strengths of VAE-based feature extraction and supervised learning to enhance the result's accuracy and applicability. The experiment was conducted in the arid region of

southern Tunisia, and it was observed that the proposed variational autoencoder, due to the Gaussian distribution of the latent space, exhibited superior feature extraction capabilities compared to the two deep learning models, Convolutional Neural Network (CNN) and Recurrent Neural Network (RNN). This property ensured a more accurate assessment of desertification, thereby enhancing the model's overall accuracy and efficacy in combating this environmental challenge.

Keywords: Desertification detection, Variational AutoEncoder, Deep Learning, Satellite Images, CNN, RNN.



Water Erosion Assessment Using MEDALUS Model in Jendouba Governorate

Taoufik Hermassi¹, Ahmed Ezzine², Fathia Jarray¹, Emna Kochlef²

¹ Institute for Research in Rural Engineering, Water, and Forestry

²National Center for Cartography and Remote Sensing

taoufikhermassi77@gmail.com

Abstract.

In Tunisia, soil degradation is mostly caused by water erosion. It represents a multidimensional natural hazard as well as an environmental challenge for the ecosystem. This phenomenon is very complex and is linked to natural and anthropogenic factors that are difficult to control in time and space scales. Thereby, understanding the quintessence of those factors is crucial for the long-term management of the environment. The choice of the method for estimating water erosion is dependent on the data availability and the study area conditions. This study aims to quantify and map the risk of water erosion in the Governorate of Jendouba, in the North-West of Tunisia. The proposed methodology aims to implement MEDALUS model, where the processes are represented in detail, in order to develop a potential erosion map for the study area for the year 2020; the average soil loss is about 25 t/ha/year. This model could be considered a powerful tool for land management and erosion control in the semi-arid areas of Tunisia and make a real contribution to planning decisions.

Keywords : MEDALUS, Medjerda, water erosion, Jendouba



Flood Risk Mapping around the Ouémé-Zou Confluence and the Contact Line between Sedimentary and Crystalline Rocks in Benin

Éric Alain Mahugnon TCHIBOZO¹, Cyriaque Apollinaire AGBON, Azize OGNONDOUN et Bidossessi Roméo David HOUESSINON

¹University of Abomey – Calavi, Bénin
tchibalain@gmail.com

Abstract: In the current context of climate change and population growth, the multiplication and/or intensification of floods, and consequently, floods have become a major issue. The objective of this study is to map the flood risk in the municipalities around the confluence of the Ouémé-Zou rivers and the contact line between the sedimentary (coastal) and crystalline (northern) rocks. The methodology used is a geomatic approach based on literature review, remote sensing image processing, and multi-criteria GIS mapping. The results show that high and very high risks together represent 54.16%, more than half of the study area, indicating its high vulnerability. The very high flood risk is symbolized over 18.76% around the contact line that crosses the most vulnerable municipalities such as Zogbodomey, Zagnanado, Toffo, Zè, Bonou, and Adjohoun. The high risk, evaluated at 35.40%, marks the municipalities of Agbangnizoun, Abomey, Bohicon, Za-Kpota, and Covè. The medium risk symbolized at 30.80% is identified in

the municipalities of Djidja and Ouinhi. The low flood risk covers 15.04% and is observed in the Ouémé Valley and around the Hlan and Azili lakes. This work serves as a decision support tool to better protect people and property against this phenomenon.

Keywords: Mapping, Flood Risk, Sub-watershed, Confluence, Contact Line.

Wednesday, 1st November 2023, DAY 3

SESSION 3

Climate change and GIS

POSTER PRESENTATIONS

Chairs: *Anis MOUMEN & Salwa SAIDI*



**Lineament mapping and analysis using optical and radar satellite data:
Case of neogene formations in the Jemmal-Zeramdine locality, Tunisia**

Imen Hentati^{1,2}, Nadhir Sebai^{1,3}, Bouthaina Mhamdi¹, Nadia Trabelsi² and Ibtissem Triki^{1,2}

¹Gafsa University, Sidi Ahmed Zarroug Campus, 2112, Gafsa, Tunisia

²University of Sfax, 3038 Sfax, Tunisia

³ Tunis El Manar University, Tunisia
imenhentati@yahoo.fr

Abstract.

Geological features mapping is a crucial task for structural geological investigations and natural disaster assessments such as earthquakes, landslides, and groundwater pollution. The Zeramdine–Jemmal Neogene formations are the subject of lineament detection and mapping in this context. The aim of this study is to map and conduct a statistical analysis of the fracture networks and compare them with the field data. For this reason, the methodology implemented is based on the use of remote sensing techniques, assisted by digital image analysis methods, coupled with geo-scientific data integrated into a geographic information system. Indeed, the automatic and semi-automatic extraction of lineaments is ensured by the processing of optical Landsat-8, Sentinel-2A and radar SRTM satellite data, respectively. The accuracy and quality of extracted lineaments depend strongly on the spatial resolution of the imagery. The lineament analysis carried out from the satellite data has highlighted a dense network of lineaments across the study region. Based on the statistical and spatial analysis of the lineaments (rose diagram for the lineaments directions, lineament density), three major fracture directions were identified: NE-SW, E-W and NW-SE. This analysis show that the best correlation between extracted lineaments and the structural map realized from previous field mapping and seismic interpretation, is obtained from the optical images. The findings of this study provide that these latter are more efficient for structural lineaments mapping than the radar imagery and confirm the efficiency of the techniques applied in geological studies.

Keywords: Fracture network, lineament analysis, Zeramdine–Jemmal, Landsat8, Sentinel2, SRTM.



Wetland carbon storage and climate change : Geochemistry of organic fluxes to the Gulf of Tunis

Raja Chairi¹, Noursene Mahmoud¹, Hajer Saidi¹, Arbia Triki¹

¹Center of Waters Research and Technologies. Cerdia Smartek
raja.chairi6468@gmail.com

The quality of the water and the sediments in the Gulf of Tunis can be determined by the riverflows of Majerda, Mélineae, El Bey and Abid. The watersheds for the wadis and other streams in this gulf, similar as the Khlij Canal, show significant differences

between rural and agricultural areas and highly industrialized and urban areas. This imbalance has resulted in serious pollution of the Tunisian coast, particularly in the area between the Méliane and El-Bey wadis.

The aim of this work was to characterize the organic matter (OM) at the mouths of the Tunis Gulf using Rok Eval pyrolysis and to estimate the organic pollution by means of various biomarkers (n-alkanes and PAHs) in order to assess the impact on the environment and climate change.

The geochemical analysis of OM fluxes from the catchments by Rock-Eval pyrolysis at the mouth of Tunis Gulf allowed to quantify and qualify the OM transported towards the Mediterranean Sea.

In general, the OM is heterogeneous and derived from higher and marine plant ($32\text{mgHC/gTOC} < \text{HI} < 376\text{mgHC/gTOC}$; $94\text{mgCO}_2/\text{gTOC} < \text{IO} < 284\text{ mgCO}_2/\text{mgTOC}$). In the Majerda delta, OM is mainly continental, while it is primarily marine at the mouth of the Melian wadi. The non correlation of total hydrocarbons ($1\text{mg HC/g sed} < \text{S1} + \text{S2} < 19\text{mg HC/g sed}$) and oxygenated compounds ($1\text{mg HC/gCO}_2 < \text{S3} < 11\text{mg HC/gCO}_2$) with TOC (1%-8%), indicates the heterogeneity of OM ($R^2 < 1$). It is generally characterized by $\text{Tp}_{\text{S2}} > 400^\circ\text{C}$ and consists of heterogeneous and complex compounds.

Some levels are rich in total hydrocarbons ($> 100\text{ppm}$), but the gravimetric analysis of these lipids reveals an abundance of polar compounds, except in the samples from the El Bey and Méliane estuaries, where they represent only 35%, which indicates a source of pollution in this area. In fact, the presence of hopanes and steranes in these samples is consistent with oil contamination, i.e. anthropogenic activity. This is also supported by the abundance of PAHs of a high molecular weight. PAH were present in all samples collected, but both the Meliane and El Bey sites are contaminated.

In the Méliane and El Bey wetlands, the high concentrations of OM increase the risk of these estuaries polluting the Mediterranean Sea. The air in this area is likely to be polluted, as indicated by the high levels of PAHs in the sediments of the estuaries. But wetlands of Tunis gulf, help to combat global warming by storing carbon dioxide. To get a better idea of the impact of stored carbon, we need to map the organic carbon in the Gulf of Tunis.

Keywords: Wetland, Organic carbon, Hydrocarbons, Biomarkers, Pollution, Tunis Gulf.



A Comprehensive GIS-Based Approach for Mapping Groundwater Potential Zones in a Semi-Arid Mediterranean Coastal Aquifer

Boutheina Farhat ¹, Rihem Mejdoub El Fehri ², Meryem Laouissi¹, Ranya Chrigui², Noamen Rebai ²

¹Faculty of Sciences of Tunis, University of Tunis El Manar, 2092 Tunis, Tunisia

² Civil Engineering Department , National Engineering School of Tunis, University of Tunis El Manar, Tunisia.
boutheina.farhat@fst.utm.tn

Abstract.

Groundwater is an indispensable natural resource, providing reliable and long-lasting water supplies globally. Its efficient management is of paramount importance, especially in arid and semi-arid regions where it serves as the primary source of fresh water. To ensure sustainable utilization, mapping Groundwater Recharge Zones (GWRZs)

has become an essential tool. This study specifically focuses on delineating GWRZs in the Takelsa basin in northeastern Tunisia. We achieve this by integrating Remote Sensing data and geospatial information, applying two multi-criteria decision-making (MCDM) techniques: the Analytical Hierarchy Process (AHP) and the Multi-Influencing Factors (MIF) methods.

Ten criteria were assessed, including lithology, land use/cover, elevation, slope, lineament density, drainage density, rainfall, soil type, Topographic Wetness Index, and curvature. Relative weights were assigned to these criteria based on their impact on groundwater potential. Notably, lithology, land use/cover, and elevation were identified as the most influential factors, contributing a 60% to the overall weighting. The computed consistency ratio (CR = 0.0448, falling below the 10% threshold) and consistency index (CI = 0.0667) affirmed the reliability of the input thematic layers. Through GIS-based analysis, GWRZ maps were created and categorized into five distinct recharge potential classes. AHP and MIF methods evaluated groundwater recharge, with AHP identifying 39% and MIF rating 32.8% of the area as having "very good" groundwater recharge potential. Conversely, AHP found approximately 9.9 % unsuitable, while MIF classified 15.4% in the same category.

Model validation, based on the distribution of inventory production wells, confirmed the method's effectiveness. According to the AHP method, 50.7% of pumping wells were concentrated in the good GWRZ, while 40.4% of wells were situated in the moderate GWRZ, and 8.9% in the poor GWRZ.

The MIF method revealed that 46.8% of wells were located in the good recharge zone, 39.8% in the moderate recharge zone, while 13.4 % of wells were found in poor GWRZ. The applied method is invaluable for decision-makers, aiding in adaptive groundwater management and development initiatives in similar arid and semi-arid environments, addressing scarcity, and promoting sustainable water resource management.

Keywords: Groundwater Recharge Zones (GWRZs), Analytical Hierarchy Process (AHP), Multi-Influencing Factors (MIF), Groundwater management, Coastal Aquifer.



Spatial and Temporal Variability Study of Soil Structural Stability in a Watershed of the Middle Medjerda Valley (Tunisia) Using Cartography and Geographic Information Systems (GIS)

Rihab Riahi¹, Abdessatar Hatira², Noamen Rebai¹, Bousnina H³

¹ National Engineering school of Tunisia (ENIT), University Tunis El Manar, Tunisia.

² Faculty of sciences of Tunisia, University Tunis El Manar, Tunisia.

³ The Rural Equipment Engineering School, Medjez El-Bab, Université de Jandouba, Tunisie
riahirihab2@gmail.com

Abstract:

The prospect of global change threatens a hydraulic crisis and the degradation of soils in a watershed of the middle Medjerda Valley under a semi-arid climate. This study evaluates soil structural stability using Hénin's structural stability test, integrating advanced mapping techniques and geographic information systems (GIS) geomatics. A classification of soil susceptibility to degradation in different homogeneous hydrological units was developed by

seasonal monitoring of the structural stability of the surface horizon, using geomatics tools to map spatial variations in structural stability. Results showed that soil structural stability is not solely dependent on soil type but rather on vegetation cover density and the nature of existing vegetation, which was carefully analyzed using collected geospatial data. Indeed, the structural stability of the surface horizon is low (or high instability index I_s) for soils in irrigated perimeters and shrub areas, and these trends were clearly identified using GIS tools. The general trend of soil structural stability in the studied watershed is deterioration during the wet season and improvement outside this season, especially during the spring season, a temporal variation that has been spatially mapped. Under cereal cultivation, the variation in structural stability differs from this general trend, and through geomatics, it has been possible to visually represent these variations. Indeed, the improvement in structural stability occurs from the dry season to the middle of the wet season, with instability index I_s values that have been geolocated and mapped, providing a detailed spatial perspective of changes in soil structural stability.

Keywords: soil, structural stability, Medjerda, watershed, mapping, GIS.



FePO₄ Strengite nanocomposite: Synthesis, characterization and properties as an Electro-Fenton catalyst

Loubna Rachidi¹, Ghizlan Kaichouh¹, Miloud El Karbane², Hind Chakchak³, Kacem El Kacemi¹, Aicha Guessous¹.

¹Faculty of Sciences of Rabat, University Mohammed V, Rabat, Morocco

²Faculty of Medicine and Pharmacy of Rabat, University Mohammed V, Rabat, Morocco

³National Center for Scientific and Technical Research (CNRST-UATRS), Rabat, Morocco.

loubna.ra.doc@gmail.com

Abstract.

The increasing presence of pharmaceutical pollutants in water resources raises significant environmental and health concerns. To address this pressing issue, innovative wastewater treatment approaches are imperative. In this study, we explore the development of an advanced electro-Fenton process for the efficient removal of antidepressant (SER-HCl). The core of this process lies in the utilization of a catalytic material synthesized via electrochemical means, which offers substantial advantages in terms of catalytic activity, stability, and selectivity. The specific properties of this material allow for an enhanced generation of hydroxyl radicals, which play a pivotal role in the

advanced oxidation of pharmaceutical pollutants such as the antidepressant (SER-HCl). We have established a series of laboratory tests to evaluate the effectiveness of this enhanced electro-Fenton process. Preliminary results demonstrate significantly increased degradation of targeted pharmaceutical pollutants compared to conventional wastewater treatment methods. Furthermore, optimization of operating parameters has further improved process efficiency, thus paving the way for potential industrial-scale application. Monitoring of the degradation and mineralization of the sertraline. Hydrochloride molecule was performed to confirm the improvement of the heterogeneous electro-Fenton process. The acquired results showed that the mineralization rates of the antidepressant pollutant by the heterogeneous electro-Fenton method are nearly instantaneous, reaching 90% after 3 hours of electrolyzing.

Keywords: heterogeneous Electro-Fenton , Sertraline. Hydrochloride, nanocomposite



Sequential pattern mining approach for forest loss survey: Case study of Kroumirie, Northwestern Tunisia

Ahmed Toujani¹, Zied Gassmi, Hammadi Achour¹, Wahbi Jawadi¹

¹SylvoPastoral Institute of Tabarka (ISPT), Jendouba University, Tunisia
ahmed.toujani@iresa.agrinet.tn

Abstract.

The subject of forest losses has been a source of great interest. Our research aims to use pattern mining techniques to identify climatic and spatial factors of forest losses.

Data acquisition was pivotal to our methodology. The Copernicus Access Hub served as our primary source, offering satellite images from 2016 to 2022 through the Sentinel 2 program. Complementing this, WorldClim provided essential climatic and spatial factors. In instances where data gaps emerged, the Power Data Access Viewer was instrumental in compiling missing information.

Our data processing involved a sequence of steps. Firstly, within GIS, we applied machine learning-based image classification techniques to all acquired satellite images. Subsequently, we join each pixel in the classified images with the relevant climatic and spatial factors.

To uncover valuable insights from this enriched dataset, we conducted pattern mining using the Prefix Span algorithm. This analysis allowed us to identify patterns and associations within datasets of sequential events of forest losses. This step allowed more understanding the interplay between studied factors and forest losses. Through this research, it has become evident that forest losses are not only attributed to climatic and spatial factors. In addition to these elements, our findings highlight the significance of anthropic impact. The multifaceted mechanisms of forest loss factors underscore the complexity of this issue and emphasize the urgent need for comprehensive approaches that consider the interplay of natural and human-induced factors to effectively address and mitigate this critical concern.

Keywords: Forest Losses, Remote Sensing, Sequential Pattern Mining, Spatial Factors



Underwater Forests: An Ecological Future

B. AIDOUNI¹, M. WAHBI¹, H. NHHALA¹ et M. MAATOUK¹

¹University Abdelmalek Essaâdi, Tanger , Maroc
bountaina.aidouni@etu.uae.ac.ma

Abstract: A state-of-the-art presentation highlighting the ecological importance of underwater forests and the benefits of algoculture in combating climate change reveals that, at a time when rainforests suffer from deforestation and can no longer be considered the primary carbon sinks, oceanic jungles are growing rapidly and are highly effective in carbon storage. Acidification, deoxygenation, and other impacts of climate change would no longer threaten ocean biodiversity and its inhabitants. Studies quantify the overall capacity of large-scale algoculture to counterbalance terrestrial carbon emissions and map regions conducive to the development of macroalgae cultivation. These studies conclude that if the cultures are properly maintained, the potential of algoculture in mitigating climate change remains real and significant.

Keywords: Algoculture, Climate Change, Oceanic Forests, Macroalgae



Development of a Mobile GIS Application for Monitoring Marine Intrusion in the El Haouaria Plain Aquifer, Nabeul

Rihem Mejdoub El Fehri ^{*1}, Noamen Rebai ¹, Hatem Ben thamer ²

¹ Civil Engineering Department, National Engineering School of Tunis, University of Tunis El Manar, Tunisia.

² Department of Agricultural Studies and Development, Regional Agricultural Development Authority (CRDA), Nabeul, Tunis, Tunisia.

rihem.majdoubfehri@fst.utm.tn

Abstract The coastal aquifer system of El Haouaria is currently experiencing progressive anthropogenic pressure that has become a concern. Continuous exploitation of the aquifer has led to a degradation of water quality and negatively impacted the hydrodynamic balance of the aquifer. This exploitation has also caused the emergence of saltwater intrusion phenomena, threatening the viability of aquifer exploitation and its proper functioning in the short term. In this study, a mobile GIS application was developed to geolocate wells of interest to the inhabitants of the El Haouaria region (hotels, restaurants, agriculture, buildings, etc.). This initiative resulted in the design and creation of a prototype platform. This platform should enable technicians and engineers from the regional agricultural development authority to consult an interactive and dynamic map containing information about wells of interest and determine the vulnerability degree of these wells to marine intrusion and its evolution over the years. The development of this platform highlighted a set of functional, organizational, and technical requirements to create a system that meets the needs of users, including farmers. We established the database using the PowerAMC relational database management system, using the PostGis spatial extension of PostgreSQL for storing geographic data. GeoServer is used as a map server to disseminate geographic data, while Apache has been configured to serve as a web server. User interfaces were developed using HTML/CSS and Javascript, integrating OpenStreet Maps and Google Maps as map backgrounds via QGis. A field survey was conducted to record some wells of interest by determining their coordinates using GPS and evaluating their quality in relation

to contamination due to marine intrusion. In the future, it would be highly beneficial to further develop the prediction model within the platform by integrating a high-precision local climate change model. This would enhance the system's validity by more accurately reflecting reality and enabling better control of marine intrusion.

Keywords: Mobile GIS, Interactive Map, Geolocation, Database, Marine Intrusion, El Haouaria