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# Organizing & Scientific Committees

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### **MS. SAMANTHA-JOE ELBEYROUTHY**

### **MR. GREGORY ANTONIOS**



# Welcome Note

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Dear Colleagues and Symposium participants,

The Lebanese American University (LAU) is proud and honored to host the 5th Environmental Symposium of the Arab-German Scientific Forum for Environmental Studies entitled: "Impact of Global Warming on Water Resources in the Middle East and North Africa", at its Byblos Campus, during the period September 20-22, 2010.

The worldwide Global Warming phenomenon will have significant and serious impact on water resources in the Middle East and North Africa. Accordingly, this conference serves as a forum where experts from Europe and Middle Eastern countries will present the latest scientific findings and discuss intensively their experience and expectations in the following significant topics related to water resources in the Middle East:

- Impact of Global Warming on Water Resources
- Water Resources Protection and Management
- Air and Soil Pollution and Protection
- Wastewater Treatments and Reuse

Abstracts of keynote lectures, oral and poster presentations are documented in this booklet and they naturally express the opinion of their authors. The Lebanese American University is grateful for the German-Arab Scientific Forum for choosing LAU as their venue for this bi-annual scientific event.

On behalf of the organizing and scientific committees, we at LAU and the German-Arab Scientific Forum for Environmental Studies, sincerely thank the Friedrich Ebert Stiftung (FES), the Arab Fund for Environmental Development (AFED), the 'Bia wa Tanmia' magazine and the International Bureau of the Federal Ministry of Education and Research, Germany, for sponsoring this conference. We also thank the Lebanese National Council for Research, the Ministry of Energy & Water and the Federal Institute for Geosciences and Natural Resources (BGR), Germany, the department of Engineering, Geology and Hydrology RWTH Aachen University and Institute for Atmospheric and Environmental Sciences for their generous support.

## Conference Chairs

### **Professor Fathi Zereini**

German-Arab Scientific Forum for  
Environmental Studies e.V.  
Frankfurt am Main  
Germany

### **Professor Fuad Hashwa**

School of Arts & Sciences  
Lebanese American University  
Byblos Campus  
Byblos, Lebanon



# Conference Program

**September 20, 2010**

**08:00 Registration**

**09:30 Opening and Welcome**

The German-Arab Scientific Forum for Environmental Studies  
School of Arts & Sciences, Lebanese American University  
Ministry of Energy & Water  
Ministry of Environment  
Arab Forum for Environment & Development (AFED), Al-Bia Wal Tanmia  
Centre Nationale de la Recherche Scientifique (CNRS)  
Friedrich-Ebert Stiftung, Beirut

**10:00 Reception ( Zakhem Bldg. Outdoor Corridor)**

## **Session 1: Impact of Global Warming on Water Resources**

(Chairman: **Najib Saab**, AFED)

- 10:30 **LI-1: Keynote lecture:** Water, scarcity, climate change in the Middle East-Some considerations p.17  
**Klingbeil, R.** (UN ESCWA) & **Assaf, H.** (Lebanon)
- 11:10 **LI-2:** Climatic conditions change scenarios and its impact on ground water resources p.17  
**Arkadan, M.** (Lebanon)
- 11:30 **LI-3:** Assessing the impact of climate change on the water resources of the Upper Litani River Basin, Lebanon p.18  
**Assaf, H.** (Lebanon)
- 11:50 **LI-4:** Effects of global warming, land degradation and socio-economic changes on human migration p.19  
**Hummel, D.** (Germany)

## **Session 2: Water Resources, Protection and Management**

(Chairman: **Fadi Comair**, Ministry of Energy & Water, Lebanon)

- 12:10 **L2-1:** Scale effects in fractured aquifers – The eternal story p.20  
**Sauter, M.** et al. (Germany)
- 12:30 **L2-2:** Water resources management and protection in the framework of the New Water Strategy of Jordan p.21  
**Subah, A. & Margane, A.** (Germany, Jordan)
- 12:50 **L2-3:** Trans-boundary groundwater aquifers p.21  
**Salameh, E.** (Jordan)

**Session 2 continued: Water Resources, Protection and Management**

(Chairman: **Hamed Assaf**, American University of Beirut)

- 14:20 **L2-4:** Methods for characterisation of karst aquifers p.22  
**Geyer, S.** et al. (Germany)
- 14:40 **L2-5:** Development of a quantitative vulnerability concept for karst systems: Application on the Jeita catchment system – Lebanon p..23  
**Doummar, J., Geyer, T. & Sauter, M.** (Germany)
- 15:00 **L2-6:** Optimization of groundwater resources management p.24  
**Nouiri, I.** et al. (Tunis)
- 15:20 **L2-7:** Nitrate contamination in the Upper Litani River Basin p.25  
**Saadeh, M.** (Lebanon)
- 15:40 **L2-8:** Hydrochemical and isotope analysis of deep groundwater from the Nubian Aquifer system in the Egyptian Oases p.26  
**Gossel, W.** et al. (Germany)

**16:00 Coffee Break and Poster Presentations** (Rima Hourani Exhibition Room)

- 16:30 **L2-9:** Identification of nitrate sources in selected aquifers of Saudi Arabia using isotope techniques p.27  
**Reshid, M.** et al. (Germany)
- 16:50 **L2-10:** Reducing pollution risks for the water supply of Beirut in a Karst Aquifer p.29  
**Margane, A. & Makki, I.** (Germany)
- 17:10 **L2-11:** Protection zone delineation using tracer tests in the Jeita groundwater catchment - Objectives and preliminary results p.30  
**Margane, A. & Doummar, J.** (Germany)

**Evening free.**

**Session 2: Water Resources, Protection and Management**

(Chairman: **Elias Salameh**, *University of Jordan*)

- 09:00 **L2-12:** Influence of saliferous Triassic formations on the groundwater quality of the Plio-Quaternary aquifer of Northern area of Tebessa, (North East of Algeria). p.30  
**Fehdi, Ch.** *et al. (Algeria)*
- 09:20 **L2-13:** Strengthening the MENA water sector through regional networking and training - MENA WANT -InWEnt Water Programme. p.31  
**Al Baz, I.** *(Germany)*
- 09:40 **L2-14:** Characterisation of surface water contaminations in R'Dom watershed, Northwest Morocco. p.32  
**Zian, A. & Benaabidate, L.** *(Morocco)*
- 10:00 **L2-15:** Reduce the evaporation by monomolecular film for the preservation of water plants in arid zones (case of northern Sahara, Algeria). p.32  
**Saggai, S. & Boutoutaou, D.** *(Algeria)*
- 10:20 **L2-16:** The effects of formal and informal mega-urban development processes on water resources – Case study area megacity Guangzhou, China. p.34  
**Strohschön, R., Baier, K. & Post, C.** *(Germany)*

**10:40 Coffee Break and Poster Presentations** (Rima Hourani Exhibition Room)

**Session 3: Air and Soils Pollution and Protection**

(Chairman: Eberhard Reimer, *Germany*)

- 11:20 **L3-1: Keynote Lecture:** Persistent organic pollutants in North and Sub-Saharan Africa – Levels in air and design of a continent-wide monitoring network. p.35  
**Lammel, G.** *et al. (Germany)*
- 12:00 **L3-2:** Verification of precipitation forecast of global ECMWF model and regional HRM model for Iran. p.36  
**Sodoudi, S. & Reimer, E.** *(Germany)*
- 12:20 **L3-3:** Estimating the compensation strength of coniferous forests and fruit orchards during climate change. p.37  
**Bonn, B.** *et al. (Germany)*
- 12:40 **L3-4:** Regional transports (Near/Middle East) of PM10 into the Teheran area. p.37  
**Reimer, E.** *(Germany)*
- 13:00 **L3-5:** Air quality assessment and implications in Beirut, Lebanon . p.38  
**Saliba, N.** *et al. (Lebanon)*
- 13:20 **L3-6:** Trace-element geochemistry of coal and suspended particulate matter at El Maghara Mine, Egypt. p.39  
**Melegy A.** *et al. (Egypt)*

**13:40 Lunch Break** (Sci 607-608)

14:40 **L3-7:** Characterization of soil and groundwater contamination by effluents (Application on Algeria N.E). p.39

**Labar, S.** *et al.* (Algeria)

**Session 4: Wastewater Treatments and Reuse**

(Chairman: **Jean Chatila**, *Lebanese American University*)

15:00 **L4-1: Keynote Lecture:** Agricultural reuse of water and nutrients from wastewater treatment. p.40

**Dichtl, N. & Bauerfeld, K.** (Germany)

15:40 **L4-2:** Impact of waste dump and waste water discharge on Lebanon's coastal water quality. p.40

**Korfali, S.** (Lebanon)

**16:00 Coffee Break and Poster Presentations** (Rima Hourani Exhibition Room)

16:20 **L4-3:** Cost-Benefit and performance analysis of centralized and decentralized wastewater treatment plant – A case study. p.41

**Chatila, J.** (Lebanon)

16:40 **L4-4:** Modelling of pollutant production by underground coal gasification. p.42

**Klebingat, S.** *et al.* (Germany)

17:00 **L4-5:** Rate determining steps study in cadmium sorption from aqueous solutions by dried activated sludge. p.43

**Benaïssa, H.** (Algeria)

**20:00 Conference Dinner**

# Posters

## Topic 1: Impact of Global Warming on Water

Climate Change and Impact on the Environment Caused by Anthropogenic – p.45  
**Omar Khodjet Kesba**,  
*National school for Hydraulics, Laboratory of water, Algeria*

Drought Analysis in Semi-Arid area: Case of the Wadi Sly Basin (Northwest Algeria) - p.45  
**Mohammed Achite**,  
*Water–Environment Laboratory, Algeria*

Geochemistry and Behaviour of Trace Elements During the Complete Evaporation of the Merouane Chott Ephemeral Lake, Southeast Algeria - p.46  
**Hacini Messaoud**,  
*Laboratoire de Biogéochimie des Milieux Désertiques, Université Kasdi Merbah de Ouargla, Algeria*

Impact of Climate Change and its Consequences on Water Resources in the Trans-Boundary Basin Tafna (North West Algeria) - p.46  
**Bouchet Benaini**, *Algeria*

Impact of Climate Changes in Ouergha - p.47  
**Siham Boukarim**, *University of Fes, Morocco*  
Lebanon Temperature and the Global Warming During the 20th Century - PAGE  
**Ahmed K. A. El-Kadi**,  
*Department of Geography, Islamic University of Gaza, Gaza Strip, Palestine*

Seawater Desalination in Algeria - p.48  
**Mohamed Bessenasse**,  
**Saad Dahlab**, *Algeria.*

The Impact of Drought on Water Quality Under Semi-Arid Climate- Case of Turonian Aquifer of Tadla, Morocco - p.49  
**Ahmed Fekri**, *Faculté des sciences Ben M'sik – Casablanca, Morocco*

## Topic 2: Water Resources Protection and Management

Aquifer Potentiel Estimation Based Geophysical Methods - p.49  
**Mabrouk Djeddi** ,  
*Laboratoire de Physique de la Terre Faculté des Hydrocarbures et de la Chimie Département de Géophysique Université de Boumerdés, Algeria*

Digital Elevation Models and GIS for Watershed Modelling and Flood Prediction, a Case Study of Inaouene River, Morocco – p.50  
**A. Driri**, *Faculty of Sciences of Fez, Morocco*

Geochemical Survey of the Waters of the Ground-Water of Mateur (North of Tunisia) - p.51  
**Besma Tlili**, *Unité de Recherche de Géochimie et de Géologie de l'Environnement, Faculté des Sciences de Tunis, Tunis*

Mechanisms of Changes in Quality of the Shallow Aquifer in Desert Climate (Northern Sahara, Algeria) - p.52  
**M. Djidel**, *Laboratory of Saharian Bio-resources. Preservation and Valorization, Kasdi Merbah University, Ouargla, Algeria.*

Modeling of GPR

Measurements for Imaging the Water Content of the Soils - p.52  
**Boualem Bouyahiaoui**,  
*Centre de Recherche en Astronomie, Astrophysique et Géophysique, Algeria*

Modelling the Propagation of the Submersion Wave in Case of a Dam Break. Case Gargar Dam (Algeria) - p.53  
**Kherfia Bouhellala**,  
*Laboratoire d'Hydrologie et gestion des Ressources en Eau, Faculté des Sciences et Technologie, Université de Bechar, Algeria*

Rationalization and Optimization of the Basic Hydrological Networks Sebou Watershed Case (Morocco) - p.54  
**Abdel-Ali Chaouni**,  
*Polydisciplinary University of Taza, Geology Department*

Reducing Pollution Risks for the Water Supply of Beirut in a Karst Aquifer - p.55  
**Margane, A.**, *Federal Institute for Geosciences and Natural Resources, Germany*

Some Problems of Irrigation Water Management in Low Cheliff Plain (North-Western of Algeria) - p.55  
**Abdelkader Douaoui**,  
*Khemis Miliana University, Algeria*

The Environmental Rangers in Jordan: General Tasks and Mission and Specific Roles in Water Resource Protection - p.56  
**Mahmoud Abu-Rumman**,  
*Royal Department for Environment Protection (Rangers), Jordan*

Tracer Tests as a Means for the Delineation of Groundwater Protection Zone in the Nahr el Kalb Catchment - p.57

**Doummar, J**, Georg-August-University Göttingen, Applied Geology, Germany

Water Resources of the Saharan Basin (North Africa): The Use of Environmental Isotopes -p.58

**Abdelhamid Guendouz**, Université de Blida Faculté des Sciences de l'ingénieur, Algeria

Water Resources Protection Zone Delineation in Jordan - p.59

**Margane, A**, Federal Institute for Geosciences and Natural Resources, Germany

Water Supply of the Abbasid Town of Kharab Sayyar in the Syrian Gezira - p.60

**Heinrich Thiemeyer**, Institute for Physical Geography, Goethe-University Frankfurt, Germany

### Topic 3: Air and Soil Pollution and Protection

Aggregate Stability as an Indicator of Soil Crusting, Soil Erodibility and Sediment Characteristics for Inter Rill Erosion - p.61

**Djamel Saidi**, Université Hassiba Benbouali de Chlef, Faculté des Sciences Agronomiques et des Sciences Biologiques, Algeria

Analysis and Treatment of Ozone (O<sub>3</sub>) on a Site Located in Annaba - p.61

**Ahmed Boumerah**, University Badji Mokhtar, Algeria

Assessment of the Effect of Waste Incineration on Environment, Case of Meknes Mohamed V Hospital, Morocco

- p.62

**N. Ameziane**, Laboratory of Georesources and Environment, USMBA, Faculty of Science and Techniques, Morocco

Assessment of Tires Waste Disposal Processes in Gaza Governorates - p.62

**Khalil I. Hassanein**, Al-Quds University, Palestine

Combustible Effects from Spark Ignition Engine in Air Emissions: Experimental Study - p.63

**Said A. Ouled**, Transfer Phenomena Laboratory, Science and Technology University, Algeria

Contamination of the Global Environment by DDT 1950-2000 - p.64

**Gerhard Lammel**, Max Planck Institute for Chemistry, Germany

Contribution to the Evaluation of Polycyclic Aromatic Hydrocarbons (HAP) for Atmospheric Particulate by Chromatographic Methods - p.65

**W. Benraouane**, Department of Process Engineering, Faculty of Engineering, University Saad Dahlab, Algeria.

Determination of Heavy Metals and Trace Metals in Ground Water and Soil in Libya by Flame AAS for Heart and Diabetics Diseases - p.66

**T. Nasser**, Department of Biological Science, Almerqeb University, Libya

Exploitation of the S.I.G for Vulnerability Assessment of the Pollution of Groundwater, Layer of Fez-Meknes by Methods DRASTIC, PRK and GOD - p.66

**Nezha Sadkaoui**

Nitrated Pollution in Groundwater of the Semi-arid Zones - Case of the valley of Western Middle Cheliff (Northern Algerian) - p.67

**N. Bettahar**, Laboratory Water & Environment, University Hassiba Ben Bouali, Algeria.

Optical Properties Calculation of Crystalline Nitric Acid Hydrates and Ammonium Nitrate Using Ab Initio Molecular Dynamic Methods - p.67

**S. Bourahla**, Hassiba Benbouali Chlef University, Algeria

Photocatalytic Oxidation of Chlortoluron in Water Suspension in a Helical Reactor - p.68

**Nadia A. Laoufi**, Laboratoire des Phénomènes de Transfert. Département de Génie Chimique et de Cryogénie. U.S.T.H.B. Faculté de Génie Mécanique & Génie des Procédés, Algeria

Photodegradation of an Angiotensin-Converting Enzyme (ACE) Inhibitor Using Immobilized Nanoparticles of TiO<sub>2</sub> Supported By Glass Plate - p.69

**N. Yeddou-Mezenner**, Faculté de Génie Mécanique et Génie des procédés Université des Sciences et de la Technologie Houari Boumediène, Algeria

Prediction of the Toxicity of a Set of Amide Herbicides - p.70

**M. Didi**, Laboratoire des Sécurité Alimentaire et Environnementale, Badji Mokhtar University, Algeria

Public Concerns about Existing Dumping Sites and Attitudes towards the Selection of Sanitary Landfill Sites - p.71

**I. A. Al-Khatib**, Department of Geography, Birzeit University, Palestine

Relationships Quantitative Structure-Activity Benzene Derivatives - p.71

**S. Touam**, Laboratory of Food Safety and Environmental (LASEA, Badji Mokhtar University, Algeria

Soil Nitrogen Dynamic in Some Mediterranean Soils: Tunisian Case Study - p.72

**Imene Dridi**, Unité de Recherche Pédologie, Département de Géologie, Faculté des Sciences de Tunis, Campus Universitaire, Tunis

The Perimeters of Catchment Protection of Groundwater in the Region of Tebessa (NE Algeria) - p.73

**Dalila Belfar**, Université de Tébéssa, Institut des Sciences de la Terre, Algeria

Treatment of Landfill Leachate Using Fixed Bed Biomass Process - p.73

**Zineb Salem**, Faculty of Mechanical and Process Engineering, University of Sciences and Technology, Houari Boumediene, Algeria

#### Topic 4: Wastewater Treatments and Reuse

Adsorption Kinetics and Mechanism of Maxilon Blue GRL on Pretreated Coffee Wastes from Aqueous Solutions - p.74

**N. Yeddou-Mezenner**, Laboratoire de Génie de la Réaction, Faculté de Génie Mécanique et Génie des procédés, Université des Sciences et de la Technologie Houari Boumediène, Algeria

Biodegradation of P-Cresol by Mixed Culture in Batch Reactor – Effect of the Nitrogen Source, Ammonium

Sulfate - p.75

**A. Hamitouche**, Laboratoire des Sciences de Génie des Procédés Industriels, Faculté de Génie Mécanique et de Génie des Procédés, Université des Sciences et de la Technologie Houari Boumediene, Algeria

Effect of Particle Size on Methylene Blue Sorption from Aqueous Solutions by Almond Peel: Experimental Studies and Modelling - p.76

**Houcine Benaïssa**, Laboratory of Sorbent materials and Water Treatment, Department of Chemistry-Faculty of Sciences, University of Tlemcen, Algeria

Equilibrium and Kinetic Study for Aromatic Amine on Coals Prepared from Agricultural Wastes - p.77

**H. Tizi**, Laboratory of Industrials Processes Engineering Science, Mechanical Engineering and Processes Engineering Faculty, University of Sciences and Technology Houari Boumediene, Algeria

Heavy Metal Content in Sediment of Inaouene River, Northern Morocco - p.77

**J. Naoura**, Laboratory of Georesources and Environment, USMBA, Faculty of Sciences and Technology of Fez, Morocco

Heterogeneous Photocatalytic Degradation of the Pharmaceutical Agent  $\beta$ -Blocker on Immobilized Titanium Dioxide - p.78

**N. Yeddou-Mezenner**, Laboratoire de Génie de la Réaction, Faculté de Génie Mécanique et Génie des procédés, Université des Sciences et de la Technologie Houari Boumediène, Algeria

Importance of Uranium Speciation in Wastewaters Treatment and Soil Remediation - p.79

**Smain Korichi**, Faculté de génie des procédés et génie mécanique, USTHB, Algeria

Removal of Zinc by the Aquatic Macrophytes *Lemna gibba* L.: Effect of Temperature, pH and Zn Source - p.80

**Nabila Khellaf**, Laboratory of Environmental Engineering, Faculty of Engineering, Badji Mokhtar University, Algeria

Study and Treatment by the Process Bioreactor with Membrane (Brm) of Water of Industrial Wastes - p.81

**Lynda Larbi**, Department of Chemical Engineering, Faculty of Science of the Engineering, UNIVERSITY BADJI-MOKHTAR, ANNABA, Algeria

Treatment of the Domestic Waste Water by the Use of Plants in the Arid Zones (Algerian Northern Sahara) - p.82

**Oum Elkheir Bachi**, Laboratory of the Saharan bio-resources, Algeria

Use of Geospatial Data for Solid Waste Selection and Environment Protection, Taza City Case (Morocco) - p.82

**Abdel-Ali Chaouni**, Polydisciplinary University of Taza, Geology Department, Algeria

Wastewater Management by Utilizing of Decentralized Wastewater Treatment Plants - p.83

**Mohammed Khalil El Halabi**, Palestine



# Social Program

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## Welcome Reception

- Date:** Monday, September 20, 2010  
**Time:** 10:00 am  
**Venue:** Zakhem Building Outdoor Corridor, LAU, Byblos  
**Cost:** Free for all

## Symposium Dinner

- Date:** Tuesday, September 21, 2010  
**Time:** 8:00 pm  
**Venue:** Al-Bahr Restaurant, Byblos  
**Dress Code:** Smart Casual  
**Cost:** Inclusive for registered participants  
Buses will depart from LAU campus at 7:30 pm and pass by all Hotels.

# Hydrological and Cultural Excursions

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## Field Trip 1: Jeita

- Date:** Wednesday, September 22, 2010  
**Venue:** Jeita Grotto and Spring, Chabrouh Dam and nearby Springs, with several lectures on geology, wastewater treatment project, and monitoring stations in the area (Tour guides and lecturers: Dr. Armin Margane and Colleagues)  
**Time:** Buses will depart from LAU campus at 7:30 am and pass by all Hotels  
**Cost:** Inclusive for all registered participants; breakfast, lunch and transportation included

## Field Trip 2: Bekaa Valley

- Date:** Thursday, September 23, 2010  
**Venue:** Temples of Baalbek, followed by lunch with wine/arak tasting, Qaro'un Lake, Aammik Swamps and Shouf Cedar Park reserve.  
**Time:** Buses will depart from LAU campus at 7:30 am and pass by all Hotels  
**Cost:** Separate registration (please inquire at Registration Desk)

## Field Trip 3: North Lebanon

- Date:** Friday, September 24, 2010  
**Time:** Buses will depart from LAU campus at 7:30 am and pass by all Hotels  
**Venue:** Ecological hike in Ehden Natural Reserve (Tour guide: Mr. Pierre Mouawad and), followed by lunch in the mountain resort Ehden, Cedar forest and Jubran Khalil Jubran Museum.  
**Cost:** Separate registration (please inquire at Registration Desk)

# Accommodation

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## **Victory Byblos Hotel & Spa**

South of Byblos, Main Highway

Tel/Fax: + 961 9 796 697

Tel/Fax: + 961 9 795 597

## **Canari de Byblos Hotel**

Voie 13, Highway Exit, Byblos

Tel: +961 9 550 550

Mobile: + 961 70 650 550

## **Byblos Comfort Hotel**

Byblos main Street, Byblos

Tel: +961 9 942 200

## **King George Hotel**

Mar Elias Street, Blat, Byblos

Tel/Fax: + 961 9 547 048

Mobile: + 961 3 542 586

# Program Information

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## **Registration Desk**

Please pass by the Registration Desk upon your arrival to:

- Collect your Name Badges and Symposium Bag.
- Register for the Symposium if you haven't done so online  
Note that this registration fee includes the field trip on Wednesday
- Register for the Thursday and/or Friday field trips
- Receive lunches, dinner and trip Coupons

## **Speakers' Preparation Room**

The Speakers' Preparation room is located in Zakhem Engineering Hall, room 402.

If they haven't emailed their presentation, Speakers are required to pass by in the morning or the coffee breaks before their lectures and hand in their lectures.

The room will be open from 8:00 am till 5:00 pm and IT personnel will be present for any required assistance.

## **Poster Presentations**

Poster presenters must submit their posters at the registration desk so that ushers will hang them up in the Exhibition Room.

Posters will be displayed from 9 am on Monday, 20 September 2010 till 5 pm on Tuesday, 21 September 2010.

Presenting authors are advised to be present at their poster during the allocated poster viewing sessions to answer any questions.

Posters not removed by the end of the Symposium will be discarded.



# General Information

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## **Badges**

Identification badges are mandatory and are required for admission to the Oral and Poster sessions.

## **Coupons**

You are required to submit the coupons corresponding to the Symposium lunches, Symposium dinner and the Field trips.

Certificate of Attendance

Please collect your certificate of attendance from the Registration Desk during the coffee breaks on Tuesday, 20 September 2010.

## **Bus Schedule**

### **Monday, 20 September:**

Departure from Hotels at 7:30 am to LAU Byblos campus upper gate.

Departure from LAU Byblos campus upper gate at the end of the lectures to the Hotels.

### **Tuesday, 21 September:**

Departure from Hotels at 8:00 am to LAU Byblos campus upper gate.

Departure from LAU Byblos campus upper gate at the end of the lectures to the Hotels.

Departure from LAU Byblos campus upper gate and Hotels at 7:30 pm to the Al-Bahr restaurant and return back after dinner.

### **Wednesday, 22 September:**

Departure from LAU Byblos campus upper gate and Hotels at 7:30 am and return back in the evening.

### **Thursday, 23 September:**

Departure from LAU Byblos campus upper gate and Hotels at 7:30 am and return back in the evening.

### **Friday, 24 September:**

Departure from LAU Byblos campus upper gate and Hotels at 7:30 am and return back in the evening.

## **Parking**

Parking will be available for those who come in cars at the LAU Byblos campus upper gate parking.

## **Internet Access**

If you need wireless internet access, please ask for a username and password at the Registration Desk.

## **Mobile Phone**

As a courtesy to speakers and other participants, please ensure that mobile phones are turned off or insilent mode during all presentations.

## **No Smoking**

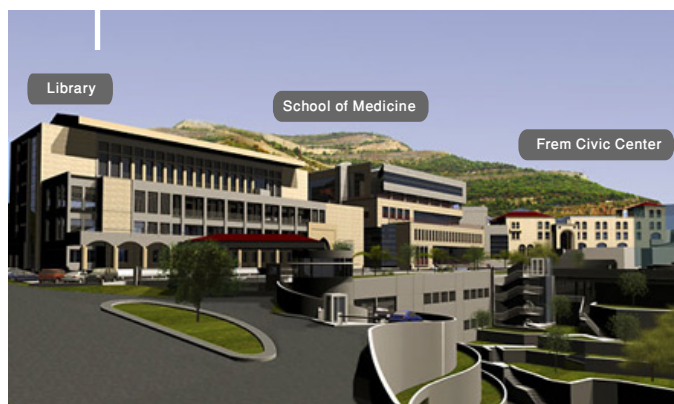
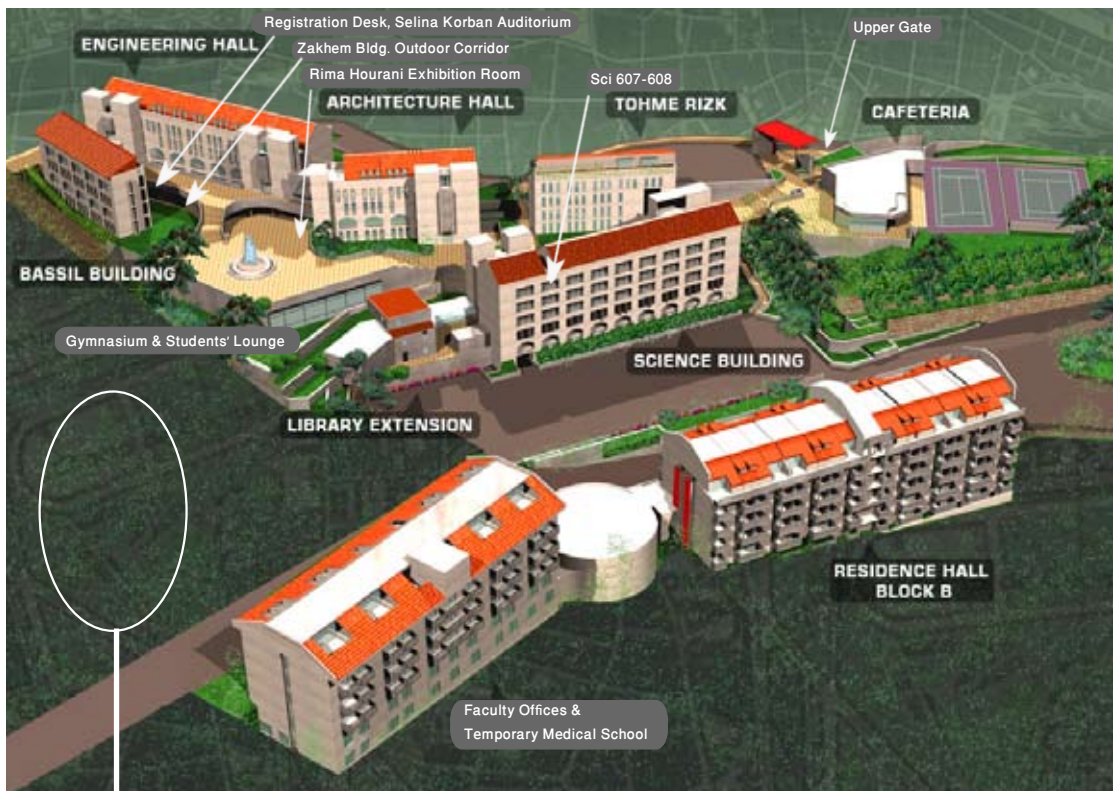
Participants are advised that smoking is prohibited in all closed rooms and in corridors at the LAU campus.

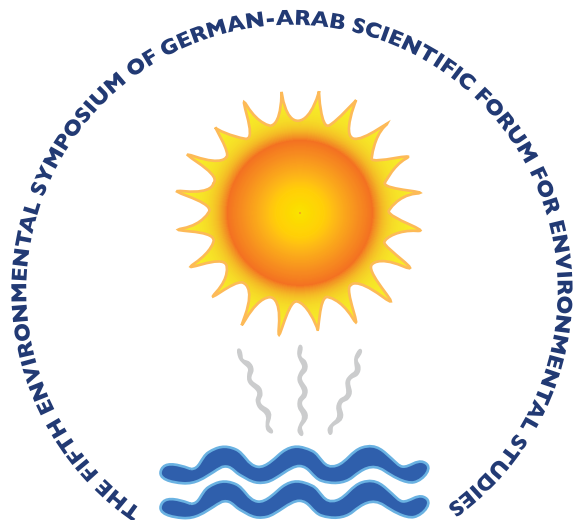
# Byblos Map





# LAU Map





**IMPACT OF GLOBAL WARMING ON WATER  
RESOURCES IN THE MIDDLE EAST & NORTH AFRICA**  
September 20-21, 2010  
Lebanese American University

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# Oral Abstracts

LI-1

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## **Water, Scarcity, Climate Change in the Middle East - Some Considerations**

**KLINGBEIL, R. (UN ESCWA) & ASSAF, H.(LEBANON)**

No abstract available.

LI-2

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## **Climatic Conditions Changes Scenarios and its Impact on Ground Water Resources. A Case Study on the Upper Catchment Area of Ibrahim River Mount-Lebanon**

**DR. ABDUL-RAHMAN M. ARKADAN**

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Climatic changes are the most discussed topic in recent years as they have a great influence on the surface hydrology. Understanding the hydrological properties of a study area requires an investigation of the main source of replenishment to the aquifer. Attempts to determine the impact of climatic changes on hydrological systems are becoming a booming business. Concerns about global warming, deforestation, and desertification have enhanced awareness and have added new terms to the climatic and hydrological dictionary such as the Ozone hole, El Nino and global warming.

Predicting the impact of future climate changes on the available water resources of a catchment area depends on two main ideas. First, that the nature of the future climate influencing the catchment hydrology can be clearly identified from the climate records being generated using the new global circulation models and predictions of greenhouse gas emission and their impacts. The Second idea is that the hydrological model parameterization obtained by calibration against the historic flow records and climate data is a good model of the hydrology of the catchment under future climate conditions.

The study is based on recorded climate data for the upper catchment of the Ibrahim River in Central Mount Lebanon. The upper catchment is restricted to the snow accumulation line which replenishes the main springs of the river. The scenarios is done on the constructed snow melt model which estimates the steps of snow fall, accumulation, melting, freezing and flowing of water from the snow pack. The available data used in the model is the daily temperature and precipitation. The scenarios have been embedded in the constructed infiltration-runoff model to observe the behavior of the river discharge flow and behavior, which as well affect the ground water resources.

Three scenarios of climatic changes have been constructed to observe the behavior of the system under possible conditions. The major controls on the outflow from the system are temperature and precipitation. These controls were adjusted independently to observe the effects on the total accumulation of snow and the quantity and timing of flows in the river. Calibrated model parameters are unaltered for all resulting simulations. These scenarios are increase in precipitation-decrease in temperature, decrease in temperature and precipitation and decrease in precipitation-increase in temperature.

The significant scenario results can be seen in the decrease in precipitation-increase in temperature and in the increase in precipitation and temperature scenarios which have a direct effect on the accumulated snow and on the volume of water calculated from the infiltration-runoff model.

## Assessing the Impact of Climate Change on the Water Resources of the Upper Litani River Basin, Lebanon

**HAMED ASSAF, PH.D., P.ENG., MASCE** AND **ABBAS FAYAD**

*Department of Civil and Environmental Engineering, American University of Beirut, Lebanon.*

Lebanon stands out as a relatively water rich country in a region known of its extreme water scarcity. However, the mismatch between water and population distribution have meant that the capital Beirut as the most densely populated part of the country is suffering from a chronic water shortage. The government is eyeing the Upper Litani River Basin (ULB) as the main source for future water supplies to Beirut. The ULB is also being considered to supply the semi-arid South and South Eastern part of the country. Considering the significance of the ULB as a major water resource fully contained with the Lebanese boundaries it is paramount that the range of hydrological variability including that influenced by climate change is adequately assessed and considered in these and other future water plans.

To support planning efforts in managing the ULB water resources, the authors have developed a water resources system model for the ULB based on the Water Evaluation and Planning (WEAP) framework. Utilizing WEAP modelling capabilities, the ULB model provides an integrated representation of hydrological processes (precipitation, evaporation, infiltration, surface runoff and groundwater), man-made water resources system components (dams, hydroelectric installations, reservoirs and aqueducts), water demand (urban, industrial and agriculture), wastewater treatment and reuse, and environmental constraint.

A set of climate change scenarios is being prepared to run through the model to assess the potential impact of climate change on ULB water resources. Obtained from the U.K. Tyndall Center for climate change research, the set includes sixteen 100 year (2001 – 2100) climate scenarios downscaled from the output of 4 general circulation models (GCMs) for 4 of the storylines introduced by the Intergovernmental Panel on Climate Change (IPCC) in their Special Reports on Emission Scenarios (SRES). The scenarios are produced on an approximately 50 km grid and includes monthly precipitation, average temperature, humidity, wind and cloud cover.

**Keywords:** *climate change, water resources, modelling, Lebanon, Litani*

## Effects of Global Warming, Land Degradation and Socio-economic Changes on Human Migration

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Recent studies about climate change, environmental degradation and their effects on human mobility, displacements and migration reveal that the interactions among ecological, social, economic and political drivers are complex, and that future developments are extremely difficult to predict. However, migration (temporal or long-term) can be regarded as an adaptation strategy to cope with social-ecological changes. This presentation focuses on the interactions of land degradation, social-ecological conditions and population movements in the Sahelian countries Mali and Senegal. Based upon recent empirical and theoretical findings, the socio-demographic factors (e.g. population distribution, growth

rate, urbanization, mortality rates, education and health status) with respect to their relevance for impacts of global warming on water resources will be emphasized, particularly concerning the livelihoods, vulnerabilities and adaptation strategies of the local people. The presentation concludes with some considerations for policy impacts.

## L2-1

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### Scale Effects In Fractured Aquifers – The Eternal Story

**MARTIN SAUTER**, TOBIAS GEYER, RALF BRAUCHLER

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Scale effects in the hydraulic characterisation of aquifers have been the topic of systematic investigation for some time. It is generally accepted that scale effects are a result of the heterogeneous nature of the aquifer geology

In the past efforts were made into the investigation of the systematics of scale effects, i.e. the frequently observed increase in hydraulic conductivity with the volume of investigation. These efforts imply the theoretical mathematical relationships, the development of numerical up-scaling techniques and the collection of data in the laboratory and in the field. The motivation for these investigations is the expectation that, given the theoretical background and respective data, large scale parameters can be derived from small scale investigations and experiments.

The problems with such an approach are manifold: a) limited systematic database, b) limited reach of investigation techniques (volume of integration), c) comparability of experimental techniques, d) experimental bias (highly permeable zones are less represented), e) high contrast in hydraulic parameters.

With fractured aquifers the parameter spectrum of hydraulic conductivities spreads across many orders of magnitude due to the presence of highly conductive features, e.g. fault zones and karst conduits, next to the tight matrix, the consideration of scale effects are of utmost importance. Granular porous and unconsolidated systems generally do not display such a large contrast in hydraulic parameters.

This paper presents the issue of scale effects in hydrogeology, the general approach to deal with them and how to obtain the respective data in the field. In the literature a number of different relationships are observed: measured data can display an independence of the respective parameter from the scale of measurement as well clear correlations. The latter can be subdivided into two cases a) an increase of the hydraulic parameter and b) a decrease with the scale of investigation.

The scale hierarchy concept, introduced by Dagan (1986) is employed to illustrate the variations in the relationships between parameter magnitude and length scale.

The authors conclude that the development of quantitative relationships for the consideration of scale effects is generally less successful should small scale measurements be employed for the prediction of large scale parameters. The characterisation of e.g. catchment scale hydraulic conductivities requires considerable information at the catchment scale so that the small scale information does not provide any added value. It is recommended to consider geological information such as the genesis of the aquifers for the regionalisation of the groundwater systems.

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Dagan, G. (1986): Statistical-theory of groundwater-flow and transport - pore to laboratory, laboratory to formation, and formation to regional scale. – Water Resources Research 22(9): 120-134.

## Water Resources Management and Protection in the Framework of the New Water Strategy of Jordan

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The Jordanian National Water Strategy 'Water for Life' has been issued by the Ministry of Water and Irrigation (MWI) in February 2009. It states the current and projected future water demand and supply situation until 2022 and specifies what will be done to manage water resources in a more sustainable manner in the future. It also mentions from which sources and by which means water supply for the different sectors will be covered. It recognizes that an institutional reform in the water sector is necessary to meet future challenges and that protection of water resources must be an integral part of water resources management.

The Jordanian Government hopes that implementing this strategy until 2022 will help solving the current large deficit between demand and supply and the overexploitation and deteriorating quality of groundwater resources. This will be achieved by implementing an action plan which will bring about:

- An efficient and effective institutional reform.
- A drastic reduction in the exploitation of the groundwater.
- A drastic reduction in the exploitation of the groundwater.
- An efficient use of water resources.
- The implementation of the Disi water conveyance and the Red Dead conveyance projects.
- The capping and regulation of irrigated agriculture in the highlands and the enforcement of related by-laws.
- Appropriate water tariffs and incentives in order to promote water efficiency in irrigation and higher economic returns for irrigated agricultural products.

In order to halt the deterioration of ground and surface water quality several measures have already been implemented over the past 15 years, many of them in the framework of bilateral technical cooperation projects between MWI and the Federal Institute for Geosciences and Natural Resources (BGR). Protection zones for important groundwater and surface water sources have been delineated covering around 30% of the drinking water supply.

Integration of the need for water resources protection into the land-use planning process is an effort of the currently implemented bilateral technical cooperation project 'Water Resources Protection in Land-use Planning'. Within the framework of this project the implementation process of previously proposed protective measures for protected drinking water supply wells will be supported. Implementation will be done in close cooperation with all involved ministries and agencies, most importantly the Water Authority of Jordan (WAJ), the Environmental Rangers and the Ministry of Municipalities. Together with the latter, protection aspects will be integrated into the current land-use plans.

## Trans-boundary Groundwater Aquifers-The Necessity of Their Sound Management

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Groundwater aquifers extending across international borders are defined as trans-boundary aquifers. Their recharge, flow, discharge, water quality and its genesis as well as the different ways of their interactions with surface water bodies, especially rivers are very complex issues, far more complicated than trans-boundary or jointly owned surface water bodies. Therefore, the sharing of trans-boundary aquifer's water is a very complicate enterprise, which for many areas in the world, especially in the dry climatic zones has become a pressing issue not only for politicians and decision-makers, but also for water scientists. The article will shed light on the nature and complexity of trans-boundary aquifers and introduce some ideas for the fair sharing of their water. The article concludes that unless the groundwater of trans-boundary aquifers is fairly shared among the respective countries conflicts may develop and investments in water projects may be lost as an ultimate result of depletion and quality deterioration due to competitive over-exploitation.

## Methods for Characterisation of Karst Aquifers

**TOBIAS GEYER<sup>1</sup>, BERNARD LADOUCHE<sup>2</sup>, JANNES KORDILLA<sup>1</sup>, JOANNA DOUMMAR<sup>1</sup>, THOMAS REIMANN<sup>3</sup>, NATHALIE DÖRFLIGER<sup>2</sup>, MARTIN SAUTER<sup>1</sup>**



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In this work results of different field experiments for characterisation of karst aquifers are compared and attributed to the structural properties of these systems. The results are important for parameterization of numerical models dealing with karst hydraulics.

Karst aquifers describe a dual flow system consisting of a low permeability fissured matrix and a highly permeable conduit system. Over a large volume the fissured matrix can be considered as continuum and a representative elementary volume (REV) can be defined. However this REV is only valid on local scale. On regional scale the drainage of the karst aquifer is controlled by the conduit system which might have a highly anisotropic geometry. In current modelling approaches for simulation of karst hydraulics the conduit system is therefore implemented as second continuum or as a discrete pipe network which is hydraulically coupled to a fissured matrix continuum (Sauter et al. 2006). A traditional method for characterisation of karst aquifers is an artificial tracer test. This test is usually applied for identification of point to point connections (e.g. between a sinkhole and a karst spring), determination of flow and transport parameters in the aquifer and estimation of geometric and hydraulic parameters of the conduit system. A disadvantage of the method is, however, that only limited information about the geometry of the conduit system and the interaction between conduit system and fissured matrix is achieved. Conventional methods for characterisation of aquifer properties on local scale are hydraulic borehole tests. Slug-tests, for example, can be applied in deep small diameter boreholes as often the case in karst systems with thick unsaturated zones. However, test results strongly depend on the location of the investigated borehole and the applied displacement depth. The spectrum of responses may range from strongly oscillating water levels in high conductivity parts of the aquifer to slow responding water levels in



low permeability parts. Because of the small volume of integration the representative elementary volume of the fissured matrix is only difficult to estimate with slug-tests. Larger aquifer volumes surrounding a borehole can be characterised applying pumping tests.

In the present study we also consider pumping tests with pumping rates of several 100 l/s which allow a regional drawdown of the water level in a karst aquifer (Maréchal et al. 2008). The high pumping rates require that the pumping well is directly connected to the conduit system. Thus, the drawdown of the water level at the beginning of the pumping test is controlled by the hydraulic and geometric properties of the conduit system. However, with increasing duration of pumping the drainage of the fissured matrix will occur. Large-scale pumping tests have therefore the potential to characterise karst aquifers scale continuous applying a single method.

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## L2-5

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# Development of a Quantitative Vulnerability Concept for Karst Systems: Application on the Jeita Catchment System - Lebanon

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Karst rocks constitute more than 90% of the total rock sequence in Lebanon. They are also renowned for being the major producing aquifer systems for water supply. Important springs such as Jeita, Afqa and Tasseh originate from karst aquifers of Cenomanian and Jurassic age.

Prediction of contamination in karst springs is highly problematic, due to the complex anisotropy and strong heterogeneity of such systems. Groundwater flow occurs in highly permeable karst conduits, as well as in fissured matrix blocks, resulting in highly complex flow and recharge processes. Challenges in conceptualizing such systems arise mainly as a result of this dual flow behaviour.

Intrinsic vulnerability is a tool in water quality management which helps define the sensitivity of a system or water body for contamination. Most vulnerability methods developed for karst systems to date rely only on a qualitative conceptual surface analysis of a catchment area. As a result, flow and transport processes in the karst system are not accounted for. The major challenge of vulnerability concepts in karst aquifers lies therefore in the analysis of measurable indicators for vulnerability aspects.

Artificial tracer test are well known for estimation of flow velocities and dispersivities, e.g. between the injection site and the spring. However, only a small part of the aquifer system is investigated. Integral aquifer characterisation methods refer to the analysis of karst springs responses (spring discharge and electrical conductivity curves) (Geyer et al. 2008) applying physically-based hydrogeological models.

In the present approach, spring responses are simulated using the watershed model MIKE-SHE (DHI 2007). The modelling tool accounts for flow and transport in the complete hydrological cycle, including different system compartments (atmosphere, snow storage, soil, unsaturated and saturated zone). The calibration of the model is based on observed karst spring responses. For this purpose, spring parameters (temperature, electrical conductivity, water level, pH and turbidity) are being currently recorded using a multi-probe system at the Jeita Spring since 2009. Sensitivity analyses on the static and spatial model parameters will allow identifying important system parameters and the development of a quantitative vulnerability method.

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## L2-6

# Optimization of Groundwater Resources Management by ALL\_WATER\_gw within the Framework of the WEAP MODFLOW DSS

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The optimization of available water resources among the demand sectors is often a difficult task for managers and decision makers, due to the complexity of the natural and man-made hydraulic systems. Matters are further complicated by high numbers of sources, demand sites, transmission links and their diverse characteristics. Decision makers face the problem to find the optimal solution that satisfies all the demand requirements, in terms of water quantity and quality, minimize the consumed energy by pumping stations (cost of unit water volume) and minimize the groundwater drawdown. A multi-objective Decision Support System (DSS) that can overcome the multiple criteria aspect and the higher dimensionality of the problem renders valuable assistance to this complex issue.

This study aims to enhance the existing WEAP-MODFLOW DSS by applying a multi-objective optimization tool, recently developed by INAT. This tool is named ALL\_WATER\_gw. It provides the optimization of abstraction rates from wells with consideration of quality, drawdown and cost. The WEAP-MODFLOW DSS for Integrated Water Resources Management (Droubi et al. 2008) has jointly been developed within a technical cooperation project between ACSAD and BGR ([www.acsad-bgr.org](http://www.acsad-bgr.org)), supported by the Stockholm Environment Institute ([www.weap21.org](http://www.weap21.org)).

Four objectives are considered in the problem formulation: i) the demand satisfaction, ii) the minimization of the unit cost of water supplied over a planning period, iii) the minimization of the maximal drawdown, and iv) the water quality satisfaction in the demand sites. The hydraulic constraints taken into account are the transmission link flow capacities as well as the maximal drawdowns and abstraction rates at the wells. Thus, to handle the formulated problem, a Multi-Objective Genetic Algorithm (MOGA) and the Pareto optimality concept are used.

The ALL\_WATER\_gw tool provides a graphical user interface which guides the user through the setup of the optimization process: First, the WEAP-MODFLOW model has to be read in. It constitutes the hydraulic system to be optimized. Secondly, the optimization objectives and constraints as well as the genetic algorithm parameters have to be defined. Finally, the optimization process can be run and the optimal solution will be computed.

The capabilities of the developed tool are tested on the study area in Zeuss Koutine, located in the Eastern South of Tunisia. In this area, groundwater is an important resource for potable water, but it is under increasing pressure because of high population growth and the socio-economic development, especially in the touristic sector. Additionally, sea water intrusion is a quality problem of the water resources. Before the groundwater reaches the end-user, it is pumped from the aquifer, collected and stored in intermediate tanks and transferred to the principal tank using booster stations. From these



principal tanks, the water is supplied to the main cities of the Eastern South of Tunisia. To raise the water up to the principal tank, between 0.4 and 2.0 KWh for each m<sup>3</sup> of water is needed. Based on real water production and consumption data a WEAP-MODFLOW DSS of the study area has been build up. Monthly time steps have been used for the simulated period 1982 – 2015. For this study, 21 wells and well fields, respectively, with two different water qualities, 11 demand sites and 22 transmission links have been considered. The optimization of the groundwater abstraction rates concerns the period between 2010 and 2015 (72 monthly time steps).

The first application of the ALL\_WATER\_gw software demonstrates its capacities to interact with the WEAP-MODFLOW DSS, to read in and aggregate the inputs and to propose optimal management scenarios.

**Keywords:** *Groundwater, management, optimization, genetic algorithm, water quality, water cost, drawdown, WEAP, MODFLOW, DSS*

**References:**

Droubi, A., Al-Sibai, M., Abdallah, A., Zahra, S., Obeissi, M., Wolfer, J., Huber, M., Hennings, V., and Schelkes, K. (2008): A Decision Support System (DSS) for Water Resources Management, -Design and Results from a Pilot Study in Syria. In: Zereini, F., Hötzl, H. (Eds.): Climatic Changes and Water Resources in the Middle East and North Africa. Springer, 199-225.

## L2-7

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### Nitrate Contamination in the Upper Litani River Basin

**DR. MARK SAADEH**

The Litani River, longest and largest in Lebanon and flowing entirely within its frontiers, has been transformed over the past decades into an elaborate and free flowing sewage system. Solid and liquid wastes are continuously being discharged into the river from domestic, agricultural and industrial sources. However, nitrate pollution stands out among the myriad other pollutants wreaking havoc through the phenomenon of cultural eutrophication, as well as rendering aquifers unsuitable as a source of potable water.

The objective of this study is to evaluate the extent of damage incurred to the Litani River, the Qaraoun reservoir, and aquifers by focusing primarily on nitrate, as well as other parameters. Many studies have been done on the Upper Litani River Basin extending from its headwaters to the Qaraoun reservoir, but they have all been snapshots and intermittent. This study encompasses these relevant works but relies on data accrued from a monitoring program initiated by the Litani River Authority since 2005.

This study revealed that eutrophication is slowly but surely suffocating the Qaraoun reservoir, and that the aquifers in the Upper Basin, can no longer be tapped for drinking water with nitrate concentrations exceeding local and international maximum contaminant levels. Recommended treatment and countermeasures are costly but inevitable.

## Hydrochemical and Isotope Analysis of Deep Groundwater from the Nubian Aquifer System in the Egyptian Oases

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The groundwater of the Nubian Aquifer System is the vital source for the water supply of the Egyptian oases in the Eastern Sahara (Western Desert of Egypt). The groundwater of the Nubian Aquifer System has been the subject to diverse studies in more than 100 years. Most recently groundwater flow and transport models were developed modelling approaches of Heinel & Brinkmann (1989); Gossel et al. (2008) and Sefelnasr (2007) shall be mentioned as only a few of the regional scale groundwater models. The groundwater is taken in the oases from deep wells with a depth of 500 – 1000 meters to ensure high quality and safe yield. The water table of the confined aquifer reaches about 2 – 50 meters below ground, in some cases the wells are flowing so that no pumping is needed at all. The water is used for drinking water supply and irrigation. Due to the big depth the groundwater is very hot and various minerals are solved. By the recent study therefore the main component analysis, the analysis of metals and measurements of hydrogen and oxygen isotopes were focussed. The ages of the groundwater of some of the wells were published by Du et al. (2006). The isotopes of hydrogen and oxygen were also subject to diverse studies in the last decades. By the hydro-chemical and isotope analyses the genesis of this very old groundwater, the hydro-chemical conditions of this part of the aquifer and the fate of solved minerals during pumping and use should be investigated.

The groundwater samples were taken from locations of the Egyptian Oases and Assiut. The main chemical components were analysed by ion chromatography, the metals by ICP-MS and ICP-OES and the isotopes were analysed with an equilibration device-IRMS system.

The results of analyses were further hydro-chemically modelled by using the modelling tool PhreeqC to obtain a consistent picture of redox conditions in the aquifer and the rock-water interaction.

The hydro-chemical analyses and model results showed that the groundwater is in most cases under reductive conditions that lead to high contents of iron, manganese and only in rare cases of other metals. A factor- and cluster analysis showed a differentiation between groundwater from the rim of the Nile valley, the North of Kharga Oasis and the other locations. A comparison of the ages of the groundwater reported by Du et al. (2006) with the results of the groundwater models showed a good accordance. The results of the isotope analyses are also consistent with former investigations. The very negative position and the highly negative excess of both the hydrogen and oxygen isotopes are not explained sufficiently by the former reports. In combination with the ages the question of the climatic conditions during the recharge of the water has to be focussed again. About several 100,000 years ago the infiltrating precipitation water must have undergone a long history of evaporation and condensation processes.

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## Identification of Nitrate Sources in Selected Aquifers of Saudi Arabia Using Isotope Techniques

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Nitrate, which – when converted to nitrite – can increase the methemoglobin level in the blood (Methemoglobinemia, Blue-Baby-Syndrome), is one of the most common drinking-water pollutants in the world (WIDORY ET AL. 2004). Although elevated concentrations in groundwater are frequently associated with anthropogenic impact such as fertilizer application or sewage water infiltration, there are a number of cases, which are not related to human activities (e.g. STADLER et al. 2008).

Also studies conducted in the Kingdom of Saudi Arabia found nitrate in groundwater for which anthropogenic origins can be largely excluded, either due to the remote location of the concerned wells or due to the prevailing depths to water table (e.g. GTZ/DCo 2010). In order to identify the nitrate sources, the hydrochemistry of selected aquifers (Biyadh, Wasia, Aruma) was characterized and 13 groundwater samples were analyzed for the isotopic composition of the detected nitrate ( $\delta^{15}\text{N-NO}_3$ ,  $\delta^{18}\text{O-NO}_3$ ). Moreover, the parameters  $\delta^{18}\text{O}$ ,  $\delta\text{D}$ ,  $^{14}\text{C-DIC}$ , and  $\delta^{13}\text{C-DIC}$  were determined (RESHID 2009).

Based on the obtained  $\delta^{15}\text{N-NO}_3$  and  $\delta^{18}\text{O-NO}_3$  values and considering other isotopic and hydrochemical data, it can be concluded that in the study area both anthropogenic as well as natural nitrate sources occur.

Some samples taken from wells used for irrigation purposes contained nitrate, which showed isotopic signatures characteristic for fertilized-derived nitrate. Also a well located in a village shows anthropogenic impact – the isotopic signature of the nitrate reflects a contamination of the aquifer by infiltrating waste water. This is supported by the high boron content of 1.08 mg/l. For some other wells, however, the  $\delta^{15}\text{N-NO}_3$  and  $\delta^{18}\text{O-NO}_3$  data suggest that the encountered nitrate comes to a large extent from nitrogen that has taken part in the soil-N-cycle. In case of some samples it can not be excluded that also atmospheric depositions contributed to a certain degree to the elevated concentrations.

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## Reducing Pollution Risks for the Water Supply of Beirut in a Karst Aquifer

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### Introduction

The water supply of Beirut depends to a large degree on springs that emerge from a limestone aquifer, which is highly karstified. Numerous pollution sources exist in the catchment of these springs. They are mainly related to: wastewater, waste disposal, quarries, small industries and gas stations. The existing land use plans presently do not integrate the need for water resources protection. Practically any kind of land use can be established anywhere in the catchment. Currently there are several decentralized wastewater treatment plants in planning to reduce the pollution risk from wastewater. However, it must be ensured that these actually achieve the objectives under the given difficult conditions, which are: lacking institutional capacity for operating wastewater treatment plants, electrical power supply for often less than 50% of the time, steep topographic gradients, active tectonic movements, highly karstified geological underground.

### Planned Activities to Reduce Pollution Risk



In the framework of a bilateral technical cooperation project, funded by the German Ministry of Economic Cooperation and Development (BMZ) for at least two years, several measures will be implemented to reduce the risk of contamination for these important drinking water resources. Groundwater protection zones will be established for all springs and wells in the project area used for drinking water supply. In order to be able to finally implement the land use restrictions, which will be proposed by the project, the water law, currently in the drafting process, needs to integrate the right of the government to declare protection zones accompanied by certain land use restrictions. Also the delineation of protection zones needs to follow an officially accepted principle. The project will propose a related guideline and try to make protection zones legally binding. The project builds on extensive experience in this field gained in Jordan, also in a karstic environment. Awareness campaigns will be conducted to increase the understanding for the land use changes which have to be implemented. The projects will also try to assist the municipalities in the catchment area in integrating water resources protection aspects into their local land use plans.

Secondly the project will assist the Council for Development and Reconstruction (CDR), which is in charge of all major investment plans in Lebanon, in finding suitable solutions for the planned decentralized wastewater treatment in the project area. Currently the need of water resources protection is not sufficiently integrated into the related planning process. Therefore CDR needs support in :

- establishing priorities for wastewater projects,
- finding suitable locations, methods and design of related facilities for collection, treatment and effluent discharge or wastewater reuse,
- preparing environmental impact assessments (EIAs) for such projects and
- preparing best practice guidelines for the design of wastewater treatment plants.

This support will be given by the project.

A third very important aspect is the installation of a suitable monitoring network. Currently water resources monitoring is virtually non-existent in Lebanon. The proposed monitoring network will a) help the Water Establishment Beirut Mount Lebanon (WEBML) to manage their resources in a more efficient way and b) help to reduce the risk of pollution in the water distribution network. The quality monitoring



network will enable WEBML to switch from a pollution affected water source to a not contaminated source after receiving alert messages.

A similar approach as mentioned above was followed in the framework of German technical cooperation projects in Jordan over the past 15 years. The immense progress made during this time shows that if the government is willing to do something for water resources protection, this objective can be achieved. Important factors for the success in this respect were:

- The proposed land use restrictions must be legally binding;
- The decision makers and the local population must be made aware of the facts that there is a water resources protection zone and that they have to change their behaviour;
- Local land use plans must be adapted to the new land use restrictions;
- The implementation of land use restrictions must be controlled (this is facilitated in Jordan by the cooperation of water institutions with so-called Environmental Rangers, a special police task force).

The technical cooperation project will try to bring about a similar change in Lebanon.

### ***Innovative Approach***

On purpose the German funding agency has commissioned two projects for achieving the same goal :

- a financial cooperation project which will establish decentralized wastewater collection and treatment facilities (implemented by KfW) and
- a technical cooperation project which will carry out the above mentioned tasks (implemented by BGR).

In many countries water resources protection is often neglected in the planning and design process of wastewater projects and water supply and wastewater issues are not dealt with in a holistic approach. It is therefore recommended to follow such a comprehensive approach in all wastewater projects.

### ***Replicability***

Compared to the amount spent for wastewater projects the amount spent for water resources protection in these two projects in Lebanon, is very low. If such an approach would be followed in all wastewater projects, the overall objective of water resources protection would be much better achieved.

## Protection Zone Delineation using Tracer Tests in the Jeita Groundwater Catchment - Objectives and Preliminary Results

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In the framework of the new German-Lebanese Technical Cooperation project 'Protection of Jeita Spring' several tracer tests will be conducted. The main aim of these tests is to allow a delineation of groundwater protection zones for the Jeita spring and other important sources of drinking water supply in the Nahr el Kalb catchment. Another objective is to facilitate the decision processes concerning several upcoming wastewater collection and treatment projects in this catchment area, implemented by the Council for Development and Reconstruction (CDR). For these projects, partly funded by foreign donors, the technical cooperation project 'Protection of Jeita Spring' will provide advice concerning the selection process for wastewater treatment plants (WWTP) and their design, the planning of wastewater collector lines and the discharge or reuse of treated wastewater. The project will prepare the hydrogeological parts of environmental impact assessments (EIAs) for all related projects in the Nahr el Kalb catchment.

The tracer tests are conducted in close cooperation with the University of Goettingen, faculty of Applied Geology, which has a vast experience concerning tracer tests in karst areas.

With respect to the delineation of protection zones the following questions will have to be addressed:

- What are the groundwater contribution zones for the four main springs in the Nahr el Kalb catchment (Jurassic aquifer: Jeita, Kashkoush; Cretaceous aquifer: Labban and Assal) ?
- What are the flow velocities in the unsaturated and saturated parts of the groundwater system (for both, Cretaceous and Jurassic aquifers) ?
- Which area would need the most urgent attention concerning investment planning for wastewater collection and treatment (protection zones 2) in order to reduce the risk of bacteriological contamination?
- Is part of the Jurassic aquifer discharging into Nahr el Kalb before reaching Jeita spring or into the Mediterranean Sea; if yes, which approximate amount ?

The first tracer test has been conducted in April/May 2010 with the aim to support the KfW project, also named 'Protection of Jeita Spring', in its decision concerning the location of a WWTP and collector lines for three villages in the central part of the Nahr el Kalb catchment (phase II). The test showed that there is a direct hydraulic connection between the proposed location of the WWTP and Jeita spring. The tracer test allowed defining velocities and dispersivities within the unsaturated zone and within the cave during prevailing flow conditions. Mean transit times between the WWTP potential site and Jeita spring over a distance of 8 km appeared to be relatively short (66 hours), as median velocities reached about 130 m/h (0.03 m/s), which are considered significant.

## Influence of Saliferous Triassic Formations on the Groundwater Quality of the Plio-Quaternary Aquifer of Northern Area of Tébessa, (North East of Algeria)

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Due to its history, recharge-discharge mechanisms, geologic formations and development of its hydrodynamic characteristics, the groundwater of the Morsott-El Aouinet basin show a very wide range of chemistries.

In this paper the groundwater hydrochemistry are studied through sampling from wells in the studied area. Hydrochemical members are identified and the sources of water salinization are defined. It was found that the evaporites within the Triassic rocks are the main contributors to the salinization of groundwater.

The ionic speciation and mineral dissolution/precipitation was calculated by wateqf software. The increase in salinity is related to the dissolution and/or precipitation processes during the water-rock interaction and to the cationic exchange reactions between groundwater and clay minerals.

The isotopic analysis of some groundwater samples shows a similarity with the meteoric waters and indicates no significant isotopic modifications by evaporation, which means that the recharge of the aquifer is quit rapid and the recharging meteoric water does not occupy the soil zone of the recharge area for a long time.

**Keywords:** Triassic, groundwater, salinity, environmental isotopes, Morsott-El Aouinet, Algeria

## Strengthening the MENA Water Sector through Regional Networking and Training - MENA WANT -InWEnt Water Programme

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InWEnt is an international organisation for capacity building and human resources development, InWEnt works on behalf of the German Ministry for Economic Cooperation and Development and on behalf of international organisation and the EU. In the water sector we conduct several activities to support capacity building of individual and partner organisation in integrated water resources management. In the MENA region, several programmes have been conducted in the last 15 - 20 years related to the water issue with the focus on practical regional experience in the field of water in the region.

Since last year 2009 new water programme “Strengthening the MENA Water Sector through Regional Networking and Training - MENA WANT- has been started.

The focus of this programme is to support ACWUA (“Arab Countries Water Utilities Association”) and AWC (“Arab Water Council”) to advocate the effective and efficient use of water resources as well as to build up capacity in order to operate and maintain water infrastructure and improve overall water service quality and delivery in the MENA region.

The out puts of the programme is to provide training courses for decision makers in the field of good water governance, to conduct training courses for water utilities in utility management, training of trainers, public awareness, and performance indicators. Additionally experts will have the opportunity to attend long term training programmes in Germany and to benefit from InWEnt follow up and net working facilities through InWEnt internet platform - Global Campus- .

The training courses will be organized in close cooperation with partner countries and through support of training institution and universities in the region.

## L2-14

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### **Characterization of Surface Water Contaminants in R'dom Watershed, NorthWest Morocco**

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The reliable assessment of hazards or risks arising from surface water contamination problems and the design of efficient and effective techniques to mitigate them require the capability to predict the behavior of chemical contaminants in waters flowing R'dom River. The watershed of this River is part of the larger basin of Sebou, located northwest of Morocco and considered one of the largest basins whose study appears important because of the situation that occupies according to its quantity of wastewaters flowing towards Sebou River.

This work aims to assess the risk of water contamination in the R'dom watershed and the origin of this contamination, by adopting measures based on knowledge of water system, sources of pollution and understanding the factors that control this pollution.

Samples have been taken along R'dom River and around the two cities of Meknes and Sidi Kacem that constitute them main sources of wastewaters issued from domestic and industrial activities. Those samples were undertaken on surface waters and on sediments in order to determine the dispersion of pollutants and the toxicity potential of sediments aqueous extracts to assess their environmental risks and finally, to locate sites that need urgent remediation those requiring a control system.

Water analysis by ICP-MS showed that surface waters are heavily contaminated R'dom heavy metals, including Cr, Mn, Fe, Ni, Cu and Zn. In deed, surface water of R'dom between the two cities of Meknes and Sidi Kacem show strong increase of pollution parameters and a deficiency in dissolved oxygen. Chromium and nickel toxic heavy metals are most frequent in these waters, which with their heavy metal concentrations, are typical of crafts activities in Meknes imperial city, thus R'dom River is the surface transporting agent for dissolved chemicals including contaminants issued from this city and rejected downstream without any pretreatment in Sebou River. This study showed that contamination problems from several sources have been reported from different parts in the studied watershed. The important sources of contamination identified in the area are chemicals that are in widespread use in urban, industrial and agricultural settings.

**Keywords:** R'dom watershed, wastewater, contamination, heavy metals

## Reduce the evaporation by monomolecular films for the preservation of water plans in arid zones (Case of Northern Sahara, Algeria)

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The water is a natural heritage which is necessary to be protected. In Algeria it is a rare resource and little which exists in dams and lakes undergoes strong losses by evaporation, losses which are, according to REMINI (2005), about 250 millions m<sup>3</sup> a year from 39 dams of capacity of 3,8 milliards m<sup>3</sup> which is approximately 6,6%.

In the Algerian arid zones, where the high air temperature, the low rates of humidity, the dry winds and the long period of sunstroke, the losses by evaporation are very important and reach quantity of 2 to 3.8 m / year.

This alarming situation led in research of a means of preservation of this vital resource especially in the arid zones by adopting a technique based on the use of a chemical substance able of forming a thin layer (monomolecular film) on the water surface for reducing the losses by evaporation.

To know the efficiency of this technique in the region of Ouargla, an experimental device consisted of three tubs type Colorado partially buried and filled with water about 80 %, were installed in the experimental station of the Technical Institute of the Development of Saharan Agronomy in Ouargla; the first tub is covered by a film of Hexadecanol, the second by a film of a mixture of Hexadecanol and Octadecanol with equal proportions (1: 1) and the third (witness) contains only water. Alcohols are put on water surface, in order to form films, every three days (0,336 g / 03jour / Tub).

The daily observations during 15 days allowed deducting that films reduced the losses by evaporation and the rates of reduction of the evaporation are remarkable and are more than 30 %.



**Keywords:** *evaporation, monomolecular film, arid zones, water plans, Algeria.*

## The Effects of Formal and Informal Mega-Urban Development Processes on Water Resources– Case Study Area Megacity Guangzhou, China

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In China urbanization developed quite late in international comparison due to the national household registration system which made migration into cities difficult until the state opened politically and economically in 1978. Since this period the case study area Guangzhou, located in the Pearl River Delta, belongs to one of the most dynamic, booming and rapid growing regions in China and East Asia.



The distance between Guangzhou in the North and Macao and Hong Kong in the South is about 120 km, and the area between gives home to nearly 50 million people – Guangzhou alone has some 11.5 million inhabitants. The highly dynamical urban growth, which goes hand in hand with migration, densification, expansion and deconstruction processes, led and still leads to a rising loss of predictability and controllability of the city. The increasingly globally linked megacity requires immense human and environmental resources, causing not at least serious consequences for the environment, especially in the water sector. Within this context, it is first important to gain an in-depth understanding of the 'system megacity' in order to be able to contribute – in a future step – to the solution of the key challenges of Guangzhou's mega-urbanization and future development as e.g. minimizing the lack of quantitatively sufficient water infrastructures and improving the access to safe water as well as controlling the serious water pollution.

The presentation outlines, first within a general and secondly, in an in-depth part dealing with the case study area Guangzhou, the effects of formal and informal mega-urban development processes on water resources. In the introducing part the spatio-temporal development of megacities worldwide, selected land use (changes), their drivers and upcoming water problems leading to the relevant key requirements in the water sector will be presented. Another focus of the first part will be on the interaction between land use and water resources.

The second part of the presentation will follow up with Guangzhou. As the urbanization processes are very complex it is required to concentrate on special issues during research as not to lose detailed information on the micro-scale which are also relevant for urban planning as well as natural resource protection and management.

The research questions here are:

1. First, how do formal and informal urban development processes affect Guangzhou's water resources in terms of quantity and quality?
2. Which types of water supply and sewage disposal do exist?
3. Is there a link between land use and urban water quality or not?

Several conditions and city structures as well as their spatio-temporal changes having relevant impacts on the water resources of Guangzhou will be shown in the presentation. The spectrum extends from increasing population to frugal dwellings located in agricultural areas without adequate sanitation facilities and informal dumps beyond to modern high-rises and industry parks. Each of those does lead to increasing vulnerability of the water resources. By means of remote sensing the land use changes in Guangzhou between 1990 and 2005 will be shown. Besides, phenomena of the current land use changes will be represented by the results of in-situ investigations on micro-level, i.e. within several investigation areas, carried out between 2007 and 2010. The additional sampling of surface water, ground water and tap water taken in the same time frame aims at the analysis of the interaction between surface water and groundwater as well as between drinking/ tap water and sewage system.

Giving a résumé the presentation's goals are to outline the spatio-temporal development of megacities worldwide, their related key drivers and evolving problems in the water sector as well as to highlight the empirical results with regard to land use changes, water supply and sanitation as much as peoples' and natures' vulnerability in the case study area Guangzhou.

## Persistent Organic Pollutants in North and Sub-Saharan Africa – Levels in Air and Design of a Continent-wide Monitoring Network

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Despite significant usage of organochlorine pesticides (OCPs) in the past and present in many African countries, the continent had not been covered by monitoring activities so far. On-going contamination of the environment in Africa by persistent organic pollutants (POPs) is due to DDT application in vector disease control programmes, inappropriately managed old stocks and illegal use of obsolete pesticides, polychlorinated dibenzodioxin and -furan (PCDD/F) supposedly emitted from burning of domestic, hospital, and industrial waste, as well as biomass burning, and polychlorinated biphenyl (PCB) emissions from old industrial facilities.

Polycyclic aromatic hydrocarbon (PAH), OCP, PCB and PCDD/F levels were monitored January-July 2008 based on monthly (quarterly in the case of PCDD/Fs) passive air sampling at 26 background, rural and urban sites in 3 North African (Egypt, Sudan and Tunisia) and 12 sub-Saharan countries. Identical samplers and analytical procedures were used [1].

While PCB at African industrial sites exhibited similar levels as in central Europe, rural and background sites had levels lower than corresponding sites in central Europe. Among OCPs, rural and mountain backgrounds showed hexachlorocyclohexane concentrations similar to the backgrounds in central Europe. Very high levels were found in the urban background of Tunis. Concentrations of DDTs ranged over three orders of magnitude in the African atmosphere. Significantly elevated levels of the main metabolite of technical DDT, i.e. p,p'-DDE, were found in Khartoum (industrial site). Atmospheric levels of hexa- and pentachlorobenzene were generally significantly lower in Africa than those found in central Europe. The PCDD/F contamination of air sampled in Cairo exceeded any other African site by more than an order of magnitude. PAH concentrations reflected the type of sampling site, i.e. low at background and high at urban and industrial sites.

Integrated POP monitoring activities are on-going under the auspices of the Stockholm Convention worldwide. These so far include air and human milk [2], while seawater and freshwater may be included in the future. Part of the Eastern Mediterranean, e.g. Turkey, is covered by the MONET-Europe programme [3]. Monitoring in North Africa has started in 2010, while monitoring has not started yet in the Asian part of the Middle East. The network to monitor the African continental and intercontinental level of background POP concentrations was designed based on the results of the pilot phase [4]: A number of criteria were applied to select the most suitable network stations including the character of POP sources and local meteorological features. Representativeness of the climate at 9 pre-selected stations during the pilot phase with climatology was assessed by comparison of the more local advection situation as given by climatological vs. observed wind roses and by comparison of backward air mass trajectories with the climatological boundary layer wind. 6-9 stations were suggested for the monitoring network. These would cover most and essential parts of the continent and of neighbouring sea regions, but would also exclude some parts. The potential of the network is not hampered by on-going long-term changes of the atmospheric flow.

The monitoring activities are coordinated by the Stockholm Convention Regional Centre for Europe (RECETOX, Brno, Czech Republic) in cooperation with the nominated Regional Centres for Africa (National Centre for Cleaner Technology and Production, Algiers, and Basel Convention Regional Centre for Francophone Africa, Dakka).

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## L3-2

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### Verification of Precipitation Forecast of Global ECMW Model and Regional HRM Model for Iran

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The first part of the study has focus on the precipitation forecast of Global model of the Centre for Medium Range Weather Forecast (ECMWF) and the second part deals with the ability of high resolution regional model (HRM) in forecast the flooding events in Iran. The performance of the Centre for Medium Range Weather Forecast (ECMWF) model (t+27 h to t+51 h) in predicting precipitation is discussed. This model is the first, which has been verified over Iran. The spatial resolution of the model is  $0.351^\circ$  and the 24-h forecasts are compared with daily observations. The study concentrates on year 2001 and the precipitation measurements were collected from the data of 2,048 rain gauges in Iran. The accuracy of four different interpolation methods (nearest neighbourhood, inverse distance, kriging, and up-scaling) was investigated. Using cross-validation, the inverse distance method (IDM) with minimum mean error was applied. Verification results are given in terms of difference fields (mean error=0.46 mm/day), rank-order correlation coefficients (0.70), as well as accuracy scores (false alarm ratio=0.50 and probability of detection=0.60) and skill scores (true skill statistics [TSS]=0.45) in year 2001. The position of the rain band was only partly captured by the ECMWF model; however, the position of maximum precipitations agrees with the observations well. The results show that the high values of TSS are associated with the large amounts of precipitation (over 25 mm). Slight to moderate precipitation events have been under-forecasted by the model (bias<1) and it leads to a small value of TSS for these thresholds (5–25 mm/day). The ECMWF model has better performance in high and mountainous regions than over flat terrain and in deserts. Comparing TSS over the Alborz and the Zagros Mountains, it is obvious that the ability of the model to predict the convective precipitation events needs some improvement. The amount of daily precipitation has been also slightly overestimated over Iran. From the beginning of January up to 21 March 2001, the ECMWF time series indicates an obvious phase shift of 1 day, although in other months, no phase shift is noticed. The second part of the study shows the ability of HRM model (with 14 km resolution) in prediction of flooding events in Iran. A case study has been considered and the model is verified for the flooding event in March 2005 in Karoon river basin (west of Iran).

## Estimating the Compensation Strength of Coniferous Forests and Fruit Orchards During Climate Change

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Since several years it has been realized that our climate conditions are changing. Scenarios to approximate future conditions as realistic as possible have been constructed and projections for different areas on Earths have been made. However, several complex processes such as aerosols and feedback cycles are not fully understood yet. One of those feedback cycles is the interaction between different vegetation types and the atmosphere. Each vegetation type has its climate optimum conditions with respect to temperature and water stress tolerance. Changing those a new distribution of plants and trees has to establish or the ecosystem has to adapt. This is usually a lengthy process but critical for coniferous forests such as in boreal regions and for fruit orchards in water limited regions. Especially the question how much of the changing climate conditions can be compensated by the vegetation on a shorter time scale is critical for the slow changing forests. Making a rough estimate Spracklen et al. (2008) obtained that the forest takes up carbon dioxide and increases its leaf area index, thus biomass. This decreases its surface albedo. Compared to a surface without forest this effect was estimated to result in  $+2.3 \text{ W m}^{-2}$ . On the contrary the forest emits notable amounts of volatile organic compounds (VOCs) under stress conditions that significantly take part in atmospheric new particle formation. These new particles grow and result in a doubling of the cloud condensation number (CCN) over Scandinavia leading to a energy reduction by about  $-2.9 \text{ W m}^{-2}$ , thus a net cooling of  $-0.6 \text{ W m}^{-2}$  ( $-0.3 \pm 0.1 \text{ W m}^{-2}$ ). This study focuses on the increase of the cooling (compensating) effect at future conditions. Therefore, we defined four nucleation parameters including the effect of ozone and water vapor on new particle formation as well as the global radiation as a proxy for OH related compounds. In doing so we found a good agreement with field observations for the nucleation parameter which included all effects. Hence, we apply this parameter for expected future conditions. Interestingly if the mean climate is warming by two degrees, the increase in ozone mixing ratio is about as strong as the water vapor mixing ratio at the same relative humidity. Thus both effects cancel each other. Solar radiation is not to be expected to change significantly. Only the terpene emission as precursor for atmospheric particle mass and maybe nucleation remains unbalanced. The emission is known to increase for the most important VOC of coniferous forest by 9% for each temperature increase by one degree. This results in ca. 20% for a mean temperature increase of  $+2\text{K}$  assumed for global change. However, the value is expected to be remarkably larger for boreal regions. If we apply 20% increase in new formed particle number and take into account the reduction during the growth process until the particles reach 50 nm in diameter (ca. +16%), where they can act as CCN, we can approximate the effect of an increase on the indirect (and direct) aerosol radiation effect. Doing so, an additional reduction of  $1 \text{ W m}^{-2}$  was calculated. With a simple rule of proportion one can calculate an additional cooling of  $0.5 \pm 0.1 \text{ W m}^{-2}$ . This is actually about a quarter of the actual change at a doubling of carbon dioxide. Thus the forest seems to be able to compensate only about 25% of the expected temperature changes and might reach a critical value within this century in notable areas. Fruit orchards on the other hand face an even stronger temperature stress and will be affected strongly by water resources. Thus, the orchards might act most pronounced at sufficient ground level water and high temperatures. However, if ambient stress factors are too large, i.e. temperature above  $40^\circ\text{C}$  and water resources are dropping, thus no clouds will form any effective compensation can take place and the plants will suffer remarkably.

## Regional Transports (Near/Middle East) of PM10 to the greater Tehran area

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In EU countries special thresholds and exceedances are defined in several directives for pollutants, like O<sub>3</sub>, NO<sub>2</sub>, particulate matters PM<sub>10</sub> and others. For reduction of air pollution levels local diagnostics about the interrelation between local sources and regional or broad scaled transports are needed.

In line with statistics in Europe diagnostics were made in Iran with measurements at air pollution monitoring stations and meteorological observations for 2006 to 2007.

Eight environmental monitoring stations in greater Tehran were given by the Tehran Environmental Agency measuring hourly concentrations of Particulate Matter PM<sub>10</sub>, and at three stations in addition NO<sub>x</sub>, NO, NO<sub>2</sub>, O<sub>3</sub> and SO<sub>2</sub>.

The meteorological data are given by the WMO meteorological network.

A dense net of 3d backward trajectories was used to analyse the seasonal and episodic relationship between measurements and possible source areas in Near and Middle East. By special statistics the surface contacts of 3d trajectories are integrated over a 1 km<sup>2</sup> grid and weighed by the locally measured concentrations of all species and the given time sections. The resulting concentration matrices for all observational sites are combined and, as a result, special source areas or transport paths are determined.

The meteorological analyses are produced by a special procedure at FU Berlin. TRAMPER (Tropospheric Realtime Applied Meteorological Procedures for Environmental Research) incorporates a numerical statistical fine mesh analysis procedure for meteorological observations from weather services and all available local measurements and has been used and improved for a long time.

The analysis system can be combined with meteorological forecast data in a medium complex way of assimilation and e.g. was utilized for diagnostics in several measurement experiments.

In general, the grid size is variable and is usable with different geographical projections. The basic variables are analysed on the surface level and up to 24 and more isentropic surfaces within the troposphere. The statistical analysis procedure is used like a correction scheme. The first guess is given by a broad scale analysis or by meteorological forecast fields, where ECMWF and German Weather Service forecast output is used. The isentropic vertical coordinate allows the optimal presentation of temperature inversion layers.

The parameters include the standard observed 3D parameters and in addition the output from forecast model is used to describe the cloud parameters as shown in the parameter table below. The observation of cloud parameters like coverage, type and height are interpolated and combined with model output. The analysis of precipitation, rain and snow, is performed purely by use of observations.

The boundary layer parameters are determined by a separate boundary layer modelling where  $u_{star}$ ,  $w_{star}$ , Monin-Obukov length and mixing height are determined by taking into account the 3D temperature and wind fields, cloud parameters, landuse and topography. By the assumption of mass conservation the wind fields are adjusted to the given topography by taking into account topographic gradients, sloping winds, turbulence and local stability.

The time step is variable and 1 and 3 hourly data sets are prepared. The boundary parameters are given with 10min time step.

The area of interest was Near and Middle East and meteorological Data were interpolated on a numerical

grid with a resolution of about 16km.

The weighted source/receptor matrices determined by backward trajectories are separately used to solve for the contribution from outside of the greater Tehran area to the City for the analyzed species.

Of special interest were the regional transports of Dust and PM10. The source/receptor statistics show that PM10 concentrations in the city of Tehran were often combined with transports from the West along the mountains with possible broad scaled transports from Turkey and Iraq and several Iranian emissions. While transports from West are often observed during the year transports from the Southern deserts are combined with high concentrations of PM10 in summertimes.

Other parameters were dominated by the city itself.

Some example for source/receptor relationships are presented and some quantitative statistics are discussed.

## L3-5

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### **Air Quality Assessment and Implications in Beirut, Lebanon**

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Particulate matter (PM) has been associated with mortality and morbidity, which necessitates extensive research in the area of atmospheric pollution. However, such studies are deficient in the eastern Mediterranean region although the geography, closed location, and meteorology, hot and humid summers are factors promoting air pollution in that area. This study presents seasonal and temporal variations of PM mass concentrations and their chemical composition over three different sites located along the North Eastern direction of Beirut. Particulate matter of two different sizes (PM10 and PM2.5) are measured by gravimetry using direct and virtual impaction PM samplers. The behaviour of inorganic ions in PMs is determined using ion chromatography (IC) and the elemental speciation is measured using proton induced X-ray emission (PIXE). It is found that PM mass concentrations varied daily due to the dynamic climatic conditions in the region. Furthermore, PM chemical composition showed that this variation is affected by dust storms coming from Arabian and Saharan deserts, marine sea salt aerosols, and high levels of nitric and sulfuric acids and other crustal and non crustal elements originating from local sources. Such a comprehensive study of PM variations in Beirut is the first of its kind in the country. It shows that in Beirut, PM levels and their chemical composition depends on the nature and proximity of the sources, the regional variability of the transport pattern and the different removal rates of aerosols. This study could help in establishing guidelines or standards for acceptable levels of ambient PM pollution.

## Trace-Element Geochemistry of Coal and Suspended Particulate Matter at El Maghara Mine

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The present work consists of characterizing geochemically the trace elements (as Ba, Ni, Sr, Ti, Zn, Mn, Zr, Cr) present in coal at abandoned El Maghara mine in North Sinai. Suspended particulate matter (SPM) was also collected and analyzed for its content of trace elements (as Zn, Ni, Mn and Co) because their toxic nature and health implications in recent years. The coal ash was analyzed for major and trace element contents. The concentration of most of the elements in the coal ash was higher than the Clarke value: Ba, Cl, Ni, Sr, Ti, Zn, Zr, Mn and Cr. Chromium ( $r=0.97$ ), Mn ( $r=0.90$ ), Zn ( $r=0.98$ ), Ti ( $r=0.95$ ) and Cl ( $r=0.90$ ) have positive correlation coefficients with the ash content, i.e. respectively high inorganic affinity, but Sr ( $r=0.08$ ) and Zr ( $r=-0.15$ ) have intermediate (organic and inorganic) affinity. Ba ( $r=-0.47$ ) and Ni ( $r=-0.47$ ) have high organic affinity. The SPM contains high concentration of Zn, Ni and Mn. The rate of deposition of dust is very high, about three times the Egyptian standards.

Spatial distribution of Fe, Mn and Zn contents in the studied air particulates of El Maghara area were mapped by interpolation using Arc GIS to illustrate the air quality and to give renewal of database and verification of heavy metal pollution.

**Keywords:** Trace elements, SPM, GIS, El Maghara mine, Egypt

## Characterization of soil and groundwater contamination by effluents (Application on Algeria N.E)

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To characterize soil and groundwater pollution, moreover of superficial table waters effluents and soils were sampled from a drainage channel within the industrial zone. The average results of physico-chemical analyses (Dissolved oxygen, BOD5, COD, PO4, Suspended Solids, Total Petroleum Hydrocarbons "TPH" and some metals) show an important qualitative degradation of the soil and groundwater, especially in the parts situated in the down gradient area and in direct proximity of the drainage channel. Key factors influencing the extent of groundwater contamination include the depth of the water table, permeability of the soil and therefore infiltration rate. In order to prevent further deterioration of groundwater quality, effluent must be transported via pipes or impervious channels for treatment prior to discharge.

**Keywords:** Effluents, Soil, Superficial water table, pollution, Skikda, Algeria

## L4-1

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# Agricultural Reuse of Water and Nutrients from Wastewater Treatment

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Since the late 19<sup>th</sup> century, wastewater from the city of Braunschweig is used for enhancing crop production on nearby cultivated areas. Nowadays, the reuse of treated wastewater and also digested sewage sludge from 250,000 inhabitants still plays an important role in the water management and recycling concept of the local wastewater association. Braunschweig in the northern part of Germany faces on-going reductions in precipitation during summer months (see figure 1). Additionally, the sandy soils, relicts of the last glacial period, are not beneficial for advanced agricultural production. Only the addition of treated wastewater and sewage sludge allows the production of crops like sugar beet and corn. The latter is especially important as the corn silage is also used for biogas production in one of the largest biogas plants in North Germany. Nevertheless a careful management especially of the nutrient input is necessary as water and sludge are produced year-round, but nutrient uptake will only last during the growing season.

The oral presentation will cover basic information about potentials of wastewater and sewage sludge reuse, taking into account potential risks for soil and public health from critical ingredients like heavy metals, organic pollutants, salts and pathogens. A main focus will be on presenting the wastewater and sludge reuse concept of Braunschweig (see figure 2) and its consequences for agricultural production. The case study is currently taken as example for an ongoing research project in Turkey, determining the potential and feasibility of implementing wastewater reuse techniques.

## L4-2

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# Impact of Waste Dump and Waste Water Discharge on Lebanon's Coastal Water Quality

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Lebanese Mediterranean coastal water encounters a variety of point source contaminants, for instance sewage outfalls, industrial waste water, coastal agricultural runoff and leachate from seafront dumps. These sources impact the quality of coastal water and might affect the marine organisms and the public health. Assessing the impact of aforementioned point sources on coastal water quality is crucial for setting proper integrated interventions critical to protect the Mediterranean water and general public health. The objective of this study is to determine the extent of chemical and microbiological contamination in the Lebanese coastal water. Sea water samples were collected based on GIS map of all types of discharged zones along the coastal line. The following were the measured chemical parameters: temperature, pH, dissolved oxygen, alkalinity, chloride, nitrate, sulfate, phosphate, Na, K, Ca, Mg, Ba, Al, Fe, Mn, Cu, Zn, Pb, Cd, Ni, Co, V, As, and Hg. Whereas, the microbiological contamination was evaluated by fecal coliform detection in water samples. Results exhibited contamination by fecal coliform in most samples, and also high levels of toxic trace metals at some sites. These results emphasize the importance and need of an integrated intervention proposal plans for the protection of coastal water organisms and public health and in accordance with international conventions for protecting the Mediterranean water from environmental pollution.

**Keywords:** Mediterranean coastal water, point source, toxic metals, microbiological contamination, waste water, public health impact, environmental interventions, Lebanon.

## L4-3

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# Cost-Benefit and Performance Analysis of Centralized and Decentralized Wastewater Treatment Plant – A Case study

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Mismanagement of wastewater in Lebanon is one of the main directives to provide WWTP. Water status in Lebanon is critical; we have a yearly precipitation of 8,600 Mm<sup>3</sup> of water, of which only 2000 Mm<sup>3</sup> are exploitable. Furthermore water quality is affected by domestic, agricultural, and industrial sectors. Because of the high demand on water in the coming years, providing performing and cost-effective WWTP is important and crucial on all aspects. In this paper, WWTP designs for the removal of organic material and nitrogen was evaluated for two alternatives, namely, decentralized (Alternative-1) and centralized (Alternative 2-a, and Alternative 2-b) WWTP. Alternatives 1 and 2-a were similar in process design each comprising a bar screen, a biological nitrogen removal unit, and a secondary clarifier. Alternative 2-b contained an extra primary clarifier as compared to alternative 2-a.

Design of the WWTP was conducted following hand calculations (H-C) using the equations in the literature and using CapdetWorks (C-W) software of Hydromantis Inc. The comparison of outcome revealed similarity of design information, and effluent water quality. Finally, after having solid evidence that the systems designed were comparable, it was concluded that the centralized WWTP comprising of an extra primary clarifier, Alternative 2-b, with a capacity of 7540 m<sup>3</sup>/d would reduce the cost by 44.2% as compared to having five individual decentralized treatment plants with capacities of 920, 1174, 1397, 1406, and 2643 m<sup>3</sup>/d. Total cost of decentralized plants amounted to \$15,430,000, whereas the cost of one centralized plants amounted to \$8,610,000. Even though the choice of plants was based on two methods, H-C and C-W design outcomes, and revealed effective treatment at a lower cost; the cost of network piping to be installed was not investigated in depth. However, it was estimated that a cost recovery of 44% in the project cost will exceed the cost of piping installation. It is worth mentioning that there are many other factors that were not taken into consideration in the costing of the WWTP. These may include the laboratory testing equipment that need to be provided at each decentralized WWTP resulting in 5 sets of equipment as compared to one set for centralized WWTP. Transportation costs of the staff were not taken into consideration. As well, other factors could act in favor of the centralized WWTP option.

# Modelling of Pollutant Production by Underground Coal Gasification

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Referring to the increasing global energy demand underground coal gasification (UCG) with combined CO<sub>2</sub> storage offers favourable economic prospects and implies the potential to take positive advantage of otherwise inaccessible deep coal deposits (KEMPKA ET AL. 2009). To ensure a long-term future perspective for this technology associated environmental concerns such as subsidence and subsurface groundwater pollution have to be taken into account (FRIEDMANN 2009). Considering groundwater quality former world-wide UCG trials demonstrated the risks of product gas escapes, leaching of organic pyrolysis and/or inorganic products from mineral ash during and after the gasification process (SURY et al 2004, BURTON et al 2006). Steering mechanisms for sustainable UCG operations with regard to groundwater protection require a detailed site characterization in terms of its regional geological and hydrogeological conditions. In addition to the evaluation of site-specific hydrogeology, operational boundary conditions of the UCG process impact groundwater protection, since quantities of the process-generated pollutants are controlled by UCG operation. In this context the quantification of UCG source pollutants is a challenging task depending on information on chemical equilibria in the UCG reactor during the process as well as in the post-phase cooling associated with tar generation dependent on the residual P/T conditions. Balancing the related groundwater risks for future UCG operations, post-phase tar generation modeling is a key issue for UCG groundwater risk assessment. SELVIG & ODE (1957) estimate the light oil and tar fraction to approximately 8 % by weight, whereas its main amount will be recovered in the product gas (CENA & THORSNESS 1981). Compared to pyrolysis generally less heavy tar is produced and tar fractions are lighter showing lower molecular weight and boiling points representing a fractionated portion of the total tar (KING et al. 1975). STEPHEN & THORSNESS (1985) point out that the temperature of the produced gas tends to influence the tar and that higher boiling tars tend to remain in the underground. This seems understandable looking at the steadily decreasing temperatures of gases during UCG post phase cooling. Generally characterized by lower temperatures, these gases are unable to transport high boiling tar components in the vapour phase and will thus support the condensation of these components in the underground. Consequently, UCG post phase cooling of the product gas with focus on generated tar masses and compositions is investigated with the present study. Therefore, phase change behaviour and masses of representative tar-pollutants are simulated taking into account UCG shutdown P/T conditions by application of the software ASPEN PLUS ®. The benefits of this approach include the evaluation of minimal pollutant output masses as well as reference data for upcoming reactive transport models.

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## L4-5

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# Rate Determining Steps Study in Cadmium Sorption from Aqueous Solutions by Dried Activated Sludge

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In the field of environmental pollution there are few subjects that, during recent years, have been developed as rapidly as the study of toxic metals. The contamination of water by toxic heavy metals is a world-wide environmental problem. Cadmium, in particular, has received a great deal of attention due to its highly toxic nature and its tendency to accumulate in the tissues of living organisms. The main sources of cadmium in streams are effluents from industries such as electroplating, smelting, paints, plastics, battery, zinc mining and refining. Because of its high toxicity, most countries include cadmium among the "priority pollutants" requiring suitable treatment prior to discharge into the environment. At present, a variety of physicochemical processes are employed to treat cadmium-containing effluents. These processes, however, prove expensive when situations involving high volume and low metal concentration (typically less than 50 mg/L) are encountered. Methods such as chemical precipitation and reverse osmosis, as examples, result in incomplete metal removal, have high reagent or energy requirements, and generate toxic sludge which are difficult to dewater and other waste products that require careful disposal. Increasing awareness of the environmental impact of metal ions in our water systems has encouraged interest in novel adsorption systems. Recently, considerable research has involved materials of biological origin and many forms of biomass have been shown to be effective metals sorbents. Dried activated sludge waste can be an alternative and favourable sorbent material for pollutants such as heavy metals, ... The sorption kinetics of cadmium from synthetic aqueous solution by dried activated sludge has been previously studied, however, no information is available for the kinetics controlling mechanisms in the literature. Determination of the rate limiting steps in sorption is necessary in order to define the rate parameters for design purposes. For solid-liquid sorption process, the solute transfer process was usually characterized by either external mass transfer (boundary layer diffusion) or intraparticle diffusion or both.

As a continuation of our previous work, the aim of this work is the study of kinetics controlling mechanisms of cadmium sorption by dried activated sludge in batch conditions: external mass transfer and intraparticle diffusion. External and intraparticle diffusion models were separately examined according to the main sorption parameters studied such as: time, initial cadmium concentration, agitation speed, initial solution pH, particle size, temperature, sorbent mass and cadmium salt nature. The approach chosen in this study was restricted to an interpretation and subsequent identification of mass transfer coefficients, based on the adequacy of correspondence models with experimental data of these parameters.



# Poster Abstracts

## Climate Change and Impact on the Environment Caused by Anthropogenic

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Over the last twenty years the world has experienced strong population growth has been accompanied by a sudden acceleration of urbanization and land use for industrial and agricultural. This led to a huge increase in discharges of pollutants in the very different receiving water bodies, and has had adverse effects on the various components of the environment.

For years, men have little concern for their environment, interfering with nature and making use of it without counting, adjusting with a vengeance, and largely rejecting effluents and wastes of all kinds. The statement today is dramatic.

Entire regions were devastated and many rivers and lakes have become polluted groundwater around the world, pollution that nature itself is hard to absorb.

From where do the different pollutants come from? What are the risks to the aquatic environment?

To prevent and combat the general decline of these ecosystems, it is important to distinguish and determine the effects of different sources of pollution and any changes that may suffer the physical environment.

The climate depends primarily on changes in Earth's orbit parameters, which affect the solar radiation received by the Earth's surface. Therefore, man participates strongly to these changes, for example, pollution is the main reason to argue the greenhouse effect, an increase of anthropogenic carbon dioxide (CO<sub>2</sub>) into the atmosphere, which promotes global the planet.

These changes are already under gold over a period unknown evil good sandstone, the strict application of anthropogenic declining in some countries, it will not be tomorrow reconciliation: man-pollution-climate-environment.

**Keywords:** man, climate, environment, anthropogenic pollution, soil, water



## Drought Analysis in Semi Arid area: Case of the Wadi Sly Basin (Northwest Algeria)

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Drought is one of the most serious problems for human societies and ecosystems, caused by climate variability. This phenomenon is of great importance in the world, especially in North Africa Countries like Algeria.

In this study, rainfall of 07 stations in the wadi Sly Basin, in the Northwest of Algeria were statistically analysed over a 41 years period (1968/69–2008/09). The principal component analysis (PCA) application showed that the first principal component [C1] explains more than 60% of the variance. Rainfall data



showed two different periods: a wet period from 1968 to 1980 and a dry period from 1980 until now. The basic characteristics of drought; duration, intensity and frequency were studied.

Several recommendations are proposed for a good water management to alleviate the impact of these climatic changes. Strategic measures will be taken, such as, sensitizing the population for water economy, generalization of localised irrigations systems (drip irrigation), rehabilitation of the purification station, fighting the dam silting by soil conservation.

**Keywords:** Drought, Climatic changes, Water management, Wadi Sly basin, Algeria

## PI-3

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### **Geochemistry and Behaviour of Trace Elements during the Complete Evaporation of the Merouane Chott Ephemeral Lake, Southeast Algeria**

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The Merouane Chott, located in arid southeastern Algeria, experiences annual cycles of filling during September through February followed by its complete evaporation from February through June. The concentration of 15 trace elements (Li, B, Ti, V, Cr, Mn, Co, Cu, Ni, Zn, As, Sr, Ba, Pb, Bi, and U) were measured in chott water samples collected from January through June 2003 during the complete evaporation of the lake. The corresponding concentrations of these trace elements in the major external inputs to this closed basin chott were also obtained. The trace metals show two distinct behaviours. Li, B, Cr, Co, and U tend to be conserved in the chott waters throughout its evaporation. Much of Cr, Co, and U originated from external sources. It is likely, therefore, that the concentration of these elements will increase in the chott waters in future years. In contrast, Ti, Sr, Ba, Zn, Ni, and Pb precipitate continuously during chott evaporation. Of these elements, most of the Sr, Ba, and Zn originated from outside the chott, and thus it is likely these elements will become increasingly concentrated in the chott bottom salts with time. V, As, and Cu exhibit intermediate behaviours. These contrasting behaviours are confirmed by analysis of chott bottom solids.

**Keywords:** Chott, geochemistry, Trace element

## PI-4



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### **Impact of Climate Change and its Consequences on Water Resources in the Trans-Boundary Basin Tafna (North West Algeria)**

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Water resources have become a major issue today across both global and regional rivalries because of the different climate and developments. These have greatly exacerbated the deterioration and water shortages already very important both quantitatively and qualitatively. This was followed by persistent drought and the over exploitation requiring special attention for our Mediterranean countries are all in their face all the problems of water deficits in difficulty Putting their own development.



It is in this context between my modest contribution that examines the impact of these phenomena on water resources in a trans-boundary basin high (Morocco and Algeria) to its geographical position currently overstretched its potential and its conditions unfavourable climate becoming erratic in recent decades and which showed a loss rate exceeding 30%. This specificity has led to often adverse consequences such as floods, droughts and devastating floods, With Negative consequences.

The efficient and sustainable management of water resources is necessary for the understanding of how their hydro-system must be planning integrating both perspectives of evolution and natural conditions in this particular climate in common geographic unit.

The availability of water in our area is more comfortable now because of the effects of climatic variations and loss of pollution in its various forms. The water issue remains a challenge because of low flows and floods punctuate how cruel life of our people.

## PI-5

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### Impact of Climate Changes in Ouergha

**SIHAM BOUKARIM**

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Water is the source of life that plays a very important role in the development of countries; however it is vulnerable to climatic risks, especially extreme phenomena.

All indicators converge and foresee that Morocco will know a significant warming and a big bareness.

Also great socio-economic choices of the country must integrate this data, since it becomes a reality and to better anticipate its negative effects and to promote its positive effects, national programs must take by consideration climate as a main factor.

The Ouergha basin covers 7300 Km<sup>2</sup> in southern Rifan side. Its proximity to the Atlantic and its Mediterranean climate permit to have developed vegetation.

In addition to that, Ouergha is the rainiest region of Morocco due to its high altitude.

Its ground is essentially made of cretaceous shale which means that it is not permeable the thing that prevents having ground water resources.

However, resources of superficial water of Ouergha basin are vulnerable because of many natural constraints (especially climatic changes) and anthropic ones (especially the over exploitation and the bad management).

The climatic changes and its effects are until now mainly tackled from a global angle, through the evaluation of important parameters (temperature and precipitation) which determine climatic equilibrium of the planet but reality is that the impact is local depends on the environmental and socio-economic correspondent characteristics, so we can deduce that it is very important to work on the identification of territorial axes of vulnerability.

Water determines the socioeconomic development, so its management should include steady work of three components: Anthropic activities, climatic changes and state of the surface. Taking by consideration whether the populations affects the environmental modification or it's itself affected.

The anticipation of the consequences of climatic changes and the proposition of some perspectives and actions of adaptation, that are necessary to minimize the impacts and reduce the vulnerability of basin.



## PI-6

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# Lebanon Temperature and the Global Warming During the 20th Century

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Lebanon annual and seasonal temperatures have been analyzed to detect the magnitude of warming during the 20th century. Annual temperature shows a long-term significant trend of 0.7oC during the 20th century. Temperature has risen strongly since mid-1980s. Spring, autumn and the annual temperature has risen by around 1.2oC since mid1980s; whilst summer has risen by about 1.5oC. The strongest warming was for winter by 2.3oC from 1990 onward. The rises of Lebanon temperature during the 20th century was similar to those reported over the world and in different countries worldwide.

**Keywords:** Lebanon, Temperature Global Warming Climate Change

## PI-7

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# Seawater Desalination in Algeria

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According to recent demographic statistical data, the number of inhabitants in Algeria should double in the next thirty years whereas availability of water resources will not change. The hydrologic situation especially for the coastal areas reflects severe drought conditions that are lasting since two decades. Seawater desalination could be an efficient alternative in order to mitigate the forecasted serious water shortage crisis. In fact, due to rural depopulation a large majority of the people and the economic activities are nowadays concentrated in the coastal cities of the Mediterranean coast along ~1280 km. The good physical and chemical features of Mediterranean seawater (19°C and medium salinity as compared to that of Persian Gulf which exhibits 30°C and much higher salinity) make of Mediterranean desalination plants more profitable with less operating costs and better efficiencies.

Reverse osmosis has been chosen as the best desalination process because it has seen many technological improvements especially with regard to better performance and longer membranes lifetimes. The latter was found lower than 0.5 €, which is quite interesting. All in all, the desalination option seems to be a good alternative to deal with the most urgent matters in terms of ensuring durable water allocation in the climatic context prevailing nowadays.

**Keywords:** Desalination, reverse osmosis, plant, drought, water resources, cost.

## The Impact of Drought on Water Quality Under Semi – Arid Climate - Case of Turonian Aquifer of Tadla, Morocco

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Water is indispensable for life, but its availability at a sustainable quality and quantity is threatened by many factors, of which climate plays a leading role.

The aim of this study is to determine the extent to which the ground water draw-down is able to impact and modify the chemical characteristics of the water, using statistical technique (PCA) and historical data on the main physico-chemical parameters.

The study area is a plain which covers 10,000 Km<sup>2</sup> in Oum Rbia watershed. This region has a high potential in groundwater resources especially in the turonian aquifer, which flows through the limestone.

The period of drought and the increase demand has produced a decline in groundwater level and a decrease in river and springs flows.

The study of hydro chemical evolution of the turonian aquifer has been based on a comparative analysis of data obtained in two surveys separated by a period of drought.

Some changes in the chemical characteristics have been detected. These results are for great benefit since they justify some hypothesis about the functioning of the turonian aquifer.

**Keywords:** Drought, Drawdown Groundwater quality, turonian, Tadla

## Aquifer Potential Estimation Based Geophysical Methods



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Locating potential water sources is a major concern for proposed developments and municipal supplies. The knowledge of the composition and the hydro- geological properties of the geological surveyed areas are essential for their characterization and for evaluating their hydraulic potential; However, the hydro - geologist or the geologist has only a partial geological information of geology provided by two sources:

- Samples collected from drilling wells and then analysed in laboratories.
- Hydro - geological studies consisting in a set of permeability and porosity tests.

However, that provides imprecise data because the results are generally local, then limited in space and in scale.



These last years, specific geophysical methods known as hydro - geophysical approaches are applied with success to extract quantitative and qualitative information from hydro – geological processes as the evaluation of porosity and the hydraulic conductivity.

Geophysical methods are used increasingly for aquifer characterization and hydrologic monitoring. Compared to conventional, direct measurements, which are commonly sparse and expensive, geophysical methods can provide high-resolution information over large areas and aquifer volumes

Surface geophysical methods may be employed to maximize hydro-geologic site characterizations with minimal errors or site disturbance. . Through geophysical techniques, such as two-dimensional resistivity and reflection or refraction seismology, large areas are surveyed in significantly less time and expenses than exploration drilling. Surface geophysics is a useful approach and a highly successful tool in guiding drilling programs. :

Seismic methods can be combined with geologic, hydrology and topographic data to locate and define favourable areas for drilling. In the other hand resistivity data can be were used to locate gravelly zones in buried stream channels. Some of the buried alluvium is thick enough to be considered a potential aquifer.

**Keywords:** *geophysics, seismic, resistivity, hydro-geology, data, porosity, permeability, characterization*

## P2-2

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# Digital Elevation Models and GIS for Watershed Modelling and Flood Prediction, A Case Study of Inaouene River, Morocco

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As the occurrence of flood event has become common in many parts of Morocco, flood events during previous years have raised public, political and scientific awareness of flood risk and flood prevent. This study is focused on the upstream part of the Inaouene River and especially one of its major tributaries called Larbaa stream. This area is known for flooding which requires understanding of the drains system organization in this area.

Geographical Information Systems (GIS) and Digital Elevation Models (DEM) can be used to perform many geospatial and hydrological modelling including drainage and watershed delineation and flood impact analysis. In the study two categories of DEMs were used to delineate drainage patterns in the studied watershed.

The channel geomorphologic parameters which are hereby analyzed comprise of Channel Length, Channel slope, Drainage Density and Bifurcation ratio. Obtained results can be used in other types of analysis in combination with other data (hydrological modelling, geomorphological analysis, monitoring of water quality and flooding...). Besides, these GIS tools are very beneficial; however, the data must be validated

To estimate flood discharge, elevation and volume, the watershed characteristics should be identified. These characteristics depend on the physical properties of watershed area. Physical characteristics include drainage area, watershed length, and watershed slope and watershed shape.

All acquired results by the use of GIS tools were compared with those acquired by classical methods based on extraction from topographic maps. Results are matching, and showed the acuteness of the

use of these tools. This approach can therefore provide a simplified means of predicting the extent of inundation during flood events for emergency action.

**Keywords:** *Inaoeune watershed, hydrographic network, flood , G.I.S.*

## P2-3

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# Geochemical Survey of the Waters of the Ground-Water of Mateur (North of Tunisia)

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The chemical quality of subterranean waters is the result of a natural acquisition of solutions. Its degradation is connected, for the main part, to the anthropological contributions.

The groundwater of Mateur, situated in the extreme North of Tunisia, where several agricultural zones were developed, is exploited for the irrigation and for the drinkable water supply. The quality of its waters is influenced by the intensification of the agricultural activities and by the infiltration of waters salted from the lake Ichkeul, which is its natural release.

The purpose of this study is determining factors and phenomena which control the mineralization of waters of the ground-water of Mateur; groundwater samples were collected from 36 wells and 4 drillings in October, 2007. The taken samples were the object of analyses of some physico-chemical parameters (Temperature, dissolved oxygen, pH, and salinity), major elements (Na<sup>+</sup>, Ca<sup>2+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Cl<sup>-</sup>, HCO<sub>3</sub><sup>-</sup> and SO<sub>4</sub><sup>2-</sup>) and nitrates.

The interpretation of the results of these analyses, allowed distinguishing two types of water:

- Greatly mineralized water, with contents raised in major elements, that presents a geochemical facies chlorinated sodique, characterize the wells situated in the south of the Ichkeul lake, in the west and the south part of the aquifer and those located in Garaet Tachegga in oued el Melah, and in Henchir Sidi Salem;
- Less loaded with waters, which present type Na-Ca-Cl-HCO<sub>3</sub> mixed facies, or Na-Ca-Cl-SO<sub>4</sub>, who characterize wells situated in the central part of the plain of Mateur and the low salt load of which would be due to the effect of the dilution of the Plio-Quaternary groundwaters of borders, who constitute an integral part of the natural recharge of Mateur aquifer.

The salt load is controlled, essentially, by the sodium and the chlorides which constitute the dominant ions, and which have for origin the dissolution of the halite present in the salty deposits of surface.

This study also demonstrates the usefulness of multivariate statistical analysis in groundwater study as a supplementary tool for interpretation of complex hydrochemical datasets.

**Keywords:** *ground-water of Mateur -Tunisia - Water Geochemistry - statistical study*

## Mechanisms of Changes in Quality of the Shallow Aquifer in Desert Climate (Northern Sahara, Algeria)

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The shallow aquifers may be the seat of action evaporating climate and anthropogenic actions (pollution from agricultural, domestic or industrial). Thus, in desert regions, evaporation of waters leads to an increase in their mineralization. However, this action is dependent on the position of the surface of the water versus the interface soil/atmosphere.

The objective of this work is to identify the mechanisms responsible for changes in shallow groundwater quality of Saharan area of Algeria, especially to allow for individualized the related mechanisms to the arid climate and human actions.

The study of the shallow aquifer in the region of Ouargla showed that the concentrations of major elements dissolved were governed by an interaction of many factors and mechanisms. These mechanisms are very diverse nature.

The arid climate character induces a high concentration of waters from the shallow aquifer, causing the formation of brines solutions. The physicochemical mechanisms that result are ionic exchanges (sodium/calcium), successive precipitation of calcite, gypsum, or mirabilite blœdite and halite. The footprint of the biological processes leads high variability of the CO<sub>2</sub> load. These biological processes are responsible for an inverse relationship between atmospheric CO<sub>2</sub> and O<sub>2</sub>.

Thus, the mechanisms responsible for the variability of water chemistry are many, nature and intensity vary widely. They are sometimes confused for example carbonate equilibria, the partial pressure of CO<sub>2</sub> is influenced by biological activity and temperature.

## Modeling of GPR Measurements for Imaging the Water Content of the Soils

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Ground penetrating radar (GPR) is a non-destructive method, which, as with other geophysical methods, has been successfully used to estimate the water content or hydraulic properties of soils (Loeffler and Bano, 2005). This method based on electromagnetic wave propagation, can provide very detailed and continuous images of the sub-surface (Davis and Annan, 1989, Annan, 2002). Since GPR is highly sensitive to the presence of water in the soil, the method has been used successfully in hydrological investigation to locate the water table and to delineate shallow, unconsolidated aquifers (Beres and haeni, 1991; Van

Overmeeren, 1994). Recent case studies have shown that GPR is an efficient method to estimate the water content of the subsurface by using the velocity of radar waves derived from common midpoint (CMP) profiles (Greaves et al, 1996; van Overmeeren et al, 1997; Garambois et al, 2002; Loeffler, 2005).

This work concerns the hydro-geophysical study of a small water catchment called “La Soutte” site, in the North-East of France. It is located at about 35 km South-West of Strasbourg, in the area of the Champ-du-Feu Mountains, at the coordinates: 48° 19'30” of latitude and 7° 19'30” of longitude, and at 950 m above sea level.

The GPR measurements were performed with the RAMAC/GPR system (Mala Géosciences, Sweden). We used 100 Mhz and 200 Mhz shielded antennas. The objective of this work is to develop methodology for determining the water content from GPR measurements; and, test several methods for estimating the error on velocity computation radar waves. The calculation velocity of electromagnetic waves in soil is necessary to estimate the dielectric permittivity, which will be used to determine the water content of the medium through the empirical model of Topp (Topp and al, 1980). To determine the error on the calculated velocity, we use three different methods. The error value obtained is about 0.003 m/ns.

This work show that GPR is an efficient method to estimate the water content of the subsurface, by using the velocity of radar waves derived from common midpoint (CMP) profiles.

## P2-6

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### **Modelling the Propagation of the Submersion Wave in Case of a Dam Break. Case Gargar Dam (Algeria)**

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The break of a hydraulic structure is an exceptional event but sometimes considerable magnitude. This event is of significance that can be known to cause extensive damage. To assess the impact and risk of spatiotemporal this break, it is necessary to know the extent of flooded areas in the valley downstream of structure and time of arrival of wave power for judge whether the safety of lives, living in the vicinity of the dam is taken into account.

Following the rupture of a dam, it forms a zone of discontinuity in severe turbulence before the area where the flow is not permanent. It is a hydraulic phenomenon outside of the equations of Saint-Venant. It occurs when switching from a hydraulic system to a torrential river water regime and results in a rapid change in water level accompanied by a loss of energy. The height of the wave front is approximately 1 / 3 the height of the dam, but it decreases rapidly with distance from the latter. The characteristics of the wave allows for solutions with discontinuities satisfying relationships so-called Hugoniot–Ranking.

The work is complemented by the use of the Castor software, which simulates the propagation of the wave of flooding at the dam and represent it with maximum impact with regard to water levels, speed and propagation time.

**Keywords:** Modeling, risk, dam break, hydraulic structures, flooded areas, Gargar

## Rationalization and Optimization of the Basic Hydrological Networks Sebou Watershed Case (Morocco)

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The Sebou River, which produces nearly a third of the surface waters of Morocco, has its source, under the name of Guigou River, in the Middle Atlas at an altitude of 2.030 m. It travels through a length of about 500 km before reaching its outlet in the Atlantic Ocean, near Kenitra city, and draining an area close to 39.000 km<sup>2</sup>. Along its route, the Sebou River intercepts several tributaries from diverse regions; the most important are the Ouergha, Inaouene, Leben, Beht and Rdom rivers.

Rainfall data are the foundation for all hydrologic studies (climate statistics, planning and management of water resources, delineation of flood zones). However, the precise knowledge of precipitation in a given area requires an extensive and well distributed, observation network. The importance of this network is often a compromise between accuracy and the desired management and budgetary constraints.

The methodology of proposed rationalization is mainly based on the application of statistical approaches for assessing the relevance of a network of stations statistical point of view and removes the station where this is unavoidable.

The observational network is characterized by a density of rainfall stations satisfactory. It contains more than 164 stations, the equivalent of a position for 250 km<sup>2</sup>. However, the network of observations in the study area is denser in plain than mountain (altitudes above 2.100 m are not documented). For the evaluation of data requirements, it is important to use techniques such as geostatistical kriging which allowed us to characterize the distribution of rain. Results from the 112 stations surveyed were in favor (with minor exceptions) with a division of the Sebou watershed in 4 large homogeneous areas that can describe a relevant variability of annual rainfall in the basin.

These areas are:

- Upper and Middle Sebou basin and the basin of Beht,
- Inaouene basin,
- Ouergha basin,
- Lower Sebou basin.

## Reducing Pollution Risks for the Water Supply of Beirut in a Karst Aquifer

**MARGANE A. & MAKKI I.**

In the Nahr el Kalb catchment, north of Beirut, groundwater protection measures will be implemented in the framework of Technical Cooperation, using the following components:

1. Integration of water resources protection aspects into the investment planning and implementation process in the wastewater sector (advice to Financial Cooperation)
2. Integration of water resources protection aspects into land-use planning
3. Collection and use of monitoring data concerning quality and quantity of water resources
4. Support of the partner institutions concerning the implementation of urgent protective measures

On purpose the German funding agency has commissioned two projects for achieving the same goal:

- A financial cooperation project which will establish decentralized wastewater collection and treatment facilities (implemented by KfW) and
- A technical cooperation project which will carry out the above mentioned tasks (implemented by BGR).

In many countries water resources protection is often neglected in the planning and design process of wastewater projects and water supply and wastewater issues are not dealt with in a holistic approach. It is therefore recommended to follow such a comprehensive approach in all wastewater projects.

## Some Problems of Irrigation Water Management in Low Cheliff Plain (North-western of Algeria)

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In the Low Cheliff plain (north-western of Algeria), the waters resources are limited, and the adoption of a rational approach in the management of irrigation water in the irrigated perimeter poses an inequality in the balance between supply and demand. The two surface water resources, Gargar and Merdjet Sidi Abed dams, does not satisfy the requirements agriculture water. According National Office of the Irrigation and Drainage data, the quantity of allocated water is never distributed; the difference between allocated water and drop water can also exceed 20 %, and then, another problem of management is that of the water losses in the distribution which can to reach the 20% again.

The shortage irrigation water resource allocated has constrained the farmers to use groundwater. The chemical analysis of 56 samples to this water showed a significant chemical diversity in the compositions. There have a high salinity risk (C3 class) or very high risk (C4 class) of soil salinization. A space chart distribution to the EC water probability to exceed 2.25 dS/m interpolated by the indicator kriging method showed that 78 % of the groundwater surface presents a significant probability to exceed this limit. The average value of the SAR is lower than 10 ( $\text{mmol}_c / \text{L}$ )<sup>0.5</sup> that indicate a moderate risk of sodization. This observation is in contradiction with the high values of the SAR measured in the soil solution. The

evolution to the irrigated soil was explained by the positive value of the residual sodium carbonate (RSC) value to the water and the high risks of sodization and alkalization to this irrigated soil.

**Keywords:** Management of the E with, irrigation, krigeage of indicatrixes, SAR, residual alkalinity.

## P2-10

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# The Environmental Rangers in Jordan: General Tasks and Mission and Specific Roles in Water Resource Protection

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### 1. Introduction and Background

With The Endorsement of His Majesty King Abdullah II, the Environmental Rangers Department was established on 15<sup>th</sup> June 2006 and begun to operate 3 months later. On 15<sup>th</sup> December 2008 it became the Royal Department for Environment Protection (RDEP). Being a unique institution in Jordan – and perhaps in the region - the Rangers are the executive arm of the Ministry of Environment (MoE). Administratively the Rangers are a unit of the Public Security Directorate (PSD). They act on directives from the MoE; they bring violator of environmental laws to the court and enforce court decisions. The Rangers are operating in coordination and cooperation with nine strategic partners consisting of govt. institutions and environmental conservation organizations.

Today about 650 officers are assigned to 15 branches in the Kingdom. Since the end of 2009 a technical adviser from the German Development Service (DED) is supporting the Rangers in the fields of:

- Institutional support and liaison with strategic partners
- Identification and documentation of water pollution
- Preventive measures in water protection zones
- Data acquisition and processing
- Awareness creation

### 2. Goals and Mission of the Royal Department for Environment Protection

The mission of the Rangers is to improve the quality of Jordan's environment through proper and effective enforcement of environmental legislations, enhance cooperation with and between relevant authorities, and increase national support and advocacy for environmental issues. To achieve the goal to reduce damages on the Jordanian environment and its elements, the Rangers need to develop partnerships with governmental and civil society organizations to enforce environmental legislations.

### 3. Tasks and duties in environmental protection

Due to the steadily increasing number of officers, the total number of pursued cases of environmental violations has increased from 7781 in 2007 to 52072 in 2009. The Rangers conduct their duties jointly with representatives from the partner institutions. These duties comprise:

- Control of acts which constitute a violation of the environment laws and take legal action against the perpetrators

- Implement decisions of the competent ministries on removal of environmental violations/hazards and precautionary closure of facilities
- Control irregularities on grazing, logging, over-fishing and encroachment on wildlife, marine and forest resources
- Control the import of environmentally harmful materials through border posts
- Controls of vehicle exhaust fumes
- Protection and control of natural and pastoral reserves
- Handover of cases and evidence to the responsible courts
- Support ministries and other partners with campaigns and the dissemination of materials on awareness creation
- Participation in seminars and conferences

#### **4. Roles and activities in Water Resources Protection**

Water is a limiting factor in Jordan's development efforts. Natural factors such as arid to semiarid climate as well as demographic changes (caused also by migration intake), socio-economic growth and the subsequent intensification of irrigated agriculture are all aspects that strain a sustainable management of scarce water resources in the country. To ensure that drinking water of good quality and sufficient quantity is made available to the people of Jordan, all water resources have to be protected efficiently.

Hereby the Rangers are cooperating closely with the Environmental Health Directorate and the Ministry of Water and Irrigation; in particular they are involved in the Water Aspects in Land Use Planning Project of the MoWI and the German Federal Institute of Geosciences and Natural Resources (BGR). One major role of the Rangers in this project is the support of the implementation of regulations in the groundwater protection zones through patrolling and awareness creation.

Institutionally this is done through a Water Resource Protection Team at the Rangers' HQ in Amman. The team is directly supported and coached by the DED adviser in the subjects of Hydrology and the application of GPS and GIS. It acts as an extension team for the branches in the whole Kingdom.

P2-11

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## **Tracer Tests as a Means for the Delineation of Groundwater Protection Zone in the Nahr el Kalb Catchment**

**DOUMMAR, J & MARGANE, A.**

Within the framework of the German-Lebanese Technical Cooperation Project Protection of Jeita Spring, groundwater protection zones for all major springs and wells in the Nahr el Kalb catchment will be delineated. The groundwater system consists of two limestone aquifers, which are highly karstified. The delineation process requires conducting tracer tests in order to assess hydraulic connections and flow velocities in the unsaturated and saturated zones. Another objective of these tracer tests is to evaluate possibilities for establishing wastewater treatment plants in the catchment without endangering the drinking water supply schemes based on four springs in the catchment. Therefore the project closely cooperates with all national and foreign institutions involved in the planning of wastewater projects in the catchment. Several tracer tests have been conducted until now showing that flow in the saturated zone is extremely fast. This makes it necessary to review the present planning for wastewater projects in the catchment.

## Water Resources of the Saharan Basin (North Africa): The Use of Environmental Isotopes

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Due to constant demographic growth and agricultural growing demand for irrigation water, the inescapable use of groundwater has continuously increased during the last forty years in North African arid and semi-arid regions. Some of these areas are known to comprise worldwide and in many locations huge underground water reserves. This is the case of the large confined aquifers of well-known sedimentary basins such as those of the Sahara desert (North Africa) and Australia (Great artesian basin).

For the sake of integrated groundwater resource management, hydro-geologists and water managers have constantly been worried by the same question that is: what are the evaporative losses and the recharge rates of those huge aquifers?

In addition to the technical and the logistic constraints related to the nature of these regions, they are also characterised by extreme climatic conditions. Whereas conventional techniques often failed, it is surprisingly in such precipitation-poor environments that isotopic tools have proven their efficiency in tackling groundwater issues. Arid zone isotope hydrology has gained more and more importance during the last three or four decades.

The isotopes results presented in this paper consist to review the contribution of this methodology as applied to the ground-waters occurring in the north western part of the Sahara sedimentary basin (North Africa). Water transfers through the unsaturated zone were investigated in order to compute steady-state groundwater recharge rates, evaporative losses, leakage between aquifers and origin of the water etc.

Many sites have been investigated during the last twenty years: Béni-Abbès, Chott Chergui, Ouargla, El-Oued in Algeria and Tozeur, Dissa in Tunisia within the framework of separate studies. These investigations aimed at estimating evaporation rates based on unsaturated zone stable isotopes profiles. This was implemented making use of the deterministic model developed by Barnes and Allison (1982). The evaporation rates obtained for a 10 m unsaturated soil profile varied between 1 and 10mm/a. These results were found in the same range as those obtained elsewhere in other arid and semi-arid locations of the world. The extrapolation of these rates to the scale of the whole studied aquifers is sought as possible.

**Keywords:** *Evaporation, stable isotopes, aquifer, modeling, Sahara*

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## P2-13

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### Water Resources Protection Zone Delineation in Jordan

**MARGANE, A. & SUBAH A.**

Within the framework of German-Jordanian Technical Cooperation Projects groundwater major efforts have been undertaken over the past 15 years to protect the country's ground and surface water resources. Several protection zones for major springs and wells in the country have been delineated and until now around one third of Jordan's drinking water resources have been placed under protection using a national guideline for protection zone delineation, proposed by the project. The success of the project is based on a general integration of aspects of groundwater protection into land-use planning, with a focus on wastewater projects, where often in the past coordination had been lacking.

Important factors in this respect were:

- The proposed land use restrictions must be legally binding;
- The decision makers and the local population must be made aware of the facts that there is a water resources protection zone and that they have to change their behavior;
- Local land-use plans must be adapted to the new land-use restrictions;
- The implementation of land-use restrictions must be controlled (this is facilitated in Jordan by the cooperation of water institutions with so-called Environmental Rangers, a special police task force).

## Water Supply of the Abbasid town of Kharab Sayyar in the Syrian Gezira

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Ever since, colonization of the semi-arid Syrian Gezira is limited by the availability of water. Today the groundwater table in NE Syria lies very low and is dropping rapidly because of accelerated water withdrawal. However, the water situation in ancient times was presumably not different from the actual one, which is characterized by winter rains and long dry periods during summer.

Kharab Sayyar is situated in NE Syria between the Euphrates' tributaries Khabur und Balikh in a flat treeless steppe with annual precipitation of approx. 150 mm and a mean annual temperature of 20 to 25 °C today, which is comparable with early medieval times. The region is built up by tertiary marine sediments and is covered by the so-called Lower Fars which has been deposited during the Miocene under lagoonal conditions consisting of anhydrite, gypsum, halite, limestone, dolomite and marl.

Soil development took place during the upper Pleistocene in fluvial and alluvial deposits as well as in a silty pleistocene coverbed which overlays the tertiary sediments. The site is situated at the confluence of two minor wadis which are tributary to the Wadi Hamar. Water discharge in the wadis is restricted to a short period in wintertime. Nowadays, mechanized rain-fed agriculture is widespread, besides nomadic sheep farming.

How could an Abbasid town like Kharab Sayyar in a semi-arid area sufficiently manage to supply roughly two thousand persons a day, plus hundreds of animals, also having a big mosque and a hamam?

Huge water reservoirs in public buildings, open basins within and outside the town as well as cisterns in private houses imply the necessity to store water for extreme dry seasons. The filling of these reservoirs was managed by collecting surface water from overland flow as well as from roofs and yards. To date, six open water reservoirs, two double cisterns at the eastern town wall, and a chain of open basins (birkeh) outside the western town wall have been found. A canal of 2.4 m width and 40 cm depth in front of the town wall probably served as a collecting and piping system during the rainy season. Also wells have supported to feed the reservoirs. In some of the excavated wells the water table was met in a depth of 5 to 6 metres. Whereas private houses had an autarchic system of water supply, public buildings were fit in a complex system of canals for supply and discharge of water. For example, there is a supply canal below the mosque and a drainage canal under the main bazaar road.

Finds of irrigated cereals show that food supply in early medieval times may have been guaranteed by a field system with small dams where the fields were waterlogged in the rainy season. However, it could not be proofed so far whether the shallow colonial deposits arose from old or actual deposition of soil material in the wadis. Morphologically, there was no evidence for dams in the two wadis. Modern ploughing may have evened the surface and mixed up older colonial deposits.

## Aggregate Stability as an Indicator of Soil Crusting, Soil Erodibility and Sediment Characteristics for Inter Rill Erosion

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Crusting and erosion of cultivated soils result from aggregate breakdown and the detachment of soil fragments by rain, and the susceptibility of soil to these processes is often inferred from measurements of aggregate stability. Here, theories of aggregate breakdown are reviewed and four main mechanisms (i.e. slaking, breakdown by differential swelling, and mechanical breakdown by raindrop impact and physico-chemical dispersion) are defined. Their relative importance depends on the nature of the rain, as well as on the soil's physical and chemical properties. The relations between aggregate breakdown, crusting and water erosion are analyzed, and existing methods for the assessment of aggregate stability are reviewed. A unified framework for the measurement of aggregate stability is proposed to assess a soil's susceptibility to crusting and erosion. It combines three treatments having various wetting conditions and energies (fast wetting, slow wetting, and stirring after pre-wetting) and measures the resulting fragment size distribution after each treatment. It is designed to compare different soils, or different climatic conditions for a given soil, not to compare time-dependent changes in that soil.

**Keywords:** Aggregate stability, crusting, erosion, and methodology.

## Analysis and Treatment of Ozone (O<sub>3</sub>) on a Site Located in Annaba

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The development of research in physical-chemical, toxicological and epidemiological domains constitutes a basic understanding first, then the treatment and finally designing the means of struggle against the increasing problems related to pollution and the environment.

Our work fits well within the framework of research in physical chemistry of the atmosphere and its main purpose the analysis and treatment of a pollutant oh so bad for humans, animals plants and property materials namely ozone (O<sub>3</sub>) tropospheric on a site located in Annaba.

The study is the comparison of two episodes of ozone pollution, to identify correlations of ozone with its precursors, including NO, NO<sub>2</sub> and CO, to present the evolution of ozone during these episodes and site characterization. This work should lead subsequently to the suggestion of a mathematical model for predicting the site in question.

**Keywords :** Atmospheric pollution, tropospheric ozone, precursors-ozone correlation.

## Assessment of the Effect of Waste Incineration on Environment, Case of Meknes Mohamed V Hospital, Morocco

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The Mohamed V hospital in Meknes is one of the biggest public health institutions with a real capacity of 531 beds among which 416 are functional; it serves a whole population on a regional scale; hence the importance to take it as model in the studies concerning the impacts of the hospital waste on the environment.

This hospital counts among the rare Moroccan public health institutions which insure the management of their solid waste of activities of care, mainly by incineration. The incinerator has the advantage of reducing considerably the volume and the weight of the waste of care activities, however it has the inconvenience also to release poison gases that could pollute the environment especially if it is not endowed with a well suited filtering and if it is not subjected to an adequate maintenance; which is the case for the ex-incinerator of the studied hospital. Indeed, the deterioration of the chimney containing the filters of the incinerator was at the origin of a permanent and excessive release of harmful smokes. The most dangerous gases released as a result of this kind of treatment are dioxins and furanes. The most affected environmental compartments are the ground and the air. Besides, dioxins are very persistent in grounds (approximately 10 years for 2, 3, 7, 8 - TCDD) and concentrate in their superficial side (generally within 10 cm situated below the surface). Consequently, they can contaminate human through the food chain by presenting an extreme danger for its health.

By the present study, we are going to try to analyze the ground of this hospital in the neighborhood of the ex-incinerator to look for dioxins. The involved technique is the chromatography in gaseous phase connected to the mass spectrometry, which constitutes the most sensitive method of choice to detect and quantify dioxins and furanes to the state of tracks.

**Keywords:** Hospital waste, incineration, dioxins, furanes, soil.

## Assessment of Tires Waste Disposal Processes in Gaza Governorates

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Tire waste and its disposal is a worldwide problem. Tires are not biodegradable; hence the time required for their decomposition is undetermined. Due to their chemical composition, when tires are burnt, they release organic and inorganic pollutants to the air and soil, including hydrocarbons, dioxins, and other toxic substances. Tire disposal requires special and expensive technology. The purpose of this research is to assess the current situation of waste tires disposal process in the Gaza Governorates, in order to provide data base for future interventions. The study was carried out through tow questionnaires that targeted the owners of the tires repair-shops and the professionals working at relevant local institutions, over a period of three months. The total sample was 101 owners of tires' repair-workshops and sixteen

professionals from different ministries and municipalities. The study illustrates that in Gaza governorates there are weaknesses in all stages of the waste tires management process which includes collection, storage, transportation and treatment. The study revealed that there are no activities done in the fields of recycling and energy recovery. The absence of a national strategy for waste tires management is represented in the lack of cooperation among the institutions who issue the work license and the repair-shops owners. No specific regulation had been developed, absence of database system and no enforcement activities from the government to regulate this field. The absence of monitoring system for the waste tires disposal activities is an additional weak point that makes the possible alternative methods for end use of waste tires difficult to implement. There is a potential for future waste tires industry in Gaza since there is about 250,000 tires or more that can be collected every year. This study is the first to be conducted in Gaza Governorates and provides first-hand data in the field of waste tires disposal process. It's recommended that an integrated process for waste tires management including establishment of new collection system, storage facilities, cooperation among the stakeholders, treatment options and the bylaws for waste tires disposal. Among the recommended treatment options are reuse and recycling of waste tires in several fields such as engineering constructions and recreational areas.

## P3-5

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### Combustible Effects From Spark Ignition Engine in Air Emissions: Experimental Study

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This study consists of the effects of two combustibles either on the efficiency of spark ignition engine or on emission profiles, and their impact on air pollution. These fuels consist of hydrogen in methane mixture and pure methane. The mixture is poor since the range of equivalence ratio varies from 0.5 to 0.7 and the engine load takes, respectively values of 0%; 40%; 50%; 80%; and 100%. These investigations are obtained at various engine loads working at 1500rpm. Hydrogen in methane mixture is considered as a basis of comparison. The results show that the addition of hydrogen in methane combustible gives practically the same engine efficiency than that in the pure methane at any value of engine load, and the volume flow rate consumed is somewhat more than in the methane combustible. Outlet engine temperature decreases consequently in hydrogen mixture of about 20°C. It is observed also a decrease of concentrations either in noxious gases such as NO<sub>x</sub>, and NO<sub>x</sub>, or in greenhouse gases such as carbon dioxide and an increase in other hydrocarbons C<sub>x</sub>H<sub>y</sub>.

**Keywords:** *hydrogen, methane, efficiency, indirect injection, spark ignition engine, pollutants.*

## Contamination of the Global Environment by DDT 1950-2000

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Dichlorodiphenyltrichloroethane (DDT) is an insecticide which was first applied in the late 1940s and until the 1970s in large amounts in agriculture worldwide, approximately 1.5 Tg. From old stocks, due to illegal use, as impurity of another pesticide (dicofol), and for vector control purposes (exemption to the Annex of the Stockholm Convention for some 20 countries) this insecticide of the first generation is currently at least regionally increasingly introduced into the environment. DDT and its metabolites are persistent and accumulate far away from the emission areas, for example in the Arctic. The global distribution is poorly characterized and the total global 'life cycle' had not been described comprehensively so far.

The global distribution and fate of DDT was modeled for the first time using a spatially resolved global multicompartment chemistry-transport model comprising a 3D coupled atmosphere and ocean GCM, coupled to 2D vegetation surfaces and top soils. Only DDT application in agriculture could be considered, while emissions from vector control and illegal use were neglected. Final sinks of DDT in the total environment are degradation in air (hydroxyl radical reaction), on vegetation surfaces, in ocean sediments and soils.

The residence times in various ocean basins were declining but varied regionally. The global ocean absorbed until 1977 and since then has been losing DDT, while large sea areas are still accumulating the pollutant. The main sink is volatilization to the atmosphere. In 1990, the year when emissions ceased, 292 kt of DDT were deposited to the global ocean, 301 kt were volatilized, and 41 kt were exported from the surface layer to the deeper levels. The sea region that has been representing the most significant (secondary) DDT source is the western N Atlantic (Gulf stream and N Atlantic Drift regions). It has been a source since approximately 1970. Also large parts of the tropical ocean and the southern midlatitude ocean have turned net volatilizational (i.e., volatilization flux > deposition flux) during the 1980s. Despite the emissions migrating southward as a consequence of substance ban in mid latitudes, the geographic distribution of the contaminant (and, hence, environmental exposure) has been migrating steadily northward since the 1960s.

## Contribution to the Evaluation of Polycyclic Aromatic Hydrocarbons (HAP) for Atmospheric Particulate by Chromatographic Methods

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Urban air of cities knows a real pollution due to increasing emissions from human activities which are multiple: motor traffic, incineration of garbage and a less important cause the extent of fast food and heating home. In these emissions we find the organic and inorganic compound that can be carcinogens and therefore harmful to human's health and the environment in general.

Moreover, growing interest is focused on a specific family of organic pollutants: the polycyclic aromatic hydrocarbons (PAHs), which are associated specifically with fine particles in the breathable fraction of air breath by humans and can reach the pulmonary alveoli. On the other hand, PAHs and their derivatives are recognized as compounds carcinogenic or mutagenic to human, thereby their determination in urban air is required.

The present work is focused on the pollution posed by polycyclic aromatic hydrocarbons (PAHs), their relevance in term of science, is their analytical study, as they are found in trace amounts, that doesn't make them always easy to evaluate with precision. It is important therefore, to look for sensitive, simple and quick methods for their identification and quantification.

A study on the ground is perform by sampling particulates found in Algiers's urban air and then analysed by liquid chromatography (HPLC), and chromatography gas coupled with mass spectrometry.

The sites selected are street Audin, the tunnel faculties of Algiers, the road east of Algiers, and exhaust from two vehicles in stock Diesel (old and recent), the purpose of this study was to determined by HPLC, the levels of PAHs found in considered sites. The results show that Algiers's urban air is found to be polluted by very divers particles found in alkanes, aromatics and alcohols. Levels of the major PAHs (pyrene: 8.76ng.m<sup>-3</sup>; benzo (a) pyrene: 1.9ng.m<sup>-3</sup>; chrysene: 4.1ng.m<sup>-3</sup>) encountered in urban air of Algiers are comparable to those of European cities of similar scope and come mainly from traffic.

These pollutants degrade in the atmosphere giving oxygenates or nitro, which are more carcinogenic than the primary pollutants. Their analysis obtained by HPLC showed that their concentrations are higher in winter and carcinogenic substances such as chyséne or benzo (a) pyrene are present in urban Algiers's aerosol.

**Keywords:** PAHs, organic matter, atmospheric chromatographic analysis.

## Determination of Heavy Metals and Trace Metals in Ground Water and Soil in Libya by Flame AAS for Heart and Diabetics Diseases

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Libya depends on ground water, rain water and desalinization program (to be started). Our research was to assay the levels of copper, lead, cadmium and other metals in ground water and in soil. Correlation of these metals was investigated by using different sites and locations. Different extraction methods were used and EDTA was proved to be a good extracting of metals from soil. Different methods were used and discussed. Different cities in Libya were compared to find correlation between levels of calcium, magnesium, and other trace metals, the correlation between trace metals and incidence of diseases such as heart and diabetics were found, which exists in large number in Libya.

## Exploitation of the S.I.G for Vulnerability Assessment of the Pollution of Groundwater, Layer of Fez-Meknes by Methods DRASTIC, PRK and GOD

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The sub-basin Saïss is part of the Watershed Sebou, it extends over a length of 1000 km and a width of approximately 30 km. North it is bounded by the Prerif, east by the valley of the Wadi Sebu, in the west by the tributaries of the wadi Beht and south by the Middle Atlas Causse. This basin includes two structural units, the plain of Saïss east and the plateau of Meknes to the west of.

The basin of Saïss contains two layers which are uneven:

- Groundwater flowing through the sands, conglomerates and lacustrine limestone areas in the Plio-Villafranchian (which is the subject of this study)
- The deep aquifer that flows in the dolomitic lime-stones of the Lias and starts to charge under the thick series of Miocene's impenetrable marls.

These two layers communicate through places, through the flexures and faults or indirectly by draining bottom.

In hydrological terms the pool of Fez-Meknes has a water system that is poorly developed, due to its karstic nature Tabular Middle Atlas, and contains many wadis, springs and days.

Our study aims at assessing the vulnerability of aquifers in this area (Fez-Meknes). It measures the sensitivity of water resources to pollution from the surface, three methods (DRASTIC, GOD and PRK) have been implemented to be compared.

## P3-10

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### **Nitrated Pollution in Groundwater of the Semi-arid Zones - Case of the Valley of Western Middle Cheliff (Northern Algerian)**

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Agriculture is the dominant activity in the valley of Western middle Cheliff (Northern Algerian). The agricultural land surface constitutes 67% of the total of which 65%, either 11700 ha, are irrigated effectively. The main cultures are arboriculture and the garden farming; this last is a large consumer of the nitrogen fertilizer type. We mention particularly the NPK 15/15/15, the urea (46%) and the sulphate of ammonium (21%).

The agricultural and other practices adopted in the valley contribute extensively in the enrichment of its soils in nitrogen. Indeed, besides irrational nitrogen fertilization carried out on the near total of the speculations by the agriculturists, the irrigation of the garden farming is carried out from the wells whose water is excessively rich of nitrate.

The appraisal of the mineral nitrogen contributions for the year 2004 shows that 97% of these last come from fertilizers against 3% only result from water of irrigation. As for the organic nitrogen contributions, the breeding constitutes the dominant share (95%) compared to the domestic wastewater (5%). The quantification of the annual nitrogen rate (mineral and organic) has enabled to identify the origin of the pollution of the groundwater by the nitrates. This pollution is essentially bound to agriculture and more especially to the nitrogenous fertilizers; the yearly nitrogenous excess that ensues is 238 kg /ha.

**Keywords:** pollution, groundwater, nitrate, fertilization, irrigation, breeding, wastewater, Algeria.

## P3-11



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### **Optical Properties Calculation of Crystalline Nitric Acid Hydrates and Ammonium Nitrate Using Ab Initio Molecular Dynamic Methods**

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Atmospheric aerosols are important precursors for the formation of larger particles which are known to strongly influence global climate, atmospheric chemistry, visibility, transport of pollutants and biological nutrients. In addition, they play critical roles in the deleterious human health effects associated with air pollution. They affect climate through scattering, transmission, and absorption of radiation as well



as by acting as nuclei for cloud formation. Thus, nano-scale active sites on surfaces influence particle phase transitions through heterogeneous nucleation. Spectroscopic studies of fundamental properties of atmospheric aerosols are essential for the understanding and quantification of climate change. The present work focuses on fundamental molecular and bulk material properties relevant to atmospheric aerosols and indirectly to the stratospheric ozone chemistry. Our emphasis is on the study and character of crystalline nitric acid hydrates present in polar stratospheric clouds (PSCs) and ammonium nitrate aerosol.

The vibrational spectra of crystalline nitric acid hydrates have been investigated at the periodic ab initio quantum level by using a high quality Gaussian type basis set and the hybrid B3LYP Hamiltonian with CRYSTAL06 code. Using as input the X-ray structures of crystalline nitric acid monohydrate NAM, dihydrate  $\alpha$ -NAD and trihydrate  $\beta$ -NAT, the inner coordinates within each unit cell have been optimized. The calculated structures of these atmospherically relevant systems are used in the evaluation of their vibrational normal modes. The full set of the obtained frequencies show in global a good agreement compared to the observed spectra in the range 4000- 600  $\text{cm}^{-1}$  and 200-20  $\text{cm}^{-1}$  for infrared and Raman spectra respectively.

Absorption, Scattering coefficients and dielectric constants calculations were performed in the temperature range 255-305 K for two pressures ( $10^2$  and  $10^5$  GPa) using the CASTEP software package. This program evaluates the total energy of periodically repeating geometries based on ab initio density-functional theory and the pseudopotential approximation. Periodic boundary conditions are used, with the occupied electronic orbitals expanded in a plane-wave basis. A gradient corrected form of the exchange correlation functional (GGA) was used. The nitrate ion exhibits a characteristic UV absorption spectrum consisting of a strong band around 180 nm and a considerably weaker absorption around 300 nm.

**Keywords:** PSCs ; aerosols ; ab initio ; molecular dynamic ; climate change

## P3-12

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# Photocatalytic Oxidation of Chlortoluron in Water Suspension in a Helical Reactor

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Chemical compounds especially phenyl-urea derivative pesticides, are used in large quantities as herbicides, they are a class of pesticides of growing importance. Because of their higher toxicity, these products are an urgent problem for which remedial measures need to be found.

Among this group of pesticides, chlortoluron is an herbicide currently used in Algeria. In spite of its high herbicidal activity, the use of this urea herbicide is no without danger due to its fairly high water solubility, and becomes as persistent water pollutants. This herbicide being a biorecalcitrant compound, its destruction needs a modern technique as a photocatalytic oxidation process (an advanced oxidation process). This method based on photocatalysis using  $\text{TiO}_2$  suspensions is particularly attractive for removing organic pollutants from water because it can destroy toxic and hazardous contaminants, not simply transfer them to another phase. The  $\text{TiO}_2/\text{UV}$  process is known to have many important advantages, and, the end products of this process are carbon dioxide, water and inorganic mineral salts. In this process, titanium dioxide is the most widely used photocatalyst for organic photodestruction due to its high catalytic activity, stability in acidic and basic media and nontoxicity and has been demonstrated to be active in the presence of sunlight.

The degradation of chlortoluron has been studied in a helical reactor in aqueous catalyst suspension of

TiO<sub>2</sub>, the titanium dioxide was exposed to UV radiations to generate reactive HO· radicals which induce the herbicide destruction. The chlortoluron photodegradation studied in various operating conditions with an irradiation lamp emitting at 365 nm (18 Watts) was reported. The effects of the recirculation flow, initial chlortoluron concentration, amount of catalyst, suspension pH and the amount of Ca<sup>2+</sup> on the chlortoluron photodegradation were investigated. These parameters were studied to find the optimal conditions for a complete oxidation of this herbicide.

Kinetic experiments were performed at 23°C over a range of herbicide concentrations from 10 to 100 mg L<sup>-1</sup>; a range of TiO<sub>2</sub> concentrations from 0,2 to 1,4 g L<sup>-1</sup>; a range of flowrate recirculation from 0,074 to 0,36 L min<sup>-1</sup>; a range of suspension pH from 3 to 11; and a range of Ca<sup>2+</sup> concentration from 0,625 to 5 mg L<sup>-1</sup>.

Results showed that the efficiency of the photocatalytic process depended strongly on the experimental conditions. All studied parameters play a significant role in the degradation process, thus, the chlortoluron degradation was more effective with a TiO<sub>2</sub> concentration of 0,9 g L<sup>-1</sup>, a flowrate recirculation of 0,23 L min<sup>-1</sup>, a free pH, in the absence of Ca<sup>2+</sup> ions and a long enough irradiation time.

The rate constants for the different parameters were evaluated. Kinetic studies showed that titanium dioxide photocatalyst P25 was very active in chlortoluron degradation; we observed that 70 % of pollutant was degraded after 7 hours of UV irradiation; furthermore, chlortoluron degradation was more effective under acidic conditions (near pH = 6) and free pH. The kinetics was described by the Langmuir-Hinshelwood (L-H) kinetic model. An overall pseudo-first order kinetic constant has been calculated for chlortoluron conversion and values obtained in acidic pH are higher than those calculated for basic pH media.

**Keywords:** chlortoluron, photocatalysis, TiO<sub>2</sub> suspension.

## P3-13

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# Photodegradation of An Angiotensin-Converting Enzyme (ACE) Inhibitor Using Immobilized Nanoparticles of TiO<sub>2</sub> Supported By Glass Plate

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Pharmaceuticals released in the environment may impose toxicity and end up in soil, surface waters and eventually in ground and drinking water after their excretion (in unmetabolized form or as active metabolites) from humans or animals via urine or feces. In addition to metabolic excretion, disposal of pharmaceuticals which are being used in agriculture, industry, medical treatment and common households, also contributes to the entry of pharmaceuticals into fresh bodies.

Photocatalytic oxidation of pharmaceutical compounds in aqueous media irradiated by UV light is a rapidly growing field of research [1] [2]. Therefore, the treatment technology for degradation of Ramipril using titanium dioxide coated on the supports such as glass plates was performed in this research. Ramipril is widely used in the clinical treatment of hypertension and heart disorders in humans [3]. The photocatalytic degradation of Ramipril using ultraviolet (UV) light source was investigated in fixed bed in which the temperature was maintained at 25°C ± 2.

The application of photocatalytic procedures for degradation of Ramipril have been studied in terms of determination of reaction kinetics, the effect of parameters such as Irradiation time, solution pH, Ramipril concentrations was examined on photodegradation efficiency.



In our experimental photocatalytic processes, it was found that the rate of Ramipril disappearance with UV illumination is higher than that without UV illumination. The degradation of the pharmaceutical compound was a fast process and included the formation of several intermediates. The experiments demonstrated that the change of pH could significantly affect the photocatalysis of Ramipril.

**Keywords:** photocatalytic pharmaceutical, nanoparticles, photoreactor

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## P3-14

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### Prediction of the Toxicity of a Set of Amide Herbicides

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Intensive agriculture employs 90% of current pesticides, based on a range of over 8000 products marketed worldwide. The massive use of synthetic fuels threatens our natural resources and the health of populations.

Pesticides are found in 91% of measurements in water streams and in more than half of groundwater. Between 25 and 75% of the amount of pesticides sprayed are scattered in the atmosphere. Dozens of epidemiological studies show that our bodies are contaminated by pesticides. The lethal dose 50 or LD<sub>50</sub> is a quantitative indicator of the toxicity of a substance. We applied new algorithms: genetic algorithm / multilinear regression (GA / MLR) and genetic algorithm / artificial neural network (GA / ANN) to model the toxicity of 50 herbicides amides characterized by the lethal dose (LD<sub>50</sub>) tested on rats male orally. The QSAR models were established using the multilinear regression analysis and / or neural networks standard 3 layers, with backpropagation learning algorithm of the gradient (Levenberg-Marquard). The 50 data were randomly split into two disjoint sets, invariant for all models: a core set of 40 compounds used for the calculation and, possibly, testing of the model; and a set of 10 compounds for external predictions.

Theoretical molecular descriptors were calculated using commercially available molecular modelling softwares. The model size was determined by optimizing the FIT of KUBINYL, and the selection of the descriptors realized by genetic algorithm.

Values obtained for the statistical parameters: R<sup>2</sup>, Q<sup>2</sup>, Q<sub>ext</sub>, SDEC, SDEP and SDEP<sub>ext</sub>, attest relevance of the models developed, with a clear superiority for the artificial neural network models.

**Keywords:** Herbicides – Toxicity – Lethal dose50 – Linear and nonlinear hybridic models.

## Public Concerns about Existing Dumping Sites and Attitudes towards the Selection of Sanitary Landfill Sites

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There are more than 150 unsanitary dumping sites randomly located in the West Bank of Palestine. The Palestinian localities have disposed their solid waste everywhere for the past 40 years in an unplanned fashion. Due to these improper site criteria, social, environmental and health problems have raised from old dumping sites, primarily with those located in or near residential areas. Recently, the Palestinian Authority (PA) started to plan the implementation of sanitary landfills. The purpose of this research, which focuses on three Palestinian districts in the West Bank, is to assess the public concerns about the existing dumping sites and the public attitudes towards the selection of safe sanitary landfill sites.

The interview survey approach through a questionnaire was designed and distributed to a random sample of heads of households. The influences of environmental, social, economic, and political factors were studied. Statistical data analysis was employed to examine trends and relationships between the public responses concerning existing dumping sites and the future sanitary landfills.

The findings of the research indicated that 64.9% of the respondents were aware with dumping sites problems and their impacts with less than 41.6% suffering from the negative impacts of these dumping sites. Environmental considerations were selected as the most important aspect for the landfills according to the sample survey participants. Due to Israeli occupation and the consequent land use limitations in the West Bank, fairness in selecting landfill site was selected as one of the most important social factors for appropriate landfill site selection. It is hoped that this research results will be significant to decision makers in the Palestinian Authority as well as many developing countries.

## Relationships Quantitative Structure-Activity Benzene Derivatives



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During the last two decades SAR and QSAR models have been developed and applied in the estimation of a wide range of chemical properties and biological activities. The first step is to select a significant training set (or test) with well-established data. Subsequently, the appropriate structural parameters (descriptors or molecular properties) are selected to establish the best possible QSAR correlation.

The statistical analysis of all obtained results can then lead to the model or to the required correlation. Before applying this model to estimate the properties or the activities desired on a large scale, it must be validated on a set of representative test.

A hybrid (GA / RNA) QSAR model was developed for the prediction of aquatic toxicity. Data cover 92 substituted benzenes have been separated in two disjointed subsets containing respectively 74 elements for calculus and test of the model, and 18 elements for its external validation. Theoretical molecular



descriptors were calculated using commercially available software of molecular modeling. The size of the model was determined by optimizing the FIT of KUBINYI, and the selection of the descriptors realized by genetic algorithm.

The values of statistical parameters (R2, Q2, Q2ext, SDEC, SDEP, SDEPext) obtained attest relevance of the developed model.

**Keywords:** *substituted benzenes, aquatic toxicity, theoretical molecular descriptors, hybrid GA /RNA model.*

## P3-17

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### **Soil Nitrogen Dynamic in Some Mediterranean Soils: Tunisian Case Study**

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Tunisia (32-38°North; 7-12°East) constituting the upper most part of North Africa on the Mediterranean basin and corresponds mainly to semi-arid and arid climate.

Soil nitrogen dynamic studies in such areas, were rare, but became an up-to-date target to be resolved. Indeed, soil nitrogen mineralization is a key process influencing the accumulation and loss of nitrogen in Mediterranean soils. These various concerns increase today the interest on nitrogen which even comes from the soil itself.

In our research, we have focused on nitrogen dynamic in relation with some pedogenetic processes.

The follow-up on the field of nitrogen evolution in some Tunisian soils was the subject of an experimentation study completed during January May 2005 period.

The results show that nitrogen dynamic was inhibited with low soil moistures and temperatures. This dynamic passes by one or two peak rates during the growing season. Then, it falls down gradually when moisture and temperature continue to increase.

Depth nitrogen results distributions decrease from top to bottom of the profile for all studied soils. In January, the results relating to the ammoniacal form are much more significant than the nitric form. The latter shows, after rainy sequences, values which tend to decrease in surface horizons and to increase in the deepest horizons especially in the hydromorphic soil. In March, nitrogen values reach their maximum then they record a regression which practically spreads for all studied soils in May.

**Keywords:** *nitrogen, mineralization, moisture, temperature, Mediterranean soils.*

## The Perimeters of Catchment Protection of Groundwater in the Region of Tébessa (NE Algeria)

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On the territory of the Tébessa, and unlike other wilaya of Algeria, nearly all of the water supplied, is drawn from groundwater through 100 wells, and contrary to popular ideas, groundwater can be very vulnerable to pollution. Contamination of groundwater response to human activities can cause adverse impacts on the health of populations. A trial design of protection areas of water catchment areas has been applied in the regions of Cheria, El Ma Abiod and Tébessa. (NE Algeria) we took into account the lithology of the studied aquifers (Maestrichtian limestones, marls, limestones of the Eocene, the quaternary formations of Cheria, sandstones and sands in El Ma Abiod region) and the origin of pollutants (Naftal service stations, sewage systems).

On the basis of determining the size, calculated perimeters of catchment are very close to the reality of land above viewpoint vulnerabilities. While the proposed perimeters must therefore ensure optimum security for the protection of the water supplied.

**Keywords:** *groundwater, vulnerability, contamination, water supply, Algeria.*

## Treatment of Landfill Leachate Using Fixed Bed Biomass Process



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Several samples from leachate domestic solid wastes landfill were evaluated. The analysis yielded the following results; very concentrated organic and mineral matter: COD about 4608 mg O<sub>2</sub>/l, BOD<sub>5</sub> of 550 mg O<sub>2</sub>/l and BOD<sub>5</sub>/COD ratio of 0.119; a basic pH of 8.9, total Nitrogen of 1409 mg/l, Ammonium Nitrogen of 300 mg/l and orthophosphates of 47.12 mg/l. These data classify them in intermediate step of their decomposition and exceed the standard norms of rejection in a receiving environment or in a network collector, where the necessity to treat.

A number of leachate treatment techniques have been applied with varying degrees of success, including: Aerobic biological treatment; anaerobic biological treatment; Spray irrigation; Ammonia stripping; Reverse osmosis; and Ozonation. The use of fixed biomass to inert materials could be an alternative to other treatments mentioned. This kind of used process in treatment of domestic wastewaters is regarded as well suited to the treatment of landfill leachate, where simplicity of operation attached to the quality of discharges, is an attractive argument. For this study, we used a fixed bed of sand where the biomass develops in biofilms, where happens the physical and biological processes of pollutant removal.

An experimental unit has been developed to that aim; it consists of two glass columns of sand (fed respectively by the raw and preaerated leachate with a loading rate of 8 L/m<sup>2</sup>/day. The present process yields very satisfactory organic matter removal especially in the preaerated leachate column for which we obtained 79.16% of COD removal, and 50% for the raw leachate column. the performance of nutrient



removal is moderately good, nitrification occurred in sand fixed bed at the temperatures of 25°C within two weeks at the same loading rate. In addition, we reached total elimination of suspended matter that has been retained in the filter pores.

The biological treatment of preaerated landfill leachate on fixed bed of sand is effective especially for the elimination of organic load. However, the effluent treated (COD of 960 mg O<sub>2</sub>/l and BOD of 175mg O<sub>2</sub>/l), still does not satisfy standard norms to reject in a receiving environment or network collector. To improve these results it would be interesting to combine this process with other treatments.

**Keywords:** leachate, landfill, pollution, biological treatment

## P4-1

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### Adsorption Kinetics and Mechanism of Maxilon Blue GRL on Pretreated Coffee Wastes from Aqueous Solutions

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Cationic dyes known as basic dyes are widely used in acrylic, nylon, silk, and wool dyeing. A large volume of dye contaminated effluent is discharged in textile dyeing processes, and 10–15% of the dye is lost in the dye effluent. The colored wastewater damages the aesthetic nature of water and reduces the light penetration through the water's surface and the photosynthetic activity of aquatic organisms due to the presence of metals, chlorides, etc., in them [1]. Removal of such compounds are difficult while many physical and chemical methods including adsorption, coagulation, precipitation, filtration, ozonation, and oxidation have been used for the treatment of dye-containing effluent. The adsorption process provides an attractive alternative for the treatment of contaminated waters, especially, if the sorbent is inexpensive [2]. In this study pretreated coffee wastes by NaOCl was used as adsorbent for the investigation of the adsorption kinetics and isotherms parameters of the basic dye (Maxilon blue) from aqueous solutions at various concentrations (5–25 mg/L), adsorbent doses (4–10 g/L) and solution pH (4–8.5). The result showed that the adsorption capacity of the dye increased with increasing initial dye concentration, adsorbent dose and solution pH. Four kinetic models, the pseudo-first- and second-order equations, Elovich equation and the intraparticle diffusion models were selected to follow the adsorption process. Kinetic parameters, rate constants, equilibrium adsorption capacities and related correlation coefficients for each kinetic model were calculated and discussed. The kinetics of adsorption of the basic dye followed pseudo-second-order kinetics. The adsorption equilibrium data obeyed Langmuir isotherm.

In order to reduce the total number of experiments to achieve the best conditions of the batch adsorption procedure, adsorption of Maxilon blue in aqueous solution by pretreated coffee wastes was studied using Response Surface Methodology. A Box–Behnken design was performed to evaluate the effect of initial dye concentration, initial solution pH and adsorbent doses on the amount of dye adsorbed at equilibrium. Initial pH played the most important effect on the adsorbed amount of Maxilon blue. The linear effect of initial dye concentration, its interaction effect with initial pH and the quadratic effect of pH were shown to be very significant.

**Keywords:** dye, adsorption statistical analysis, low cost adsorbent

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## Biodegradation of P-Cresol by Mixed Culture in Batch Reactor – Effect of the Nitrogen Source, Ammonium Sulfate

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Phenols are distributed either as nature or artificial mono-aromatic compounds in various environmental sites as major pollutants. Their existence in wastes from industrial processes such as oil refineries, coking plants, wastewater treatment plants, petroleum-based processing, phenol resin industry manufacturing and plants, has been well established. Many processes have been used for the remediation of Phenolic compounds. Conventional methods of treatment have been largely chemical or physical, but these processes have led to secondary effluent problems and costly. Biological treatment is an effective method that is used where many micro-organisms can be growing on Phenolic compounds as the sole source of carbon.

The temperature (30°C), the stirring velocity (200 r/min), NaH<sub>2</sub>PO<sub>4</sub> concentration (1 g.L<sup>-1</sup>), KH<sub>2</sub>PO<sub>4</sub> concentration (3 g.L<sup>-1</sup>), MgSO<sub>4</sub> concentration (0.1 g.L<sup>-1</sup>), initial concentration of p-cresol (100 mg.L<sup>-1</sup>) and the initial pH (7) were kept constant; while the initial concentration of nitrogen sources ((NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, NH<sub>4</sub>NO<sub>3</sub>, NH<sub>4</sub>Cl) was varied in the following range, 0 – 2 g.L<sup>-1</sup>. All experiments were carried out at a given initial bacterial concentration, 0.08 g.L<sup>-1</sup> (based on optical density determination, 0.079).

Irrespective of the culture conditions, total p-cresol degradation (100 mg.L<sup>-1</sup>) was recorded for culture time ranging from 32.5 to 49 h. the optimal concentration were therefore, 1 g.L<sup>-1</sup> for all nitrogen sources, leading to a specific growth rate of 0.3 h<sup>-1</sup>. Higher maximum specific growth rate values were recorded during this work, if compared to those reported in the available literature, even those dealing with mixed culture. This result showed the relevance of the specific microbial consortium used.

Two mathematical models were used to describe the rate of cell population increase with times; the growth of cell was fitted using Riccati and Volterra models, all parameters of this models were estimated, the correlation coefficient was varied in the following range, 0.88 – 0.98.

**Keywords:** Biodegradation, Phenol, Microbial consortium, Batch kinetics.

## Effect of Particle Size on Methylene Blue Sorption from Aqueous Solutions by Almond Peel: Experimental Studies and Modelling

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Synthetic dyes are extensively used for dyeing and printing in industries. Over  $7 \times 10^5$  tons and approximately 10,000 different dyes and pigments are produced annually worldwide, of which about 10% are lost in industrial effluents. Commercial dyes have a great variety of colours, high stability to light, temperature, detergent and microbial attack. They are not toxic, while their colours in industrial effluents cause environmental concern. Their presence in watercourses is aesthetically unacceptable and may be visible at concentration as low as 1 ppm. Moreover, they may also affect photosynthetic activity in aquatic systems by reducing light penetration. Among the various types of dyes, various cationic dyes, including methylene blue, are used in dye, paint production and in wool dyeing. Methylene blue has wider applications, which include colouring paper, temporary hair colorant, dyeing cottons, wools, coating for paper stock, etc. Though methylene blue is not strongly hazardous, it can cause some harmful effects. Due to low biodegradability of dyes, a conventional biological treatment process is not very effective in treating a dye wastewater. It is usually treated by physical and/or chemical methods. Although these treatment methods are efficient, they are quite expensive and have operational problems. Sorption of molecules onto various sorbent materials is an ideal option for decolourization, which is evidenced by the effectiveness of sorption for various dye types. The main drawbacks which exist at the present time are the high costs involved in the regeneration of the adsorbent. Also, since activated carbon is the most widely used and most effective adsorbent, its high cost tends to increase the cost of adsorption systems. As a result, there is a search for low-cost, naturally occurring, abundant sorbent materials that can serve as viable alternatives to activated carbon. Sorption of methylene blue has been extensively studied by many researchers using several low cost materials. Almond peel waste can be an alternative and favourable sorbent material for pollutants such as dyes. To date, except some works carried out in our laboratory, no information is available in the literature for dye sorption from aqueous solutions by almond peel. This low-cost material may be particularly suitable for application in small industries and developing countries.

As a continuation of our previous works in this field, the aim of this study is focussed on the effect of particle size on Methylene blue sorption from synthetic aqueous solutions, in single dye solutions, using a biological natural waste: almond peel as an inexpensive sorbent material. Experiments of dye sorption kinetics and equilibrium were performed in batch conditions. Pseudo second-order model was selected to analyze the data obtained from the dye sorption kinetics. In order to obtain information about the maximum dye sorption capacity of almond peel, the model of Langmuir was selected to analyse the experimental sorption equilibrium data. The kinetics controlling mechanisms of Methylene blue by almond peel: external mass transfer and intraparticle diffusion were also investigated.

## Equilibrium and Kinetic Study for Aromatic Amine on Coals Prepared from Agricultural Wastes

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The objective of this work is the development new adsorbent supports of vegetable origin and their use in the water treatment polluted by organic compounds.

In this context, we considered the fixing of the aromatic amine on coals prepared with apricot cores, treated beforehand with the mineral acids sulfuric, hydrochloric and phosphoric at a temperature of  $100 \pm 2^\circ\text{C}$ . The samples treated by chemical way are carbonized in a muffle furnace with a law of heating of  $5^\circ\text{C}$  at  $800^\circ\text{C}$ .

The adsorption of 4-bromoaniline on these supports according to several physicochemical parameters was studied and optimized. The tests of adsorption were conducted in a batch stirred reactor; the residual concentration is analyzed by spectrophotometry UV.

It appears from these results that the acids hydrochloric and phosphoric have a very positive effect on the development of porous texture. The kinetic study showed that the process of elimination of 4-bromoaniline is fast and that the best yields of elimination of the molecule considered are obtained with the coals treated with the acids phosphoric and hydrochloric.

The ultimate capacities of adsorption of 4-bromoaniline on the three coals treated an optimal way (HCl;  $\text{H}_3\text{PO}_4$  and  $\text{H}_2\text{SO}_4$  are 285.714 - 212.765 - 192.307 mg.g<sup>-1</sup> respectively.

## Heavy Metal Content in Sediment of Inaouene River, Northern Morocco

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The study area includes a part of Inaouene watershed which constitutes the Eastern part of the large Sebou watershed. This study area is situated upstream of the dam Idriss I<sup>st</sup> and covers an area of 3,100 km<sup>2</sup>.

In this work, the used material for analysis of sediment of sampled sites along the river and some main tributaries during 2008/2009 hydrological cycle, revealed three classes of metals analyzed:

Class 1: Includes metals (Fe, Sr, Mn, Zn, Rb, Pb) detected on all sampling sites  
Class 2: Includes metals (Cu, Ni, Cr, As, Co, Pt, Au, Sn) detected only on certain sites.  
Class 3: Includes metals (Ag, Cd, Hg) who were below the limit of detection  
The absence of three metals (Ar, Cd, Hg) can be explained by the threshold of detection device used, because they have sources which found refuge in



the study area that constitutes a target for intense anthropogenic pollution. The Inaouene River courses through all solid urban landfills of the city of Taza, Bab Marzouk, Amlil and Bou Hlou), it is also the spillway wastewater that does not undergo any prior treatment.

The highlighted metals at all sampled sites are Fe, Sr, Mn, Zn, Rb, Pb. The evolution of their concentrations during the two years is almost the same, except for some fluctuations at diverse sites for Sr, Rb and Pr. High concentrations of Fe, Mn, Zn, in the site (H1), are issued from a natural origin. This site is located near the carbonate outcrops and iron-rich laterites, which explains the presence of Fe Chekka old mines. For the site (H2), they can be natural or due to pollution sources. For Pb, the high values are due to the sources of pollution; water pipes, batteries tanks, paints, gasoline additives; runoff of highways, pharmaceutical and steel industries (Baize and Janiece, 1994).

The obtained results indicate that for most of the studied metals had common sources, dependence and the same behavior during transportation.

**Keywords:** Inaouene River, wastewaters, sediments, heavy metals, pollution.

## P4-6

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# Heterogeneous Photocatalytic Degradation of the Pharmaceutical Agent $\beta$ -Blocker on Immobilized Titanium Dioxide

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Recent studies have shown pharmaceutical compounds entering sewage treatment systems are not fully removed and are discharged to the aquatic environment.

Heterogeneous photocatalysis plays a major role in detoxifying hazardous pollutants to innocuous end products. The application of photocatalytic procedures for remediation have been mostly studied in terms of determination of reaction kinetics, the reaction mechanisms involved in the process as well as of the identification of major transient intermediates. Nanoscaled  $\text{TiO}_2$  particles have attracted a great deal of attentions in waste treatment, due to their high photocatalytic degradation (PCD) rate of various organic compounds [1], but the recycling difficulties restricted the utilization of finer  $\text{TiO}_2$  particles. Thus, in practical applications,  $\text{TiO}_2$  nanoparticles have been considered to be fixed on inert and ideal supports [2]. A simple and efficient method was used in this study for immobilization of  $\text{TiO}_2$  nanoparticles, which is ideal for industrialization. The objective of this work was to experimentally examine the performance of an alternative immobilized  $\text{TiO}_2$  on glass plate's reactor design for removal Acebutolol, which is a  $\beta$ -blocker [3]. The rate and extent of photocatalytic degradation process is affected by variables such as initial pharmaceutical compound concentration, pH, light intensity, flow rate. Previous experiments (adsorption, photolysis and thermodegradation) were developed to evaluate non-catalytic degradation for  $\beta$ -blocker.

Preliminary studies showed very poor pharmaceutical removal with UV irradiation without catalyst for nearly 6 h and less than 30% by adsorption on catalyst alone without UV irradiation.

In the present paper,  $\beta$ -blocker removal from aqueous solutions by photocatalytic process was investigated and 23 full factorial design was applied. In the study, three parameters affected the performance and two levels of these parameters were investigated. The chosen parameters were initial pharmaceutical compound, pH and flow rate. The significance of the effects was checked by analysis of variance. The

model-function equation for  $\beta$ -blocker photodegradation was obtained. The results showed that initial pharmaceutical compound, pH and flow rate affected  $\beta$ -blocker removal by photodegradation.

**Keywords:** photocatalytic pharmaceutical, experimental design, immobilized  $\text{TiO}_2$

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## P4-7

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### Importance of Uranium Speciation in Wastewaters Treatment and Soil Remediation

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Uranium speciation is strongly dependent on the chemical conditions, thus distribution coefficient values can vary greatly in different chemical environments and with different porous media. Uranium diffusion in soil is always found to be coupled with sorption to the solid phase; such processes retard the mobility of Uranium in the porous sediments.

Migration of uranium in the aqueous environment is influenced by sorption to soil. To better understand the chemical mechanisms involved in uranium transport in soil, much effort has been invested in recent years in defining the uptake of uranium from aqueous phase onto solid surfaces. Therefore, knowledge on the interactions of uranyl ions with soil surfaces is imperative for the performance assessment of wastewaters treatment.

The evaluation of the mobility of uranium in ground waters requires knowledge of transport processes and their kinetic, convection and diffusion characteristics within the water, sorption and of desorption from soil in contact with the aqueous phase.

In this work, batch experiments were carried out for studying uranium sorption onto clay samples. Effect of several parameters (pH, ionic strength, uranium concentration, etc...) and distribution coefficient ( $K_d$ ) were estimated. Several properties of clay samples were studied by using Hg-porosimetry and  $\text{N}_2$ -adsorption.

Modelling must take into account the speciation of uranium in the groundwater systems, which is a function of the chemical composition of the aqueous phase. The Minteq code was used in this study for uranium speciation determination.

**Keywords:** Uranium speciation; wastewaters; Minteq code; distribution coefficient.

## Removal of Zinc by the Aquatic Macrophytes *Lemna gibba* L.: Effect of Temperature, pH and Zn Source

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More recently, the use of aquatic plants in the removal of toxic and undesirable elements has been an alternative technique for the remediation of contaminated waters. This technology commonly called constructed wetland is more and more widely studied and employed throughout the world (Wang et al., 2010; Rai, 2009). The selection of species to be used in a wetland system is largely governed by location and site conditions since metal phytoaccumulation depends upon numerous biotic and abiotic factors such as features of plant species, temperature, pH, salinity and dissolved ions in water (Rai, 2009; Demirezen et al., 2007).

Earlier experiments in our laboratory demonstrated the capacity of the duckweed *L. gibba*, originated from northeast Algeria, in Zn removal. The macrophytes were effective in removing metal ions from the nutrient medium (61- 71%) (Khellaf & Zerdaoui, 2009). However, there was no detailed study on the effect of abiotic factors on the remedial process. In this work, we aimed to investigate the effect of temperature (17, 21, 25 and 29 °C), medium pH (3.0, 4.0, 5.0 and 6.0) and Zn source (ZnSO<sub>4</sub>, Zn(NO<sub>3</sub>)<sub>2</sub> and ZnCl<sub>2</sub>) in order to evaluate which of the factors led to an optimal Zn phytoaccumulation by *L. gibba*. Our results revealed that temperatures greater than or equal to 21 °C were more efficient in the metal uptake. At 21, 25 and 29 °C, the plants reduced initial Zn concentration (~ 18 mg/L) to 4.64, 1.69 and 1.92 mg/L, respectively with 9.1-22.1 mg g<sup>-1</sup> DW of the metal accumulated in the biomass. Low Zn accumulation in *L. gibba* biomass (7.5 mg g<sup>-1</sup> DW) corresponding to a low growth of duckweed was observed at pH 3.0 and 4.0 indicating that this species is not tolerant to water acidity. A very low Zn concentration in *Lemna* biomass (1.1 mg g<sup>-1</sup> DW) was observed when Zn (NO<sub>3</sub>)<sub>2</sub> was used as Zn source. These results demonstrated that temperature greater than or equal to 21 °C and pH values of 5 and 6 are favourable factors for the phytoaccumulation of Zn by *L. gibba*.

We conclude that the duckweed *L. gibba* L. proved to be a potent tool for the removal of Zn from contaminated water mainly at elevated temperatures and pH 5 and 6. It is a viable species in an artificial wetland of water effluent treatment plant. The lower growth at low temperature, water acidity and high nitrates concentration are some limitations of the use of duckweed as phytoremediation agent. More work may be developing to ameliorate these limitations.

**Keywords:** Abiotic factor; Metal pollutant; Removal; Zn accumulation.

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## Study and Treatment by the Process Bioreactor with Membrane (Brm) of Water of Industrial Wastes

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The objective of our study is to recycle water of industrial wastes of an Industrial Complex in study by treating them by process BRM.

In order to produce this framework of work, water quality in question was first of all studied.

In order to characterize it a series of physicochemical analyzes was carried out according to standardized directives and methods.

To follow-up to meet the regulatory requirements with rejection of water in study was done thanks to monitoring permanently following relevant parameters:

Flow, temperature, pH, electrical conductivity, salinity, turbidity, solids suspensions, dissolved oxygen, alkalinity, hydrometrics, chlorides, sulphates, sodium, potassium, free carbon dioxide, chemical oxygen demand, biochemical oxygen demand, silica, oils, phenols, nitrites, nitrates, cyanides, phosphate, iron, copper and quicksilver.

According to information collected, it was established, sampling rates to which the quality control was done.

The results of the quality control some contents of water of rejections are not in the Algerian standards.

In our case of objective, the concern of the setting in standard is blurred by recycling them at industrial ends.

The process retained by BRM for their treatment is in study; first of all in the focusing of the experimental by characterizing the reactor and the selected membrane.

The project is a considerable stake because the recycling of this water will make it possible to reduce the impact of the liquid rejections on the environment, to reduce the procedure of the pollutant paying and will carry out an economy and autonomy with the Industrial Complex.

**Keywords:** *Environment, wastewater, control quality, recycling, process BRM*

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## Treatment of the Domestic Waste Water by the Use of Plants in the Arid Zones (Algerian Northern Sahara)

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The arid zones are poor in resources in water, this rarity led to minimize the consumption of these heritage and to think of the re-use of waste water after preliminary treatment in the irrigation. Among the used techniques, there is biological epuration technique in which plants are used for treatment.

The present work, aims to study the efficiency of this technique by analyzing the water of the station of "WasteWater Garden" in the region of Témacine. The obtained results show the capability of this system in the elimination of suspension materials. We registered a minimal value of concentration (about 24, 57 mg / l) in the downstream of the station, a low turbidity. The reduction of suspension materials contributes to good yield on the DBO<sub>5</sub> and the DCO. Concerning the bacteriological analyses we registered a better elimination of most of the popular bacteria (total and fecal coliformes, the total and fecal Streptococci and the Escherichia coli).

**Keywords:** WasteWater Garden, wastewater, water quality, Témacine, Algéria.

## Use of Geospatial Data for Solid Waste Selection and Environment Protection, Taza City Case (Morocco)

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Among the many challenges and the most pressing to the earth's sustainability, global warming and declining biodiversity in many regions. Municipal solid waste management is one of the major problems facing city planners all over the world. The problem is severe especially in most developing-country cities where increased urbanization, poor planning, and lack of adequate resources contribute to the poor state of municipal solid waste management. Selecting a new landfill site is, also, a very complicated task involving a series of parameters: the life of the proposed landfill; amount of waste generated; amount of waste to be reduced/recovered, combusted, and land filled; size of land required; availability and suitability of land; financial aspects; and impacts of the proposed landfill on the environment, specifically, the pollution of groundwater. Selection of such sites may be achieved at low cost using Geographic Information Systems (GIS) methods.

Methodologies used are based on a composite suitability analysis using map overlays and their extension to include statistical analysis. The approach is to use models, which combine and integrate maps (features and their attributes) to determine an optimal landfill sitting. There are a number of integration models in GIS. For the present case, we have selected the Boolean Logic and the Analytical Hierarchy Process. We applied Boolean operators to a set of input maps and produce a various layers of evidence. The output is

a binary map, because each location is either satisfactory or not. With the Analytical Hierarchy Process model, we assigned scores to each factor maps, as well as the maps themselves receive different weights. Weights are generally assigned to these maps to express the relative importance. Determining the weight is basically accomplished by decision makers, experts and decision-making committee. Scored maps are combined with constraint maps to eliminate areas of absolute unacceptability. A final map is generated that identifies regions that are most suitable for the location of a landfill site. An optimal site is chosen based on the highest suitability values and the size of the site.

The approach, using ArcGIS toolbar, is a very flexible and straightforward tool. It provides a selection of environmentally friendly disposal sites, thus supplying reasonable, convenient and administratively transparent solutions to the waste landfill selection in Taza (Morocco). It could be applied to any region and site selection problems and should result in an optimal result given the same data.

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### **Wastewater Management by Utilizing of Decentralized Wastewater Treatment Plants**

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In Middle East, enormous attempts were done tackle urban water pollution problems by applying conventional treatment systems and centralized management approaches. However, it is apparent that these centralized approaches are overloaded and started to cause environmental deterioration after surrounding the near village, moreover, lack of water resources for drinking and irrigation and also the budgets to construct more units, which are simply not affordable for the water authority in Gaza strip. The decentralized wastewater management approach enables a safe nutrient recycling at source at much lower treatment costs, can easily be adapted to the different effluent requirements and therefore is certainly a promising solution for water pollution control. Conventional septic systems are the most common treatment units on household level in rural areas in Gaza and West bank; unfortunately their treatment efficiency is quite low. The anaerobic baffled septic tank (ABST) could be a valuable alternative to conventional septic tanks. In this study, two small-scale systems were implemented and studied to treat domestic gray water in the rural areas. The systems were anaerobic filter with septic tank and trickling filter and septic tank with trickling filter. They operated at seven families effluent with average influent BOD, COD and SS are 613 mg/l , 1376 mg/l and 538 mg/l with removal rate 52%, 50% and 29% respectively for the first system and were 246 mg/l, 424 mg/l , 58 % and 70% for the second system BOD, COD, and BOD, COD removal rates respectively. Other effluent contents such as PH, Ecw, TDS, Ca<sup>++</sup>, Mg<sup>++</sup>, Na<sup>++</sup>, Cl<sup>-</sup>, SO<sub>4</sub><sup>-</sup>, NO<sub>3</sub> - N. Based on these preliminary results, a pilot-scale treatment unit was installed at Research Station of Green Plains Organization in Gaza strip, where the treatment performance of The anaerobic baffled septic tank (ABST) operated and investigated. The results were a mathematical analysis and software program considering the conditions of Gaza as a semi-arid to produce a good system design for the treatment of gray water and to increase the treatment efficiency of BOD, COD, SS and the other elements to be able to reuse such treated gray water for irrigation.

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