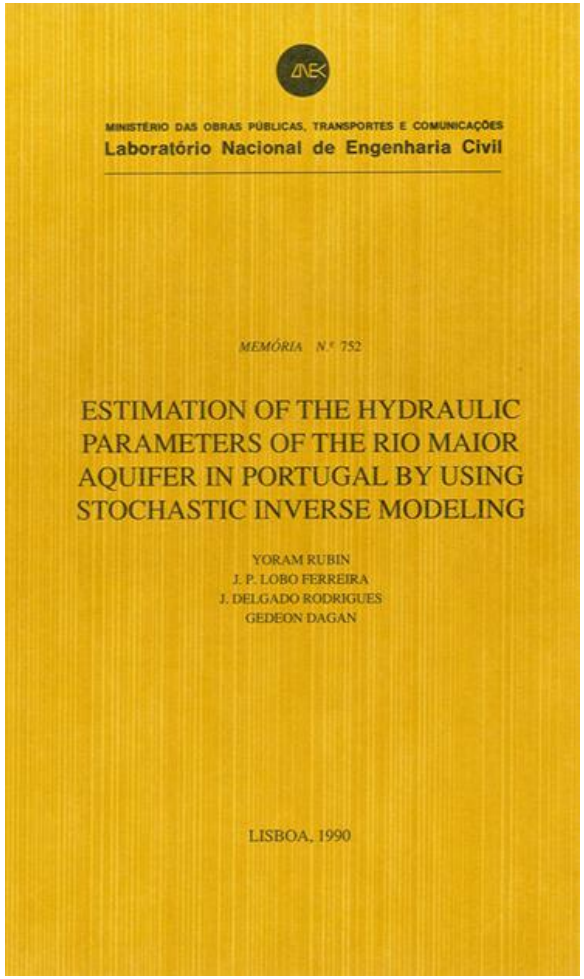
Bilateral working session Israel-Portugal

Highlighting 3 decades of Portuguese - Israeli cooperation on Water Resources Research : EU/USAID/NATO sponsored projects of LNEC with Tel-Aviv University, Technion, EWRE, University of Haifa Mekorot,... (1983 - 2014)

the international water association

– Prof. João Paulo Lobo Ferreira, Researcher – Coordinator, LNEC - National Laboratory for Civil Engineering

LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL



Technion Israel Institute of Technology

MEKOROT ISRAEL NATIONAL WATER CO.

Relation of Groundwater Quantity and Quality - Symposium held during the IUGG Assembly at Hamburg, August 1983

USAID sponsored Israel – Portugal project

LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

אוניברסיטת תל-אביב
TEL AVIV UNIVERSITY

LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

CONVITE PARA A CONFERÊNCIA

do Prof. Gedeon Dagan (*)

THE IMPACT OF FIELD CHARACTERIZATION METHODOLOGY UPON PREDICTION OF TRANSPORT OF POLLUTANTS

Quarta-Feira, 25 de junho de 2014, 11:00 h

LNEC, Pequeno Auditório, Avenida do Brasil, 101, Lisboa

Abstract

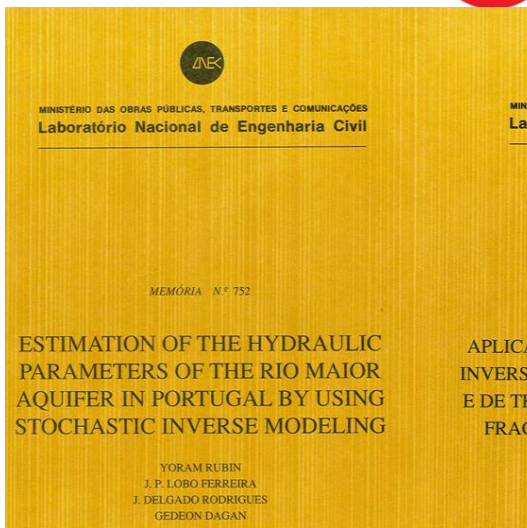
The basic concepts of solute transport in spatially variable aquifers are first introduced. The main part of the lecture is focused on the characterization of the MADE (Macrodispersion Experiment at Columbus Airforce Base) experimental site. The hydraulic conductivity K of the aquifer of the MADE transport experiment, was measured in the past at a dense three-dimensional network of sampling stations. Two methodologies were employed: initially, the flowmeter (using numerous piezometers) and recently the DPIL (direct push injection logger) method. The results for the statistical moments of the lognormal K distribution were similar for the horizontal and vertical integral scales, but quite different for the geometric mean and the variance. By using our recently developed model of transport in highly heterogeneous formations we were able to predict the observed longitudinal mass distribution spreading and to compare with measurements. We found that prediction based on DPIL parameters led to agreement, while flowmeter data resulted in discrepancy. Using our transport model, we explore here in a systematic manner the impact of the different statistical parameters upon the breakthrough curve at different distances from the injection zone.

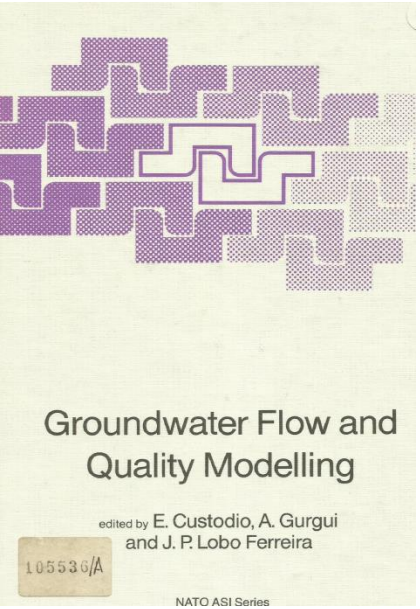
(*)Prof. Gedeon Dagan Honors and Awards

- The Horton Award of the Hydrology Section of the American Geophysical Union (1984)
- Elected Fellow, American Geophysical Union (1989)
- Visiting Miller Research Professorship, University of California, Berkeley (1991).
- Doctor Honoris Causa, Université "Pierre et Marie Curie" Paris 6 (1996).
- Stockholm Water Prize (1998)
- Water Academy (life membership), Oslo, Norway (1998)
- Member of the 100 Highly Cited Researchers List (Engineering), Institute for Scientific Information, USA (2000)
- Robert E. Horton Medal, American Geophysical Union (2005).
- Elected member, Israel Academy of Sciences and Humanities (2006)
- Doctor Honoris Causa, The Technical University of Civil Engineering, Bucharest, (2006).
- The Rothschild Prize in Engineering (2006).
- Doctor Honoris Causa, University "Frederico II", Napoli, Italy, 2012.
- Israel Prize (2013)

Apoio Associação Portuguesa dos Recursos Hídricos

Organização





the international water association

Proceedings of the NATO Advanced Research Workshop on
Advances in Analytical and Numerical Groundwater Flow and Quality Modelling
Lisbon, Portugal
June 2-6, 1987

Library of Congress Cataloging in Publication Data

NATO Advanced Workshop on Advances in Analytical and Numerical Groundwater Flow and Quality Modelling (1987: Lisbon, Portugal)

Groundwater flow and quality modelling / edited by E. Custodio, A. Gurgui, J. P. Lobo Ferreira.

p. cm. — (NATO ASI series. Series C, Mathematical and physical sciences; vol. 224)

"Proceedings of the NATO Advanced Research Workshop on Advances in Analytical and Numerical Groundwater Flow and Quality Modelling, Lisbon, Portugal, June 2–6, 1987" — T.p. verso.

"Published in cooperation with NATO Scientific Affairs Division."

Includes index.

ISBN 90–277–2655–8

1. Groundwater flow—Mathematical models—Congresses. 2. Water, Underground —Quality—Mathematical models—Congresses. I. Custodio, Emilio. II. Gurgui, A. (Antonio), 1953– . III. Ferreira, J. P. Lobo (João Paulo Lobo), 1952– . IV. North Atlantic Treaty Organization. Scientific Affairs Division. V. Title. VI. Series: NATO ASI series. Series C, Mathematical and physical sciences; no. 224.

TC176.N386 1987

628.1'14 — dc 19 87–30968

CIP

MINISTERIO DO EQUIPAMENTO, DO PLANEAMENTO E DA ADMINISTRAÇAO DO TERRITORIO

Laboratório Nacional de Engenharia Civil

DEPARTAMENTO DE HIDRAULICA - GRUPO DE INVESTIGAÇAO DE AGUAS SUBTERRANEAS

International short course on

MODELING FLOW AND POLLUTION IN THE SUBSURFACE

Principal lecturer

Prof. JACOB BEAR

Technion - Israel Institute of Technology

September 7-11, 1998

Lisboa, Portugal

THE COURSE WILL INCLUDE
(a) 22 hours of lectures on the conceptual and mathematical modelling of flow and contaminant transport in the subsurface, with classroom exercises and discussion of case studies, (b) 14 hours (including evening sessions) on numerical solution techniques, and hands-on computer laboratory, with such codes as MODFLOW and BEAVERSOFT, and others. All lectures will be given in English.

GABARDINE
EU - FP6 - Project
Consortium Meeting #2
May 7–11
Haifa - Israel

Project No. 518118-1

Location of meeting and accommodation

Hotel Dan Panorama
107 Hanassi Avenue
Haifa 34632
Israel
Tel: 972-4-835-2222
Fax: 972-4-835-2235
Web: http://www.danhotels.com/danSite/eng
Email: Reservations-T.PanoramaHaifa@DanHotels.com

Organization

Technion – Israel Institute of Technology
Grand Water Research Institute
Technion City
32000 Haifa
Israel
Technion research team: Jacob Bear, Haim Kutiel, Shlomit Paz, Lea Wittenberg and Jacob Bensabat

GABARDINE Project
"Groundwater artificial recharge based on alternative sources of water: Advanced integrated technologies and management"

LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

GABARDINE WP 5 Coordinating Authors of and participating authors from each Test Site for Deliverable D5.1

Portugal: João Paulo Lobo Ferreira, Catarina Diamantino, Maria João Moinante, Manuel Oliveira, Teresa Leitão, Maria José Henriques, Albino Medeiros (LNEC)

Spain: Xavier Sanchez-Vila and Manuela Barbieri (Universitat Politecnica de Catalunya)

Greece: Klisthenis Dimitriadis and Mike Styllas (GEOSERVICE), Thanassis Soupilas (EYATH), Panagiotis Maheras, Christina Anagnostopoulou, Konstantia Tolika, Margaritis Vafiadis, Christos Machairas (AUTH)

Israel: Jacob Bensabat (EWRE), Avichai Hadad (HSI)

Palestine: Ayman Rabi and Abdel Rahman Tamimi (Palestinian Hydrology Group)

Integrating groundwater artificial recharge for management of scarce water resources in Israel

Jacob Bensabat,
Environmental & Water Resources Engineering Ltd. Haifa

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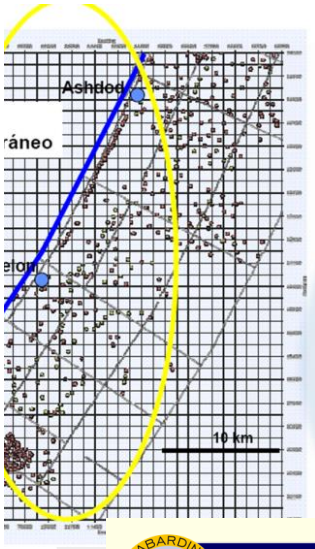
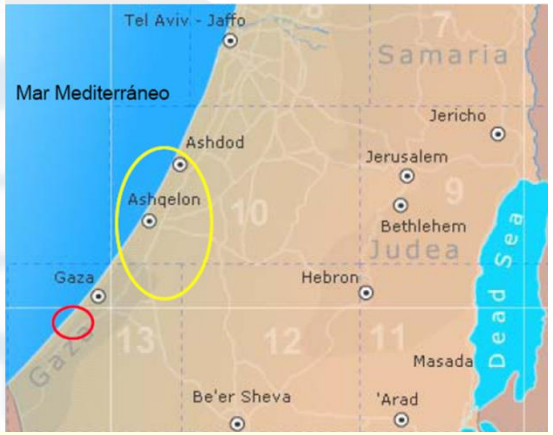
GABARDINE



3. Israel



GABARDINE

Groundwater artificial recharge based on alternative sources of water: advanced integrated technologies and management

Contract no.: 518118-1

SIXTH FRAMEWORK PROGRAMME
PRIORITY 1.1.6.3
Global change and Ecosystems

DELIVERABLE 51

Test sites and their characteristics

Due date of deliverable: November, 2006
Submission date to EC: December, 2006

Start date of Project: November, 1st , 2005
Duration: 3 years

Coordinating Authors: João Paulo Lobo Ferreira, Catarina Diamantino, Maria João Moinante, Manuel Oliveira, Teresa Leitão, Maria José Henriques, Albino Medeiros (LNEC).

Participating Authors from each Test Site: Klisthenis Dimitriadis and Mike Styllas (GEOSERVICE), Thanassis Soupilas (EYATH), Panagiotis Maheras, Christina Anagnostopoulou, Konstantia Tolika, Margaritis Vafiadis, Christos Machairas (AUTH), Xavier Sanchez-Vila and Manuela Barbieri (Universitat Politecnica de Catalunya), Jacob Bensabat (EWRE), Avichai Hadad (HSI), Ayman Rabi and Abdel Rahman Tamimi (Palestinian Hydrology Group).

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Tel.: +351 218443609 Fax: +351 218443016

Organisation name of lead contractor for this deliverable: Laboratório Nacional de Engenharia Civil - LNEC

GABARDINE

GABARDINE

WP II – Deliverable summary: the relationship between the MERR and RRU.

Thanks to Dr. Joseph Guttman, Mekorot water company, Israel

Hadas Reiser, Haim Kutiel, Shlomit Paz
(hreiser@geo.haifa.ac.il, kutiel@geo.haifa.ac.il, shlomit@geo.haifa.ac.il)

Laboratory of Climatology,
Department of Geography & Environmental Studies,
University of Haifa

Final consortium meeting, Göttingen/Germany
April 27 – 28, 2009

ARTIFICIAL AQUIFER RECHARGE EXPERIMENTS IN THE PORTUGUESE CAMPINA DE FARO CASE-STUDY AREA, DEVELOPED IN THE FRAMEWORK OF GABARDINE PROJECT

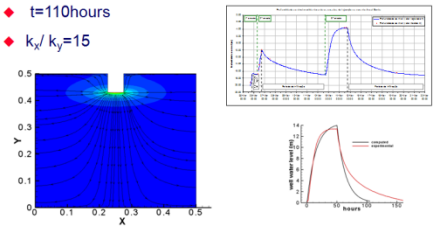
LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

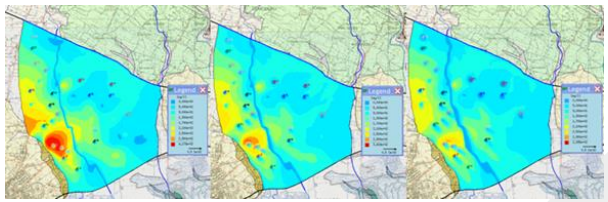
•Flow and transport groundwater modeling for different artificial recharge scenarios in Campina de Faro

The University of Nottingham

Portuguese Infiltration well

- t=110hours
- $k_x / k_y = 15$

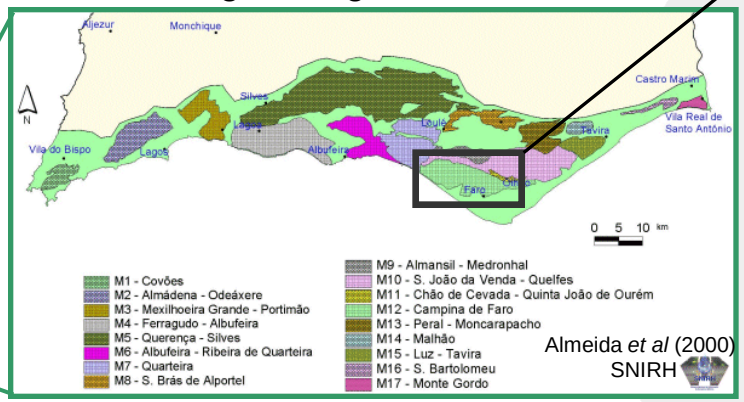




plane at z=25m

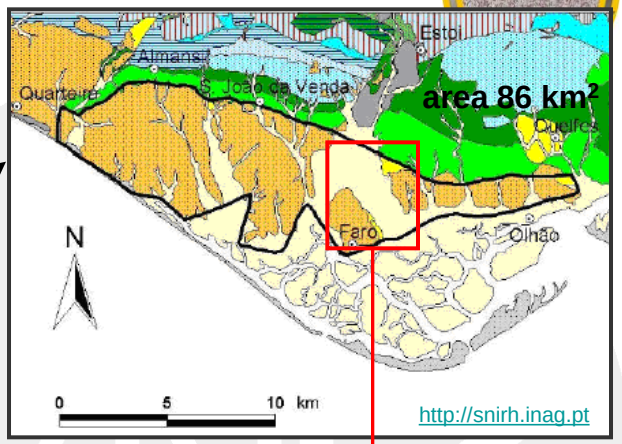
Well water level

Algarve region

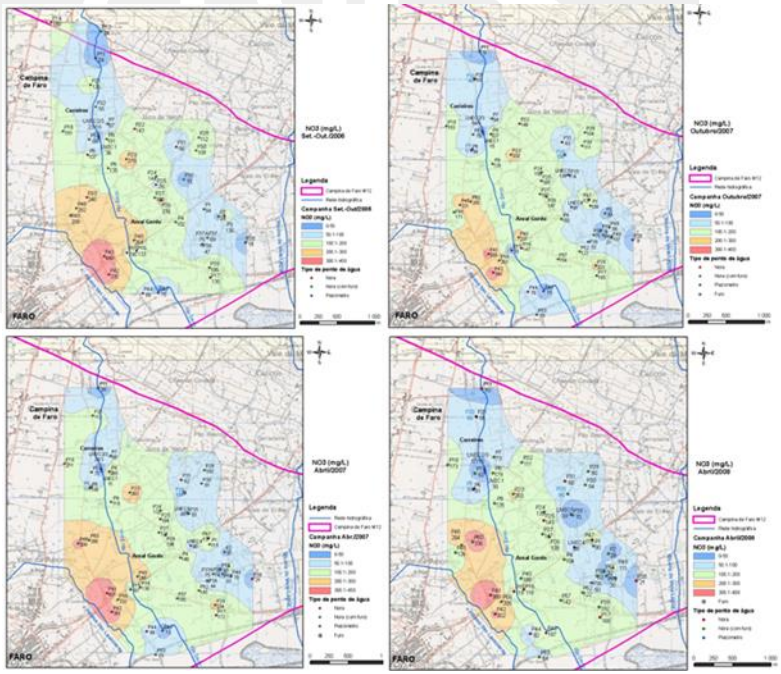


Almeida *et al* (2000)
SNIRH

Aquifer system of Campina de Faro

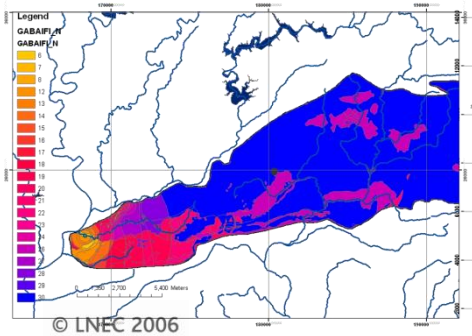


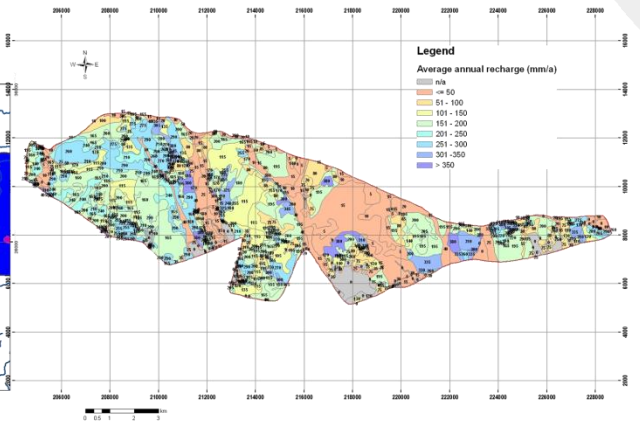
http://snirh.inag.pt



Aquifer recharge

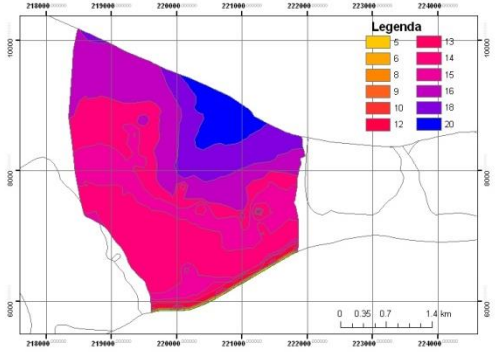
GABA-IFIN





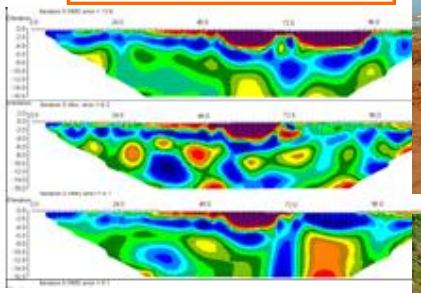
Main Results/Conclusions

- Methodology to identify preliminary candidate areas to implement artificial recharge (GABA-IFI Index)



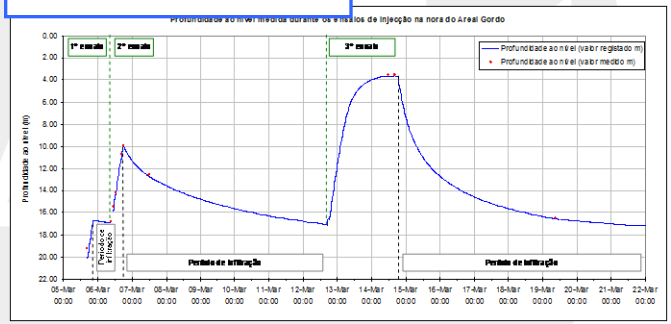
- Artificial recharge infiltration and tracer tests in Campina de Faro

1) Areal Gordo test site
3 Infiltration basins

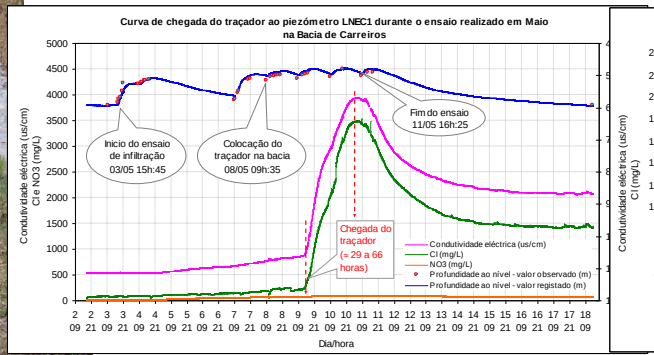


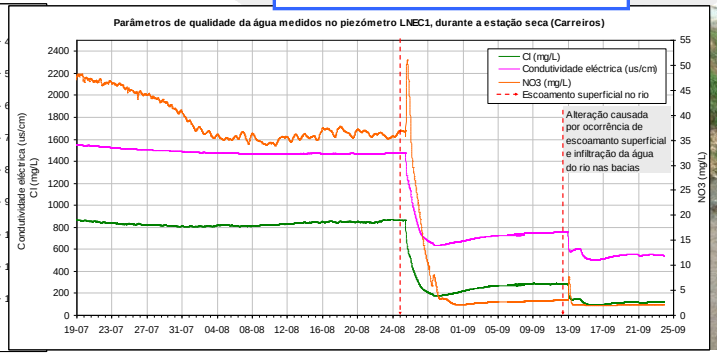
3) Carreiros test site
2 Infiltration basins
in the river bed

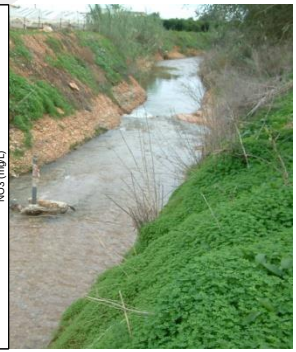
2A) Areal Gordo test site
Injection tests in large diameter well "nora"



2B) Areal Gordo test site
Injection test in medium diameter well







MAR Solutions - Managed Aquifer Recharge Strategies and Actions (AG128)

Led by: João-Paulo Lobo-Ferreira

Priority Area: Flood and drought risk management

Develop and demonstrate solutions, based on **Managed Aquifer Recharge** (MAR) in nine case studies, with inclusion of ecological modelling, economic incentives and risk aspects.

M.A.R. TO MAR-k€t

FP-7 ENV

EIP Water Online Market Place
Matchmaking for water innovation

MAR SOL MANAGED AQUIFER RECHARGE SOLUTIONS

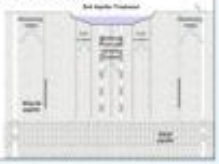
MARSOL: Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought

The **Mediterranean region** is suffering from increasing **water scarcity**, which is further exacerbated by climate change, high population density, and high water consumption by agricultural, industrial, and urban uses. Not only quantity but also **quality** is of increasing importance, e.g. due to intensive use of fertilizers and seawater intrusion. Meanwhile, **large water quantities are lost** to the Mediterranean Sea as surface runoff, river discharge, discharge of treated and untreated wastewater, and as discharge of excess water from various sources during periods of low demand. This water can be used in principle for the **controlled (re-)filling of exploited aquifers by artificial infiltration, referred to as *Managed Aquifer Recharge* (MAR).**

1. Lavrion Technological & Cultural Park, Greece

⇒ Development and implementation of advanced sensors

- Treated wastewater effluents
- Infiltration basins
- Replenishment of exploited aquifer
- Combating seawater intrusion
- Soil Aquifer Treatment



2. Algarve and Alentejo, Portugal

⇒ River water infiltration at three sites

- Surface water
- Infiltration basins
- Wells
- Improving the ecological and chemical status of the aquifer

3. Arenales, Castile and Leon, Spain

⇒ River water infiltration in two catchments

- Surface water
- Treated wastewater effluents
- Infiltration ponds, artificial wetlands, drainage ditches
- Replenishment of exploited aquifer
- Soil Aquifer Treatment

Demonstration Sites

For the project eight demonstration sites have been selected to represent different MAR purposes and hydrological settings.

MARSOL follows an holistic approach, which considers different:

- **Recharge water sources**
- **Recharge techniques**
- **MAR objectives**

4. Llobregat River, Catalonia, Spain

⇒ River water infiltration basin

- Surface water
- Infiltration basin
- Replenishment of exploited aquifer
- Improving the ecological and chemical status of the aquifer

5. River Brenta Catchment, Vicenza, Italy

⇒ Agricultural area with a network of ditches

- Surface water
- Forested infiltration area
- Replenishment of exploited aquifer
- Improving the ecological and chemical status of the aquifer

6. Serchio River Well Field, Tuscany, Italy

⇒ River bank infiltration with an advanced monitoring network

- Surface water
- Induced river bank filtration
- Improving groundwater quantity and quality
- Continuous monitoring and automated operations

7. Menashe Infiltration Basin, Hadera, Israel

⇒ Aquifer storage of surplus water from the Hadera desalination plant

- Desalinated water
- Infiltration basin
- Seasonal storage and aquifer storage recovery of surplus desalinated water

8. South Malta Coastal Aquifer, Malta

⇒ Create a seawater intrusion barrier at a coastal wastewater treatment plant

- Treated municipal sewage effluent
- Injection boreholes
- Combating seawater intrusion

The Project

- 21 Partners
- 36 months, starting 12/2013
- Total budget ~ 8.0 million EUR
- EU contribution ~ 5.2 million EUR

MARSOL Project—Main Objectives

- **Demonstrate at 8 field sites that MAR is a sound, safe, and sustainable strategy** to increase the availability of freshwater under conditions of water scarcity.
- Improve the state of MAR applications to enable **low-cost, high-efficiency MAR solutions** that will create market opportunities for European Industry and SMEs (**MAR to Market**).
- Promote the advantages of MAR **by tailored training and dissemination programs** to enable and **accelerate market penetration**.
- Deliver a **key technology to face the challenge of increasing water scarcity** in the Mediterranean region of southern Europe and other regions of the world.

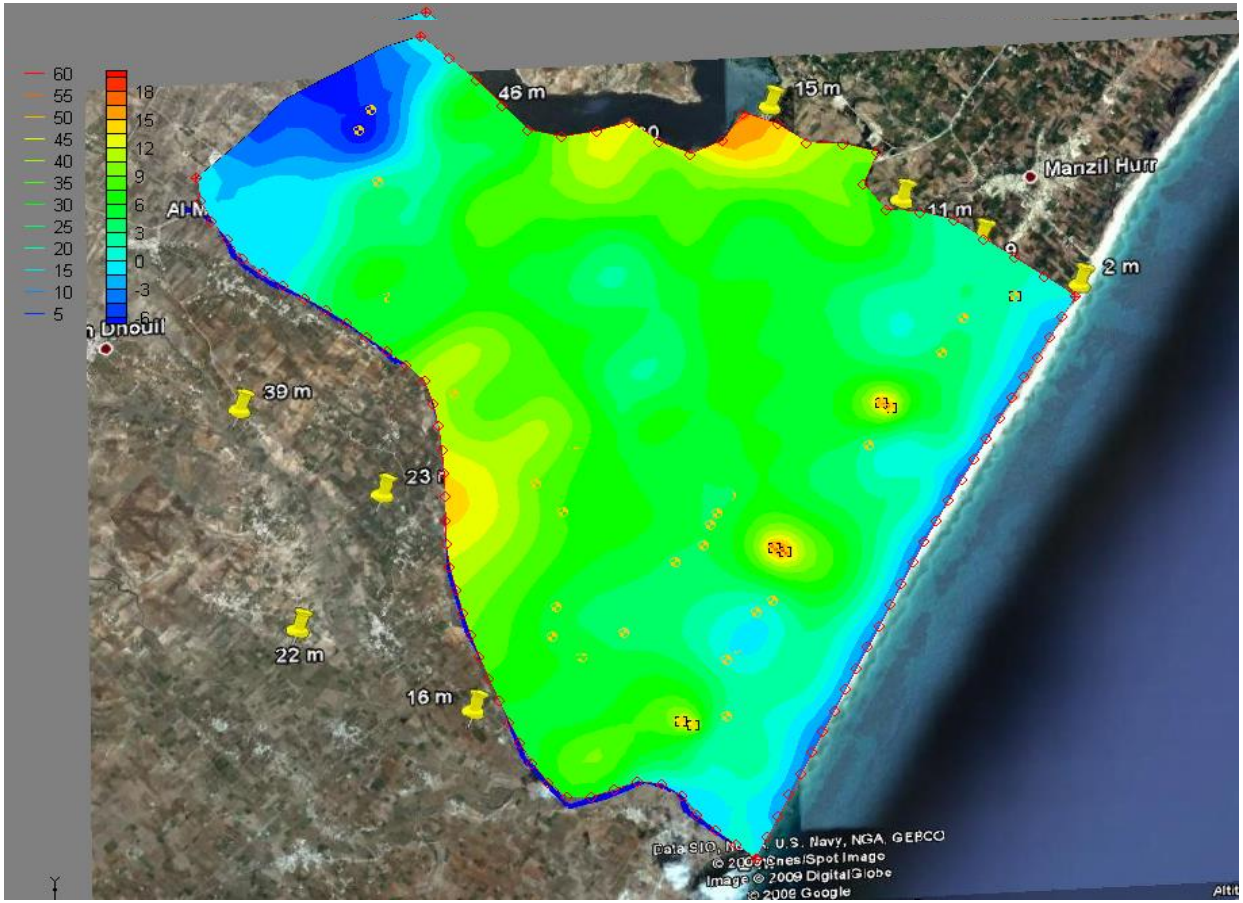
Tools to Reach the Objectives

- **Data collection**
- **Monitoring** (improvement of sensors, new sensors)
- **Improvement of MAR devices** (planning, design, and maintenance)
- **Modelling** (to simulate the impact of MAR on aquifer hydrology and hydrogeochemistry)
- **Scenario analysis**
- Development of a **Decision Support System**
- Definition of **guidelines and policies**
- Increase of public participation within **Public Private Partnership** (PPP) schemes
- **Market analysis** on the potential market exploitation solutions

www.marsol.eu

ARTIFICIAL RECHARGE ENHANCEMENT TO PREVENT SEAWATER INTRUSION, KORBA (TUNISIA)

- Results and conclusions
  - Transient state modelling – 3000 m^3/d of MAR in 3 different locations (9000 m^3/d)



•**Terceiro, A., Oliveira, L.G.S., Lobo Ferreira, J.P., Miguel, G., Gaaloul, N., Rocha, E. (2010) – "Modelação matemática em aquíferos costeiros. Aplicação a dois casos de estudo em países africanos: Angola e Tunísia". 10.º Congresso da Água, Hotel Pestana Alvor Praia, Algarve.**

תודה רבה
Muito Obrigado

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the international water association

World Water Congress & Exhibition 2014, Lisbon

LISBON CONGRESS CENTRE, 21 – 26 SEPTEMBER 2014

inspiring change