

**Joint International Workshop EU FP7 MARSOL and EU HORIZON 2020 FREEWAT projects and EU EIP MAR Solutions - Managed Aquifer Recharge Strategies and Actions (AG128)**

# **Advantages of using Numerical Modeling in Water Resources Management and Managed Aquifer Recharge schemes**

**April 21<sup>st</sup> 2015**

**Aula Magna - Scuola Superiore Sant'Anna**

**Piazza Martiri della Libertà, 33 – Pisa, Italy**

The workshop “Advantages of using numerical modeling in water resource management and in Managed Aquifer Recharge schemes” is a joint event organized by the EU FP7 MARSOL project ([www.marsol.eu](http://www.marsol.eu)) and the recently approved EU HORIZON 2020 FREEWAT project and within the framework of the European Innovation Partnership *MAR Solutions - Managed Aquifer Recharge Strategies and Actions (AG128)*. The MARSOL (*Demonstrating Managed Aquifer Recharge as a Solution to Water Scarcity and Drought*) project started in December 2013 and its main objective is to demonstrate that Managed Aquifer Recharge (MAR) is a sound, safe and sustainable strategy that can be applied with great confidence and therefore offering a key approach for tackling water scarcity in Southern Europe. Key approach is a combination of monitoring and modeling for both water quantity and water quality at 8 different field sites in the Mediterranean. In the FREEWAT (*FREE and open source software tools for WATER resource management*) project (starting April the 1<sup>st</sup> 2015), the aim is to develop the FREEWAT platform which will be an open source and public domain GIS integrated modeling platform for the simulation of water quantity and quality in surface water and groundwater, with an integrated water management and planning module. FREEWAT includes hydrological and hydrogeological models for flow and transport (including variable density models for the simulation of seawater intrusion), a dedicated module for water management and planning that will help to manage and aggregate all the distributed data coming from the simulation scenarios, a whole module for calibration, uncertainty and sensitivity analysis, a module for solute transport in the unsaturated zone, a module for crop growth and water requirements in agriculture and tools for dealing with groundwater quality issues. The main objectives of this workshop are 1) to gather a number of researchers, consultants, administrators and stakeholders interested in learning about how simulation models have been applied to address scientific and resources-management questions in Europe and in the US, 2) to present and discuss the importance of using numerical models for water resources management and, in Europe, for the implementation of the Water Framework Directive and related Directives, and 3) to promote the discussion about how to use models and how to present modeling results to different groups, such as stakeholders, decision makers. The speakers will present their experiences providing guidelines on the importance of combining open source modeling approaches to stakeholders involvement in order to improve water resources management. Workshop presentations, through case studies on the use of modeling in planning, monitoring and managing, are expected to increase understanding of water resource systems at different scales. This will include both water quantity and water quality issues and on innovative management schemes (such as MAR). Current challenges that will be dealt include, among the others, understanding the aquifer's response to drought and climate change, protecting the quality of water, limiting subsidence caused by groundwater pumping, and implementing aquifer storage and recovery programs, water uses in rural areas.

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## WORKSHOP AGENDA

08:30	<i>Participant Registration</i>	
09:00	<b>Welcome: Mario Enrico Pé - Head of Institute of Life Sciences</b>	
<i>Morning Session - Chairperson: Laura Foglia</i>		
09:15	<b>M.C. Hill</b> <i>University of Kansas, USA</i>	<i>Computer models and water resource management: examples, perspectives, and a few opinions</i>
10:00	<b>C. Schüth</b> <i>Technical University Darmstadt (TUDa), Germany</i>	<i>The MARSOL project - implementation and evaluation of managed aquifer recharge systems in southern Europe</i>
10:20	<b>R. Rossetto</b> <i>Scuola Superiore Sant'Anna (SSSA), Italy</i>	<i>The Horizon 2020 FREEWAT project: FREE and open source software tools for WATER management</i>
<i>Coffee break</i>		
11:00	<b>A. E. Fernández-Escalante</b> <i>IAH MAR Commission Co-Chair - TRAGSA Group</i>	<i>IAH MAR Commission's notice. Next coming activities related to MAR</i>
11:10	<b>D. Fernández-Garcia</b> <i>Polytechnic University of Catalonia (UPC), Spain</i>	<i>Modeling reactive transport with Lagrangian approaches: implications to human health risk</i>
11:55	<b>Y. Filali Meknassi</b> <i>United Nations Educational, Scientific and Cultural Organization (UNESCO)\Hydro Open-source software Platform of Experts (Hope)</i>	<i>The UNESCO's Hydro Free and/or Open source software Platform of Experts (HOPE) initiative - from the design to the implementation</i>
12:15	<b>V. Markantonis</b> <i>Joint Research Centre (JRC), EU</i>	<i>JRC activities on water management in developing countries</i>
<i>Lunch</i>		
<i>Afternoon Session - Chairperson: Rudy Rossetto</i>		
14:00	<b>J. Greskowiak</b> <i>Oldenburg University, Germany</i>	<i>Model-based quantification of groundwater quality changes during managed aquifer recharge</i>
14:45	<b>I. Borsi</b> <i>TEA SISTEMI SpA (TEA), Italy</i>	<i>SID&amp;GRID towards FREEWAT: GIS-integrated modeling tools for water resources management</i>
15:05	<b>D.V. Velasco-Mansilla, E. Vázquez-Suñe</b> <i>Institute of Environmental Assessment and Water Research-Spanish Council for Scientific Research (IDAEA-CSIC), Spain</i>	<i>GIS-based tools for hydrogeological analysis</i>
15:25	<b>L. Foglia</b> <i>Technical University Darmstadt (TUDa), Germany</i>	<i>Evaluating processes, parameters and observations using computationally frugal sensitivity analysis and calibration methods</i>
<i>Coffee Break</i>		
16:05	<b>J.P. Lobo Ferreira</b> <i>National Laboratory for Civil Engineering (LNEC), Portugal</i>	<i>MARSOL demonstration case-study areas: modeling studies to fulfill the aim of "comparable" modeling</i>
16:25	<b>E. Crestaz</b> <i>SAIPEM, Italy</i>	<i>Reflections on challenges in coupling spatial databases, GIS and groundwater modeling tools, promoting more effective modeling practice</i>
16:45	<b>A. Chahoud<sup>1</sup>, P. Severi<sup>2</sup></b> <i><sup>1</sup>Environmental Protection Agency Emilia-Romagna region (ARPAER) / <sup>2</sup>Emilia-Romagna Regional Authority, Italy</i>	<i>Groundwater flow modeling application to Managed Aquifer Recharge (MAR) of Marecchia River alluvial Fan (Rimini, Italy): modeling approach for the feasibility study and for supporting experimental phases</i>
17:05	<b>Discussion and Conclusions</b>	

## SPEAKER PRESENTATION



**Mary C Hill** is a Professor at the University of Kansas, Lawrence, Kansas. She was a senior research hydrologist at the U.S. Geological Survey for 33 years. She holds a PhD in Civil Engineering from Princeton University. She has published over 135 journal articles, reports, book chapters, and a book. She has taught over 30 short and semester courses and is the recipient of the National Ground Water Association Darcy Lectureship and M. King Hubbert Award, and the American Society of Civil Engineers Walter L. Huber Prize. She is a Fellow of the Geological Society of America. Her research focus is on how to best use data to inform numerical models of environmental systems and how to use models to manage environmental systems, understand sources and measures of uncertainty and risk, and inform data collection.

**Christoph Schüth** got his PhD in Applied Geology from the University of Tübingen in 1995. After a PostDoc at Stanford University, he again joined the University of Tübingen. Since 2005 he is Full Professor for Hydrogeology at Darmstadt Technical University. Since 2011 he is also scientific director at IWW Water Centre, a private non-profit institute with a staff of 100 focusing on drinking water issues. In his research he focuses on (i) water resources management especially in arid areas, (ii) the fate of organic contaminants in the environment, and (iii), the development of novel methods to remediate soil and groundwater contaminations.



**Rudy Rossetto** (Scuola Superiore Sant'Anna, Italy) deals with surface and subsurface hydrology. He holds a MSc in Earth Science from Uni. of Pisa (IT), a MSc in Geoenvironmental Engineering from Cardiff Uni. (UK) and a PhD in Engineering Geology from Uni. of Siena (IT). Main research fields are: development and application of GIS integrated groundwater and solute transport numerical models to water management issues in the Mediterranean environment with special focus on low flow conditions and analysis of water related agro-ecosystem services (phyto-treatment plants and Managed Aquifer Recharge schemes). He is coordinator of the EU

HORIZON 2020 FREEWAT project and WP8 leader in EU FPVII MARSOL Sant'Alessio induced riverbank filtration case study. Since 2012 he is Co-Editor in Chief of Acque Sotterranee-Italian Journal of Groundwater.

**Alvaro Enrique Fernández Escalante**, Dr. in Geological Sc and Specialist in Hydrogeology by Complutense University of Madrid. 25 years of experience in the hydrogeology sector, at least 15 dedicating most of my activity to water management and environmental hydrogeology. Co-coordinator of the Commission on Managed aquifer Recharge of the International Association of Hydrogeologist. Certificate of Appreciation or "Noble prime" 2013 awarded by the IAH. Associated teacher in Moncloa Campus and, since 2015, Technical Secretary of the Spanish Water Technological Platform. Author, coauthor or editor of 16 books, most of them related to MAR technique. Coordinator of the DINA-MAR project and steering group member of MARSOL project.



**Daniel Fernández-García**, civil engineer with a Ph.D. in environmental science and engineering at Colorado School of Mines, USA (2003), is Associate Professor at the Technical University of Catalonia. His research is mainly focused on subsurface contaminant hydrology. This includes upscaling of flow and transport parameters, applied geostatistics, saltwater intrusion, capture zones, stochastic methods applied to contaminant hydrology, modeling flow and transport in porous media, probabilistic risk analysis, remediation engineering, reactive transport and particle tracking methods. He has published more than 50 articles and he has participated in more than 20 international and national projects. He has taught graduate and undergraduate courses on several of the above mentioned topics and supervised 6 MS thesis and 5 PhD students. He is currently Associate Editor of Water Resources Research Journal and a member of the Editorial Board of the ISRN Geology Journal.

**Filali-Meknassi** studied Chemical Engineering at the Mohammed V University and got his Master degree in Environment engineering from Sherbrook University. Dr. Filali also holds a Ph.D. degree in water treatment processes from the INRS a highly selective post-graduate school which trains its top Engineers in Water management. At the end of his studies, he completed his first Pos-doc at the Universitat Politècnica de Catalunya and a second Post-doc at the Missouri University of S&T. Dr. Filali then was promoted to Research Assistant Professor in 2005 due to his great contributions to the Environmental Research Center. He joined UNESCO in September 2006. In 2007, he got the Wesley W. Horner Award from the ASCE. While Dr. Filali's focus was on emerging contaminants, he also provided critical support other topics as well. For example, he collaborated with USGS on a project focused on the chemical contamination caused by Hurricane Katrina in New Orleans and the Louisiana Peninsula.





**Vasileios Markantonis**, environmental economist, was awarded a PhD (2010) from the Panteion University of Athens in climate change economics and cost-assessment of river floods impacts. He holds a Bachelor in environmental science from the University of the Aegean and a Master degree in economics and regional development from the Panteion University. Currently he is a scientific/project officer at the JRC of the European Commission. Being a member of the Water4Dev team he is conducting research and policy support on water economics in developing countries (Mekrou project). Prior to his current position, he has been post-doctoral researcher at the Helmholtz Environmental Research Center (UFZ) working in the fields of natural hazards management, resilience and climate change economics. He was also lecturer/researcher at the Chemnitz University of Technology, as well as researcher at the Institute of Urban Environment and Human Resources (UEHR) and Marie Curie PhD fellow at the Bjerkness Center of Climate Change. He has been involved in several projects related to water resources management including river basin economics, floods management, institutional and governance arrangements.

**Janek Greskowiak** works as a research scientist at the Department Hydrogeology and Landscape Hydrology, Carl von Ossietzky University of Oldenburg, Germany. His expertise is modelling reactive transport processes in groundwater. The focus is on investigating organic and inorganic macro- and micro-pollutants in groundwater depending on prevailing hydrochemical conditions. He has more than 10 years of experience in developing multi-component reactive transport models to investigate hydrochemistry changes including the fate of pharmaceuticals during artificial recharge of groundwater and river bank filtration, as well as to study contaminant transport of traditional pollutants such as chlorinated, polycyclic hydrocarbons and radio nuclides.



**Iacopo Borsi** is an applied mathematician with more than 12 years of experience on modeling industrial and environmental processes, with emphasis on physical modelling. Specific skill in flow in porous media description, single and multi-phase, with particular interest in hydrological/hydrogeological processes (groundwater flow and solute transport). Expertise in software tools, GIS modeling and programming languages. Teaching experience at national and international level. Author of one monograph and more than twenty-five papers in international journals. Reviewer for international journals on applied and industrial mathematics, environmental and chemical engineering. Since 2012, Co-editor in chief of *Acque Sotteranee-Italian Journal of Groundwater*. Since 2013, Member of Managing Board of SIMAI (Italian Society for Applied and Industrial Mathematics). Member of IAH and IAMGS (International Association for Mathematical Geosciences). Iacopo is currently employed as Senior Environmental Modeler at TEA Sistemi SpA, an Italian private company delivering research and consultancy services in energy and environment sector.

**Domitila Violeta Velasco Mansilla.** Ph.D (2013) at the Technical University of Catalonia (Barcelona, Spain) Around 9 years of experience in geological and hydrogeological characterization. Specific skills in 3D geological modelling of the sedimentary media. Field experience focused on groundwater monitoring and sampling. Experience in geotechnical and geophysical studies. Expertise in designing and developing spatial database and software platforms in GIS environments specifically oriented to hydrogeological analysis. Teaching experience in GIS applied to hydrogeology and in General Geology. Participation in national and international research projects. Co-director of two doctoral thesis. Reviewer and session chair of scientific international congress. Author of several papers in international journals.



**Enric Vázquez Suñé.** Ph D. in Geological Sciences (2003), at the Technical University of Catalonia (UPC), Barcelona (Spain). Research experience concentrates in the characterization of permeable media and the human impact by means of hydraulic, hydrochemical and environmental isotope data. Applications include groundwater resources evaluation, aquifer management, groundwater pollution control, seawater intrusion, interaction of civil works and groundwater, etc. Other tasks are related with developments in numerical groundwater modeling techniques. Director of several doctoral Thesis. More than 30 articles in SCI journals. Director of *Master Profesional de Hidrología Subterránea* (FCIHS-UPC) and Chief of Department of Geosciences of IDAEA (CSIC).

**Laura Foglia** is Research Associate at Technical University, Darmstadt, Germany. She holds a PhD in Environmental Engineering from ETH Zurich. Her research focuses on understanding integrated groundwater/surface water systems at local and macro-scale with emphasis on model calibration and uncertainty analysis and applications to different watersheds and with coupling to ecohydrological problems and to enhanced water management solutions. She worked for three years as consultant engineer in a private environmental company in Davis, California, and she was involved in large projects about water scarcity, salinity and nitrate loads in Central Valley. She teaches groundwater modelling courses at the TU Darmstadt.





**João Paulo Lobo-Ferreira**, Doktor-Ingenieur by the Technische Universität Berlin, Germany, is Principal Research Officer with Habilitation Degree, in the Board of Directors of LNEC for International Relations, since May 2013. Former Head of the Groundwater Division of Laboratório Nacional de Engenharia Civil, Lisbon, Portugal (1990-2013). Coordinator of more than twenty-five National, European, and International research projects funded by National funds and the EU, author of more than 300 publications, former President of the Board of Directors of the Portuguese Water Resources Association, he was awarded the "First Prize of Research Works on the Environment" by the Portuguese Secretary of State of the Environment and Natural Resources. Areas of activity: Mathematical modeling of flow and transport of pollutants in groundwater; Mathematical modeling of water balances including groundwater recharge assessment; Assessment of groundwater vulnerability to pollution; Geographical zoning for groundwater resources protection.

**Ezio Crestaz** is a geologist, with specializations in GIScience and Computer Science. Since 1986, he has been working at various ENI companies, in Italy and abroad, in geothermal, mining, water management, environmental protection and remediation fields, taking part, among others, in regional scale and transboundary projects funded by UNDP, OLADE and EC. Following a PostDoc position at JRC of the European Commission, focused on water-agriculture-energy nexus in developing and emerging countries, he currently works in Saipem SpA. Contract professor in groundwater hydrology at Camerino Un., in 2006-2007, and guest lecturer in GISc at Birkbeck College/UCL, London, in 2010-2013, he is author of various scientific contributions in groundwater hydrology, spatial analysis, spatial databases and GIS applications design and development.



**Andrea Chahoud**, graduated in Chemical Engineering at the University of Bologna in 1992. PhD in Safety and Environmental Chemical Engineering at the University of Bologna in 1997. Since 1997 he works for Emilia-Romagna Regional Agency for Environmental Protection (ARPA). Over the past decade his main activity has been referred to the following topics: groundwater flow and transport modeling, land subsidence modeling, artificial recharge of groundwater, groundwater modeling application to water resource ordinary and emergency management. Currently he is responsible of the Groundwater Modeling Working Unit inside the Technical Directorate of ARPA Emilia-Romagna. He joined the Editorial Board of Acque Sotterranee - Italian Journal of Groundwater in 2012.

**Paolo Severi**, geologist, since 1989 works in the Geological Survey of the Emilia-Romagna Region (Italy). His main fields of activity are: geological mapping in surface and subsurface of alluvial plains, 3D reconstruction of alluvial aquifers, groundwater studies in alluvial and coastal plains, implementation of EU Water Directives. Since 2012 he coordinated a large scale experiment on managed aquifer recharge in the alluvial aquifer of the Marecchia river fan. He presented over 30 speeches in scientific congresses and authored or co-authored over 50 scientific papers. Since 2014 he is contract professor of Geological Mapping at University of Bologna.

