



## Newsletters

# Newsletter

2

July 2023

### Highlights

- Assessing the spatial feasibility of MAR implementation at four Mediterranean demo regions
- Initiation and partial implementation of AQUATOOL and MODFLOW models to support decision-making processes
- Stakeholders engagement for needs assessments, co-development and validation of MAR feasibility maps
- Project presentation at conferences and mobility of staff members

Funded by

Financial support has been provided by PRIMA; a program supported by the European Union



## What is AGREEMAR?

**AGREEMAR** (*"Adaptive agreements on benefits sharing for managed aquifer recharge in the Mediterranean region"*) is a project funded under the PRIMA 2021 program for three years (Jun 2022 – May 2025).

## Work plan

**AGREEMAR** includes six work packages that cover stakeholders' engagement, feasibility mapping, groundwater modelling, governance frameworks and agreements, and project management.

## About the project

**AGREEMAR** will develop an adaptive governance framework integrated with a set of management tools that will assist water policy makers and water managers to reach sustainable water resources management.

## Demo sites

**AGREEMAR** approach will be validated at four case studies from Cyprus, Portugal, Spain and Tunisia, which will enable its integration into a larger context in the Mediterranean basin and worldwide.

## Objectives

**AGREEMAR** aims to optimize the hydrological balance by developing governance models, management strategies, technical specifications and simulation tools.

## Partners

**AGREEMAR** includes universities, public companies and national research centres from Germany, Spain, Cyprus, Portugal and Tunisia, together with stakeholders from four Mediterranean regions.



Discover more...

# Events

## AGREEMAR presented by the Cypriot partners at the Cyprus Info Day – PRIMA 2023 event, 9 February 2023

On 9 February 2023, the Cypriot partner Dr. Konstantinos Panagiotou presented the AGREEMAR project as invited speaker to the online event “Cyprus Info Day – PRIMA Call 2023”.

DRIVING GROWTH ▲



RESEARCH  
& INNOVATION  
FOUNDATION



RESEARCH  
& INNOVATION  
FOUNDATION



**PRIMA**  
PARTNERSHIP FOR RESEARCH AND INNOVATION  
IN THE MEDITERRANEAN AREA

### CYPRUS INFO DAY - PRIMA CALL 2023

The seminar was organised by the Research and Innovation Foundation of Cyprus and introduced the topics of the 2023 Call of the Partnership for Research and Innovation in the Mediterranean (PRIMA), under which also the AGREEMAR project is funded.

The list of speakers included Mr. Christos Aspris, Deputy Ministry of Research, Innovation and Digital Policy, Ms. Eda Demir and Mr. Marco Orlando, PRIMA Officers, and Prof. Adriana Bruggeman (Cyprus Institute) and Dr. Konstantinos Panagiotou (ERATOSTHENES CoE), local coordinators or two ongoing PRIMA-funded projects. The audience of

the webinar mainly consisted of academics from public and private organizations with activities related to the thematic areas of PRIMA and with interest in participating in the next call for proposals.

During his talk, Dr. Panagiotou shared his experience with application for PRIMA funding and answered questions from the participants of the seminar.

#### **Download meeting agenda:**

<https://www.research.org.cy/wp-content/uploads/Agenda-PRIMA-Info-Day-09022023.pdf>.

# Events

## A Master student from Martin-Luther-University Halle-Wittenberg conducted a three-month internship at the Polytechnic University of Valencia, February-May 2023

From 6 February to 6 May 2023, the Institute of Water and Environmental Engineering (IIAMA) at the Polytechnic University of Valencia (UPV) hosted Oskar Bensch, a visiting student from Martin-Luther-University Halle-Wittenberg (MLU) in Germany.



At MLU, Oskar is enrolled in a Master programme on Applied Geosciences with a focus on Hydrogeology. The first contact with the AGREEMAR team dates back from September 2022 during the 4<sup>th</sup> International Summer School on Managed Aquifer Recharge. At UPV, Oskar will advance his knowledge on MAR and will support the Water Resources Engineering Research group with the development of a numerical groundwater flow model for one of the Spanish demo sites. Oskar will collaborate with UPV and TUD partners on constructing the conceptual model and its implementation on the web-based modelling platform of the INOWAS group.

*Oskar Bensch (photo: personal archive)*



# Events

## Field visit by LNEC at the MAR site of Comporta wastewater treatment plant and local modelling area, 10 March 2023

On 10 March 2023, a team from LNEC conducted a field visit to the Portuguese study area with the main objective of collecting additional information to feed the numerical model to be assembled within the AGREEMAR project.



*Infiltration basins at Comporta wastewater treatment plant managed by Águas do Alentejo SA (AgdA) (photo: Marcel Horovitz)*

The National Laboratory for Civil Engineering (LNEC), with the authorization and collaboration of Águas do Alentejo SA (AgdA), has been continuously monitoring in the last month the groundwater temperature, electrical conductivity and level in the Comporta wastewater treatment plant / MAR site. The information gathered from monitoring the study site will provide a deeper insight on the aquifer conceptual model, particularly in understanding the possible interactions with the sea (at 2 km distance) and the groundwater quality variations induced by the implemented MAR infiltration basins. These basins were developed with the objective of infiltrating secondary treated wastewater effluent, allowing a further treatment during infiltration.

Besides interviewing the local community, the team at LNEC focused on inventory water points (wells) and collecting water level data to serve as calibration points. This recent visit was helpful to understand the local dynamics in water use and water needs, what are the main water sources available and how MAR implementation would be beneficial, not only the involved stakeholders but also the communities and businesses, particularly farmers and tourism. These two sectors are particularly relevant in the region and can be characterized as two of the main water users. This understanding is to be integrated in future MAR implementation agreements in order to mitigate possible water use conflicts.

# Events

## First meeting of the National Steering Committee of AGREEMAR project in Tunisia, 14 March 2023

The first meeting of the National Steering Committee of the AGREEMAR project in Tunisia took place at the National Agronomical Institute of Tunisia on 14 March 2023.



*First meeting of the Steering Committee of AGREEMAR in Tunisia. 14 March 2023 (photo: Anis Chkirbene)*

At the recommendation of several stakeholders, a National Steering Committee (STC) was formed in Tunisia under the coordination of the National Agronomical Institute of Tunisia. On 14 March 2023, participants from eight institutions in narrow relation to MAR attended the first meeting of the Tunisian Steering Committee of the project. After a brief self-introduction of the attendees, Catalin Stefan, the coordinator of AGREEMAR, took the (online) floor and presented briefly the main objective of the project and his expectations from the STC. After that, INAT team presented the

AGREEMAR project activities, progress in work packages, deliverables, and next steps. STC members discussed many points such as the involvement of further stakeholders with pertinent activity in treated wastewater. They also discussed the proposed weighting system and the proposed methodology for water availability, especially the used guidelines to assess the water quality standards for MAR use. Finally, the STC members have set a series of future meetings during the remaining project period with an overall frequency of four months.

# Events

## AGREEMAR presented at the 16<sup>th</sup> Portuguese Water Congress in Lisbon, Portugal, 22 March 2023

On 22 March (the World Water Day), the AGREEMAR project was presented by Dr. Teresa Leitão from LNEC at the 16<sup>th</sup> Portuguese Water Congress in Lisbon, Portugal with a talk entitled “Promoting Managed Aquifer Recharge Implementation in the Mediterranean Area. AGREEMAR Project and Expected Outputs”.



*Dr. Teresa Leitão (LNEC) presenting the AGREEMAR project at the 16<sup>th</sup> Portuguese Water Congress in Lisbon, Portugal, on 22 March 2022 (photo: Tiago Martins)*

The talk of Dr. Teresa Leitão was presented in the technical session “Groundwater Management in Scarcity Scenarios, Innovation and Adaptation and Threats to Water Resources” (see Book of Proceedings, pp. 139). The main project objectives and the possible outcomes were later discussed with the audience in a Q&A round, which evidenced the growing interest in complementary methodologies and sources for improving water resources management.

Looking into the outcomes of the 16th Water Congress, the topic of MAR has also been referred in other communications and keynotes, on par with the topics of automation/modernization of the water sector technologies. One of the most attended round-tables “Water scarcity in the

Southern Region of Portugal. How to Adapt to a new Context?” (see Book of Proceedings, pp. 19) was attended by the Director of the regional delegation of the Portuguese Environment Agency of Alentejo, one of the main Portuguese stakeholders, and who referred to the AGREEMAR project as one of the small steps forward in developing solutions to cope with the challenges ahead. Overall, MAR is slowly penetrating into the mindset of the water managers in Portugal. We hope that AGREEMAR can contribute to have MAR as a daily operation tool contributing to decrease water scarcity impacts in Portugal.

### **Download the Book of Proceedings:**

[https://www.aprh.pt/wp-content/uploads/2022/12/16CA\\_livro-de-resumos.pdf](https://www.aprh.pt/wp-content/uploads/2022/12/16CA_livro-de-resumos.pdf).



# Events

## Syrine Ghannem from Polytechnic University of Valencia conducted a one-month research stay in Tunisia, February – March 2023

From February 27, 2023, to March 13, 2023, Syrine Ghannem, a researcher of the AGREEMAR project at the Polytechnic University of Valencia visited the National Agronomic Institute of Tunisia in order to carry out a stay within the scope of work package 3 of the AGREEMAR project.



*Chiba dam is the main source of water for agricultural sector in the Chiba basin but is now completely empty due to prolonged periods of draught in the region (photo: Anis Chkirbene)*

During her one-month visit to Tunisia, Syrine Ghannem visited different Tunisian institutions in order to better understand the components of the Chiba basin and to gather the necessary data for the elaboration of a model of the basin in the AQUATOOL Decision Support System.

This model will be used to simulate different management strategies, and to support the water governance related to aquifer recharge.

**More info about the AQUATOOL software:**

<https://aquatool.webs.upv.es/aqt/en/aquatool-2>.



# Events

## Assessing the stakeholders' needs and demo site requirements in Cyprus, 27-31 March 2023

The AGREEMAR project reached a significant milestone with its latest needs assessment mission to the project demo site in Cyprus, spanning from 27 to 31 March 2023. During this mission, the project partners adelphi, ERATOSTHENES CoE and TU Dresden engaged in productive discussions with key stakeholders of the water sector and nature conversation.



*AGREEMAR partners adelphi and ERATOSTHENES CoE met on 28 March 2023 with representatives of Water Development Department (WDD) in Nicosia, Cyprus (photo: Ronjon Heim)*

The stakeholders involved in the mission included the Water Development Department (WDD), the Geological Survey Department (GSD), and the Federation of Environmental Organizations in Cyprus (OPOK). The focus of the discussions centred around strategically tailoring the project's results to the local needs and requirements of Cyprus. At the core of the mission was the establishment of trust, ownership, and encouragement of future collaboration with key stakeholders creating an environment conducive to co-creating agreeable results.

During the mission, the project team held bilateral meetings with key stakeholders, including the Water Development Department (Headquarter in Nicosia

and District Office in Limassol close to the demo site), Geological Survey Department, and OPOK. Discussions centred on stakeholder roles, interests, and demands for key project outcomes: feasibility maps, groundwater models, and MAR agreements. Existing MAR processes, institutions, conflicts, benefits, and perceptions were explored. Roles and cooperation steps for upcoming project activities were agreed upon. Findings were integrated into the stakeholder engagement strategy (D1.1 Plan), which was first published in January 2023 and is continuously refined throughout the project duration.

**Read more:** <https://shorturl.at/lpTZ7>.

# Events

## AGREEMAR at the International Training Course on “Conjunctive Management of Surface and Groundwater in the Mediterranean”, 17-19 May 2023

The AGREEMAR project was presented by Prof. Joaquín Andreu during the international Training Course on “Conjunctive Management of Surface and Groundwater in the Mediterranean” organized by UNESCO, between 17-19 May 2023 at the Júcar River Basin Agency, in Valencia, Spain.



*Prof. Joaquín Andreu (UPV) highlighted the project's main objectives during the international Training Course on “Conjunctive Management of Surface and Groundwater in the Mediterranean” held on 17-19 May 2023 in Valencia, Spain*

The international training course on conjunctive management of surface water and groundwater brought together water management experts, researchers, and policymakers. Prof. Joaquín Andreu highlighted the main objectives of the AGREEMAR project and engaged in a fruitful discussion with the attendees regarding the potential outcomes. The engagement and interest displayed by the attendees underscored the growing recognition of conjunctive management methodologies and diverse water sources as vital components for enhancing water resources management. The fruitful dialogue further highlighted the shared commitment to finding

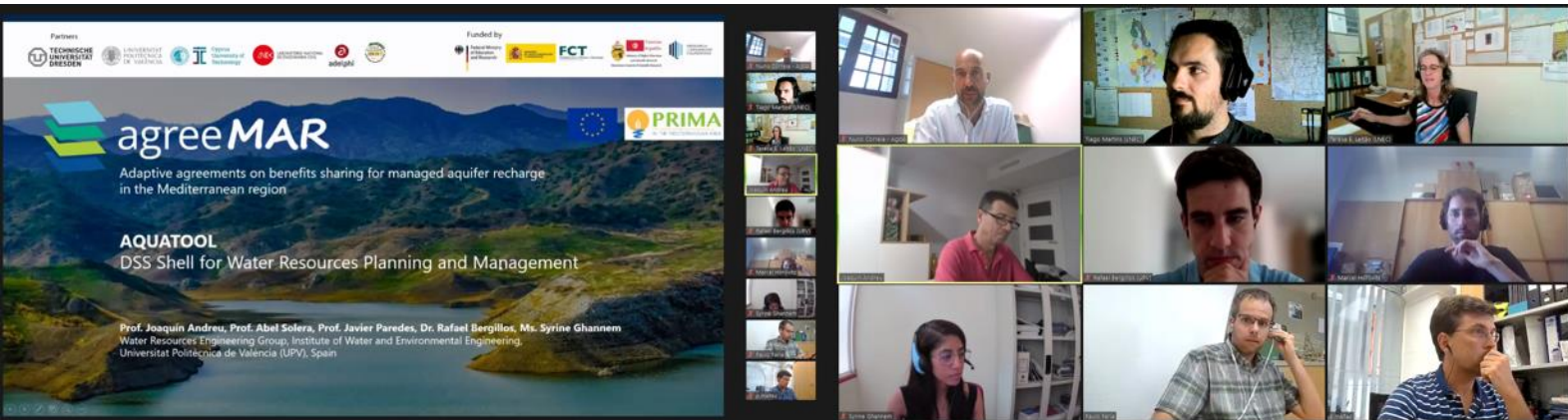
innovative approaches that promote sustainability and address the pressing water challenges faced in the Mediterranean region.

By featuring the AGREEMAR project in this training session, we aimed to raise awareness about the project's contributions and its potential to address pressing challenges in water governance and managed aquifer recharge systems. The interaction and feedback received from the attendees further validate the relevance and need for comprehensive and integrated approaches to water resources management.

# Events

## Online meeting with Águas do Alentejo (AgdA) to explore the development of an AQUATOOL model, 30 June 2023

An online meeting between LNEC, UPV and Águas do Alentejo (AgdA) took place on 30 June 2023 with the aim to discuss the possibility of supporting the decision-making on water management in Alentejo with the aid of an AQUATOOL model.



*LNEC, UPV and AgdA met online on 30 June 2023 to discuss the applicability of AQUATOOL for the Alentejo water supply system*

Within the framework of the work package 3 of the AGREEMAR project, an online meeting between LNEC, UPV and Águas do Alentejo (AgdA) was conducted on 30 June 2023. The scope of the meeting was to explore opportunities for the implementation of the AQUATOOL DSS at the AGREEMAR demo region Alentejo in Portugal.

During the meeting, a detailed introduction to the AQUATOOL capabilities and previous implementations was presented by Joaquín Andreu (UPV). The objective of this implementation is to reproduce a section of AgdA's water supply system within the whole water management model to support the decision-making process. The expected

outcome within AGREEMAR is to explore possible MAR solutions that may increase the water supply efficiency and resilience but, outside the project objective, is also aiming to provide AgdA with a decision-making support tool that may be useful for the overall management of the water supply system.

The structure of the necessary data was discussed in more detail, possible information gaps were identified and implementation milestones were delineated. AgdA is now in direct contact with UPV for the exchange of all the information necessary. The first step will be to provide the design of the water supply system.



# Events

## Validation workshop of the MAR feasibility maps in Tunisia, 13 July 2023

On 13 July, the MAR feasibility maps developed by the AGREEMAR team at INAT were validated in a participative workshop attended by representatives of relevant stakeholders in Tunisia.



*Participants of the AGREEMAR validation workshop organised by INAT on 13 July 2023 in Tunisia*

As part of the participative approach of AGREEMAR project in Tunisia, a validation workshop of the WP2 results with the key stakeholders from national, regional, and local levels was held on 13 July 2023 at the Department of Rural Engineering Water and Forests, Agronomic National Institute of Tunisia (INAT). The MAR feasibility mapping procedure was discussed with representatives from relevant stakeholders in Tunisia. The thematic maps of intrinsic site suitability, water availability and water demand were presented by INAT team and

discussed and validated by the participants. The MAR feasibility maps of the demo region of Chiba watershed in Tunisia were developed based on various weights of the three thematic layers. The final MAR feasibility maps were established based on a participative approach where the attendees applied the weighting process using the pairwise matrix method. The workshop was a successful event thanks to the engagement of the Tunisian partners from socio-economic and academic institutions.

# Events

## Validation of the MAR feasibility maps with the Water Authority of Alentejo at the Portuguese demo region, 27 July 2023

On 27 July 2023, the MAR feasibility maps developed by the AGREEMAR team at LNEC were discussed and validated in a meeting with the main regional stakeholder at the demo region in Portugal, the Water Authority of Alentejo (APA Alentejo).



*Representatives from LNEC and APA Alentejo met on 27 July 2023 in Évora to discuss and validate the MAR feasibility maps resulted from the AGREEMAR project*

On 27 July 2023, AGREEMAR project partners from LNEC met in Évora with representatives of the main regional stakeholder, the Water Authority of Alentejo (APA Alentejo). The research methodology used for the compilation of the feasibility maps and the results obtained were presented by LNEC, followed by a constructive discussion among all participants concerning the criteria selection, weighting procedure and maps reclassification.

Overall, the methodology was well accepted and appreciated by APA Alentejo, who considers the MAR feasibility maps an important tool that can provide the information needed for the decision procedures and strengthen the outcomes of their daily water licensing procedure, as well as supporting future implementation requests for MAR projects.

# Team

## New AGREEMAR team members

During the reporting period (January – July 2023), the AGREEMAR team received three new members who are currently supporting the teams at Laboratório Nacional de Engenharia Civil (LNEC), Portugal and Institut National Agronomique de Tunisie (INAT), Tunisia.



**MARCEL HOROVITZ**

**Laboratório Nacional de Engenharia Civil (LNEC), Portugal**

Starting with March 2023, the project team at the National Laboratory for Civil Engineering (LNEC) benefits of a new member. Marcel Horovitz is currently developing his PhD thesis on the subject of Soil-Aquifer Treatment at LNEC, Portugal and TU Darmstadt, Germany. He holds a German Diploma in Geology with emphasis in Hydrogeology and worked four years as hydrogeologist in a consulting company in Germany prior starting his PhD position at LNEC. In the AGREEMAR project he will support the team of LNEC in the development of a numerical groundwater model for one of the Portuguese demo sites.



**Dr KHAOULA KHEMIRI**

**Institut National Agronomique de Tunisie (INAT), Tunisia**

Starting with 15 April 2023, our Tunisian partner INAT received a new member: Dr Khaoula Khemiri will work as postdoctoral researcher at the National Institute of Agronomy of University of Carthage. Dr Khemiri holds a PhD in Hydraulic Engineering from the National Engineering School of Tunis (ENIT). She also holds a master degree in Hydraulic and Environmental Modeling and a degree of Hydro-Meteorological engineering from ENIT. Dr. Khemiri's research revolves around water resource management, climate change, and human activities utilizing GIS, geophysical methods, and modeling techniques.



**KEYLA ALPES**

**Laboratório Nacional de Engenharia Civil (LNEC), Portugal**

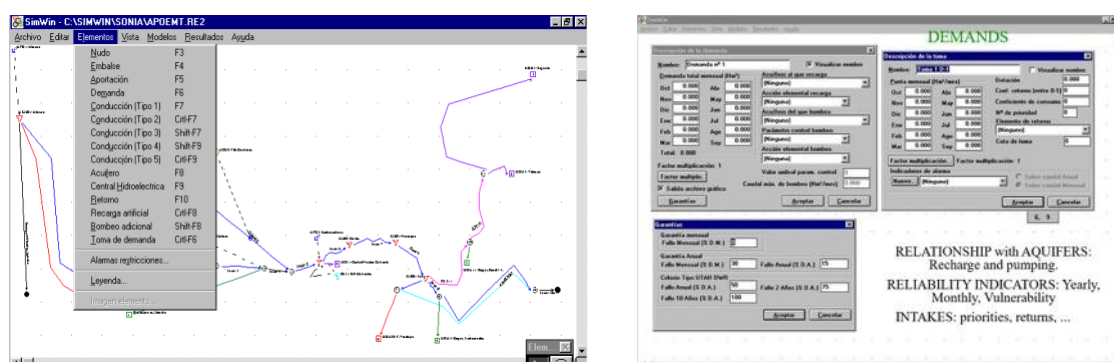
Keyla Alpes is currently a PhD student at New University of Lisbon (UNL) in Human Ecology. She holds a Master's degree in Development and Environment from the Federal University of Pernambuco, a degree in chemistry from the Catholic University of Pernambuco and a degree from Environmental Management from the Federal institution of Pernambuco, Brazil. Her research interests are water resource management and cohousing, collaborative methodologies, human ecology, environment conflicts. Keyla supports the team at LNEC since May 2023.



# Research

## Enhancing decision-making for managed aquifer recharge: insights from AQUATOOL models

The development and utilization of AQUATOOL models for the different demo regions within the AGREEMAR project offer significant potential for achieving a range of expected outcomes. These outcomes include the optimization of water resource systems by comprehensively characterizing the sources and understanding the relationships between water needs and water availability.



Screenshots from the AQUATOOL software showing different modules for data input and graphic representation

In AGREEMAR, AQUATOOL provide researchers, water managers, and policymakers with a holistic understanding of the feasibility, effectiveness, and potential risks associated with MAR projects in specific contexts. By leveraging the capabilities of the AQUATOOL models, stakeholders can make informed decisions, optimize MAR implementation strategies, and identify the most appropriate approaches tailored to the unique characteristics of each case study.

At the **Spanish** demo regions, dedicated AQUATOOL models were developed for both the Belcaire pond and the Algar reservoir. The process began by gathering the necessary data for both case studies, including hydrological parameters, information on existing infrastructures, water usage patterns and socio-economic factors. Once the necessary data was collected, the AQUATOOL model was implemented and customized to suit the specific characteristics of each case study. The model was then calibrated using historical data to ensure its accuracy and reliability in representing the hydrological dynamics and associated water resources of the study areas. Subsequently, various management scenarios were simulated, encompassing aquifer recharge strategies, wastewater management practices, and water

desalination techniques. The simulations aimed to evaluate the potential impact of these scenarios on MAR and determine their effectiveness in improving water availability.

For the **Tunisian** demo region in the Chiba River basin, data gathering was conducted within the country through several meetings with various stakeholders. The purpose of these meetings was to gain a comprehensive understanding of the different components of the water system in the region. Following these meetings, the implementation of the AQUATOOL model began but it is still in progress due to data gaps that have been encountered.

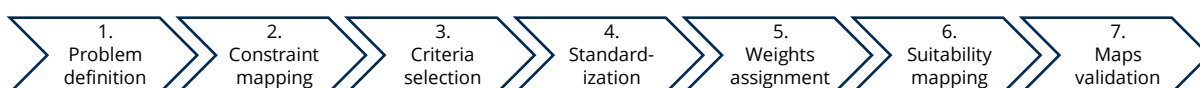
For the **Portuguese** demo regions of Alentejo and Algarve, data gathering has been initiated through a meeting with the Águas Públicas do Alentejo (AgdA) in which the objectives and applications of utilizing the AQUATOOL models were discussed. Through collaboration with AgdA and the acquisition of relevant data, the AQUATOOL model will provide valuable insights into the potential benefits and challenges of MAR implementation in these Portuguese regions.

In **Cyprus**, the implementation of AQUATOOL is planned to start after the summer vacation.

# Research

## Assessing the spatial feasibility of MAR implementation at four Mediterranean demo regions using a GIS-based multi-criteria decision analysis

The activities in work package 2 focused on the development of spatial feasibility maps for the implementation of MAR projects in four AGREEMAR demo regions. The maps were compiled following a seven-step methodology that involved participatory activities with regional and national stakeholders from Tunisia, Spain, Portugal and Cyprus. The final feasibility maps will be published in the deliverable D2.3 at the end of August 2023 and will be available for download on the project website.



*The methodology for MAR feasibility mapping followed seven steps, from defining the governing objectives to participative validation of the maps involving representative stakeholders from the demo regions in Spain, Portugal, Tunisia and Cyprus*

A comprehensive list of feasibility criteria was published in October 2022 in the deliverable **D2.1** (<https://shorturl.at/sBH68>) and the participative methodology for criteria selection and weighting was described in the deliverable **D2.2** (<https://shorturl.at/dhjZ0>).

Based on these preliminary works, the activities in WP2 continued in 2023 with the compilation of three sets of maps following a seven-step methodology:

**Step 1.** At each demo region, two MAR typologies were agreed with regional stakeholders in respect to site-specific MAR objectives, technical infiltration methods, available water sources and other local considerations. These typologies were decisive for the selection of criteria and their relevance.

**Step 2.** Some preliminary conditions restricting the implementation of MAR were identified and mapped, including challenging terrain features, geopolitical considerations, land use limitations and inadequate subsurface characteristics. These areas were either excluded from further analysis or rendered as unsuitable for MAR implementation.

**Step 3.** In total, 39 criteria were used to describe the physical and hydraulic characteristics of the aquifer and the unsaturated soil zone, the surface morphology, the climatic context, the surface water availability and the provisioning, regulatory and supporting ecosystem services. A different set of

criteria was used at each demo region following the specific MAR typology agreed with stakeholders.

**Step 4.** A common standardization methodology was developed for the reclassification of selected criteria, bringing all values into a 0 to 1 range to facilitate further GIS-based calculations.

**Step 5.** Two parallel workflows were used to describe the relevance of each criterion in the general analysis: a) by integrating the impact of non-physical criteria (i.e., implementation costs, awareness for MAR, etc.) on the physical criteria (general expert-based analysis conducted by AGREEMAR consortium, valid for all demo regions), and b) by ranking the criteria using public consultations with regional stakeholders (site-specific, different for each demo-region). The final weights were obtained by averaging these two datasets.

**Step 6.** A set of suitability maps was compiled for each demo region using the site-specific criteria and average weights presented above. In particular cases, the seasonal climate variability was considered in the assessment of water availability and for water demand characterisation.

**Step 7.** The final maps were validated by stakeholders in joint participative workshops, where further discussions were initiated regarding potential development scenarios for an integrated management of water resources.

# Research

## Numerical groundwater flow modelling using MODFLOW and the web-based platform INOWAS.com

Numerical groundwater flow models will be developed in MODFLOW for the validation of spatial feasibility maps in regard to the quantitative evaluation of MAR impact on the groundwater resources at local and regional scale. The models will be implemented on the web-based modelling platform inowas.com to allow an interactive model development and analysis with active stakeholders' participation.

In January 2023, the research activities in the working package 4 started with the definition of the modelling objectives at the various AGREEMAR study sites together with the local stakeholders taking into account the main social and environmental challenges affecting the local water use. Currently, historical hydrogeological, hydrological and meteorological data is gathered at all demo regions and field investigations are taking place to be able to define the conceptual models for

the case study sites. As a next step, regional groundwater flow models representing the current groundwater status (business-as-usual) and implementation of MAR scenarios will be implemented on the web-based INOWAS platform (<https://www.inowas.com>). This will also include the calibration and validation of the base models with the help of observation data. First model results are expected already this autumn.

**SEAWAT** VDF VSC Variable-density groundwater flow

**MT3DMS** BTN ADV DSP SSM GCG Groundwater solute-transport

**MODFLOW-2005** Groundwater flow

Columns: 1 2 3 4 5 6 7 8 9  
Rows: 1 2 3 4 5  
Layers: 1 2 3 4 5

**Model creation and run**

- Domain discretization  
model grid, stress periods
- Model layers  
top-bottom elevation, soil hydraulic parameters
- Boundary conditions  
CHD WEL RCH RIV GHB EVT DRN
- Head observations  
model calibration

**Data acquisition and processing**

- Manual input  
draw-on-map, input numerical values
- Upload files  
GeoJSON, CSV, TIFF data formats
- Import from external sources  
sensors, external data providers

**Results visualisation**

- Cross sections  
2D map of groundwater heads / drawdowns with cross-sections (by model layer and stress periods)
- Time series  
groundwater heads vs. time (transient models)
- Scenario analysis  
comparison of heads in multiple scenarios

INOWAS

The INOWAS platform uses MODFLOW-2005, a three-dimensional finite-difference groundwater model that can be used to simulate steady and transient water flow through an aquifer system. The user can create groundwater flow models equipped with additional packages for solute transport (MT3DMS), variable-density flow and transport (SEAWAT), as well as scenarios analyser and semi-automatic groundwater flow modelling using (near) real-time sensor data.



# Publications

## Conference contributions

- Leitão, T., Martins, T., Oliveira, M., Stefan, C. (2023) **Promoting managed aquifer recharge implementation in the Mediterranean area. The AGREEMAR project and expected outputs.** Presentation at 16<sup>th</sup> Congresso de Água "Viver com a Água". Lisbon, Portugal, 21-14 March 2023. <https://bit.ly/3ndxD5X>
- Chekirbane, A., Panagiotou, C.F., Dorsaf, A., Stefan, C. (2023) **A coupled GIS-MCDA approach to map the feasibility of Managed Aquifer Recharge.** Presentation at the General Assembly of the European Geosciences Union (EGU2023), Vienna, Austria, 23-28 April 2023. <https://doi.org/10.5194/egusphere-egu23-8315>

## Invited talks

- Panagiotou, C. (2023) **AGREEMAR PRIMA Project: A journey from failure to success.** Invited talk at the online seminar "Cyprus Info Day – PRIMA 2023" organised by the Research and Innovation Foundation of cyprus. 9 February 2023, online event.

## Project deliverables



### Deliverable #D3.1

Preliminary analysis of indicators and methodologies for decision-making

### D3.1 Preliminary analysis of indicators and methodologies for decision-making

The deliverable D3.1 provides a preliminary analysis of indicators and methodologies for decision-making and highlights the importance of integrated water management and the use of indicators for planning and sustainable exploitation of managed aquifer recharge (MAR) projects.

**Download report:** <https://shorturl.at/qyAIY>.





# Acknowledgement

The AGREEMAR project is funded by National Funding Agencies from:

- Germany: Bundesministerium für Bildung und Forschung (BMBF), grant no. 02WPM1649
- Cyprus: Research & Innovation Foundation (RIF), grant no. 0321-0024
- Portugal: Fundação para a Ciência e a Tecnologia (FCT), grant no. PRIMA/0004/2021
- Spain: Agencia Estatal de Investigación, Ministerio de Ciencia e Innovación (MCI), grant no. PCI2022-133001
- Tunisia: Ministère de l'Enseignement Supérieur et de la Recherche Scientifique (MESRSI), grant no. PRIMA/TN/21/07.

The project is funded under the Partnership for Research and Innovation in the Mediterranean Area (PRIMA). The PRIMA Programme is supported under Horizon 2020 by the European Union's Framework for Research and Innovation.

## Contact

### Project coordinator

**Dr Catalin Stefan**

Technische Universität Dresden (TUD)  
Institute of Groundwater Management (IGW)  
Research Group on Managed Aquifer Recharge  
(INOWAS)

Helmholtzstr. 10  
01069 Dresden, Germany  
+49 351 463-44144  
[catalin.stefan@tu-dresden.de](mailto:catalin.stefan@tu-dresden.de)  
[www.agreemar.inowas.com](http://www.agreemar.inowas.com)

### Coordinators of demo regions

**SPAIN****Prof Joaquín Andreu**

Universitat Politècnica de  
València (UPV), Institute of  
Water and Environmental  
Engineering (IIAMA),  
Water Resources  
Engineering Research  
(WRER) group  
+34 963 877 614  
[ximoand@upvnet.upv.es](mailto:ximoand@upvnet.upv.es)

**PORTUGAL****Dr Teresa E. Leitão**

Laboratório Nacional de  
Engenharia Civil (LNEC),  
Hydraulics and Environment  
Department  
+351 218 443 802  
[tleitao@lnec.pt](mailto:tleitao@lnec.pt)

**CYPRUS****Dr Constantinos  
Panagiotou**

ERATOSTHENES Centre of  
Excellence, Cyprus  
University of Technology,  
Department of Civil  
Engineering and Geomatics  
+357 25 002500  
[co.panayiotou@cut.ac.cy](mailto:co.panayiotou@cut.ac.cy)

**TUNISIA****Dr Anis Chekirbane**

Institut National  
Agronomique de Tunisie  
(INAT), University of  
Carthage  
+216 23 482 882  
[a.chkirbane@ecopark.rnrt.tn](mailto:a.chkirbane@ecopark.rnrt.tn)