

Interreg



CENTRAL EUROPE

European Union
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DEEPWATER-CE

DEEPWATER-CE
MAY 2019 - APRIL 2022
NEWSLETTER / 4



YEAR 2 / APRIL 2021

<https://www.interreg-central.eu/Content.Node/DEEPWATER-CE.html>

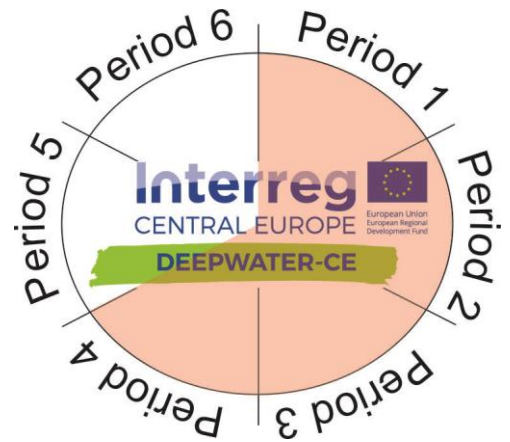


Introduction

DEEPWATER-CE partners join their forces to develop integrated environmental management capacities of responsible public actors for a comprehensive transnational water resources approach and adoption of MANAGED AQUIFER RECHARGE (MAR) solutions in Central European countries as a solution to climate change inducing water scarcity and decreasing usage conflicts with other social and economic sectors!

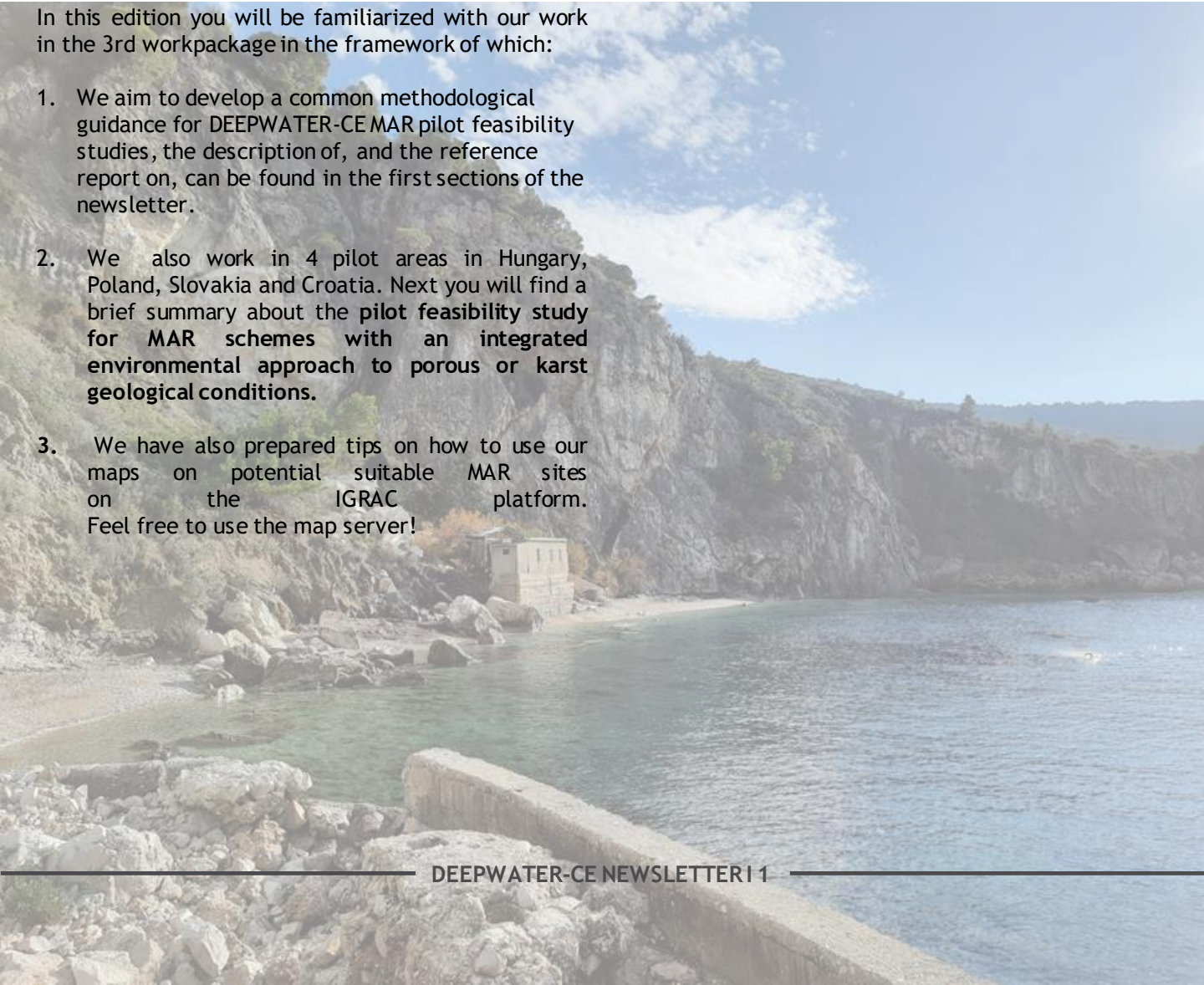
We encourage you to familiarize yourself with our current project activities and achievements.

We have been cooperating to achieve the project goals for 2 years!



In this edition you will be familiarized with our work in the 3rd workpackage in the framework of which:

1. We aim to develop a common methodological guidance for DEEPWATER-CE MAR pilot feasibility studies, the description of, and the reference report on, can be found in the first sections of the newsletter.
2. We also work in 4 pilot areas in Hungary, Poland, Slovakia and Croatia. Next you will find a brief summary about the **pilot feasibility study for MAR schemes with an integrated environmental approach to porous or karst geological conditions.**
3. We have also prepared tips on how to use our maps on potential suitable MAR sites on the IGRAC platform. Feel free to use the map server!



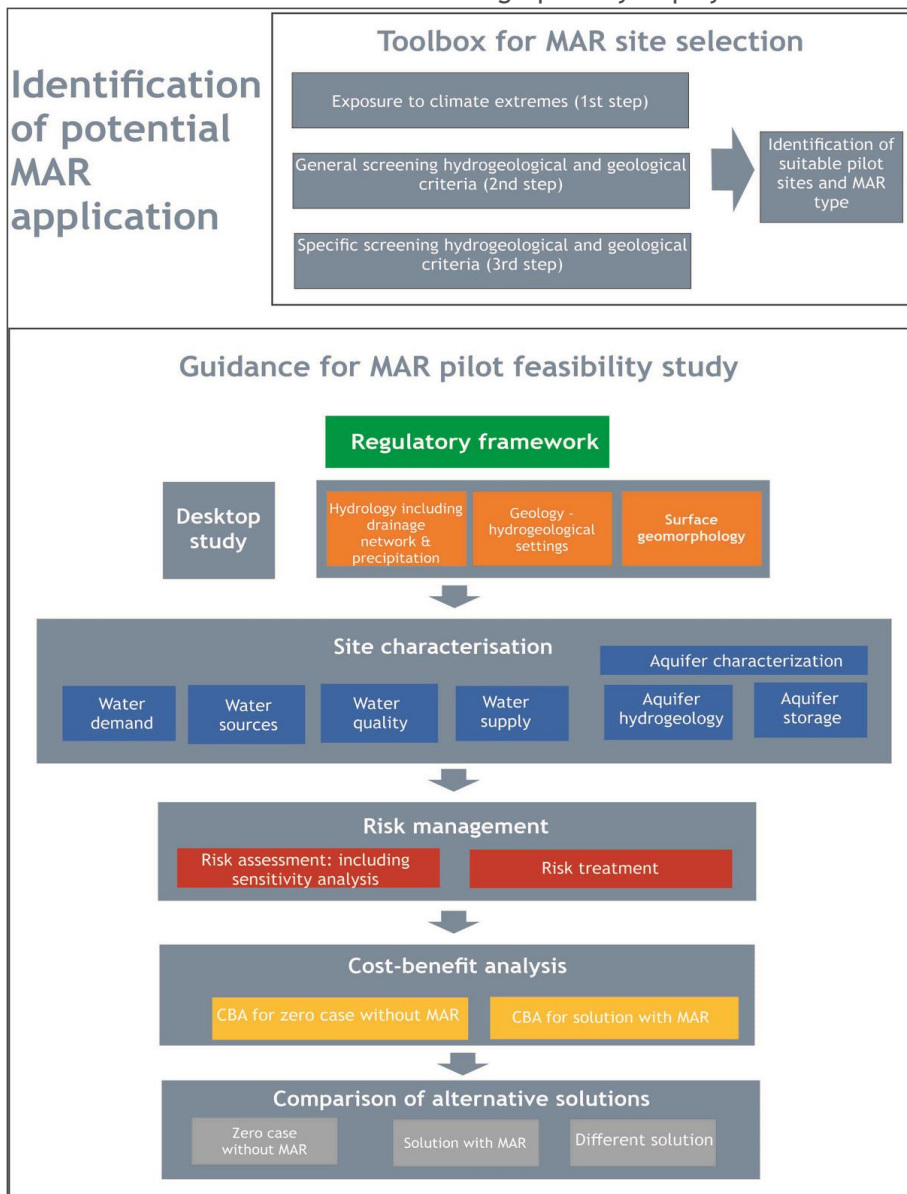


WORK PACKAGE 3

Feasibility assessment of MAR schemes in CE

In the second work package we have developed a transnational decision support toolbox for identification of potentially suitable MAR locations in Central Europe (output O.T2.1). Based on this toolbox, pilot sites with applicable MAR types can be found (deliverables D.T3.3-6.1-5).

In the third work package, we aim to develop a common methodological guidance for DEEPWATER-CE MAR pilot feasibility studies in order to assess the actual feasibility of the identified potentially suitable MAR site for special MAR type using the toolbox. In the following figure the connection between the toolbox and the feasibility study for MAR pilot sites is graphically displayed.



Connection between the toolbox and the feasibility study for MAR pilot sites.



WORK PACKAGE 3

COMMON METHODOLOGY for carrying out pilot feasibility studies for MAR projects, including risk management approaches.

The common methodological guidance for DEEPWATER-CE MAR pilot feasibility studies (deliverable D.T3.2.5), is composed of six components (previous figure). Within the methodological guidance, literature studies concerning suited approaches for the components are given.

In the first step the user will identify the **regulatory framework** of the MAR schemes. We have summarized the national legislation of the four partner countries. They are in line with the European Union legislative framework for the implementation of MAR solutions.

The **initial desktop study of the pilot site** will identify, with rudimentary and readily available information, the degree of difficulty of the project and will assess whether the pilot site is suitable for the intended project under application of reasonable efforts. This will be done with existing records in archives by the regional governments and also by field visits.

After having conducted a desktop study and having obtained a positive decision about the commencement of the project, further investigation for the planning and implementation of the MAR scheme will be carried out in the form of a **site characterization process**. The objectives of the site characterization will be to answer the questions, whether there are sufficient demand and supply possibilities for water, whether the aquifer is suitable for storage and recovery of the required volume of water and whether there is sufficient space available to capture and treat the water.

Risk management of the MAR scheme will be carried out in a next step. It will include the identification of all potential risks, their analysis and their evaluation. Furthermore, also risk treatment and prospective risk monitoring schemes will be proposed.

An economic evaluation of water projects in most cases aims to determine whether their benefits justify anticipated costs and/or to compare alternative options. A **cost-benefit analysis** is proposed to determine the economic feasibility of the project.

In order to objectively assess the feasibility of the MAR scheme it can be helpful to **compare the intended MAR scheme to other technical solutions** (e.g. water treatment plants, desalination plants, changed irrigation schemes) that could meet the same goal. Also the comparison to a solution without any technical implementation (the „blank” case) can be useful. Technical, social and economic aspects, as well as environmental aspects, can be considered to enable this a comparison.

Combining the toolbox from the second work package with the steps proposed in the common guideline for MAR pilot feasibility studies can help the user identify potentially suitable and feasible MAR sites. Do not hesitate to contact us, and download your copy of our documents on <https://www.interreg-central.eu/Content.Node/DEEPWATER-CE.html>.



WORK PACKAGE 3

The Pilot Feasibility Study for MAR schemes with integrated environmental approach in porous geological conditions in HUNGARY

MAR SOLUTIONS IN FOODPLAIN ALLUVIAL SYSTEMS

In the framework of the Hungarian pilot action (in the Maros alluvial plain), the investigation of a potential underground dam has been continued. The result of the final site selection was an area located between the settlements of Csanádapáca and Medgyesbodzás, in an agricultural region irrigated by drainage channels, and crossed by a paleo-river channel.

Archive geological, hydrogeological and geophysical data have been reviewed and interpreted. Based on this information, the fieldwork has been carried out. Geophysical geoelectric (ERT) measurements were performed perpendicularly to the paleo-river beds mapped on topographic maps. Modified Cone Penetration Tests combined with borehole log measurements (GCPT) and groundwater sampling (partly linked to the GCPTs) were also performed.

This provides information to refine the hydrogeological conceptual model and improves the reliability of the numerical hydrogeological model for assessment of suitability and effectiveness of a prospective underground dam.

The groundwater sampling was done on March 22, the World Water Day, emphasizing the importance of sustainable groundwater management. One of its tools is the application of MAR systems.



Start of the fieldwork day.



Geophysical geoelectric (ERT) measurements.



WORK PACKAGE 3

The Pilot Feasibility Study for MAR schemes with integrated environmental approach in porous geological conditions in POLAND

MAR IN AQUIFERS NEAR INDUSTRIAL SITES

During the past six months of the pilot feasibility investigations, we were able to carry out most of the planned work, including:

- shallow hand probe drilling,
- drilling of new piezometers,
- installation of data loggers for continuous measurement of groundwater table fluctuations, temperature, and electric conductivity,
- periodical hand measurements of groundwater and surface water level,
- field measurements of physicochemical parameters of surface water and groundwater carried out a monthly basis coupled with water sampling for isotopic analyses,
- chemical analyses of water including ionic composition, occurrence of pharmaceuticals and personal care products (PPCP), surfactants, microplastic and organic compounds,
- chemical and mineralogical analyses of soil samples and sediments collected from the bottom of the ditches.

lot of valuable information and archive data about the pilot site, which help us to understand the conditions of groundwater flow and how the quality of the abstracted groundwater is shaped.

The feasibility study is conducted for two types of MAR in Poland and includes induced river bank filtration and the infiltration ditches. The investigation will be supported by numerical hydrological and hydrogeological models.

To properly conduct our field investigation, laboratory analyses and numerical modeling, we have also collected a number of archival data including, among others, environmental maps, detailed climatic data, hydrogeological documentations, and archival chemical analyses.

Over the next few months, we will continue to conduct measurement of groundwater level and periodical chemical analyses of groundwater and surface water.



Periodical water sampling for chemical and isotopic analyses of groundwater and surface water.



Drilling of piezometers to collect water and soil samples.



WORK PACKAGE 3

The Pilot Feasibility Study for MAR schemes with integrated environmental approach in porous geological conditions in SLOVAKIA

MAR IN POROUS AQUIFERS IN AREAS USED FOR FOR AGRICULTURAL PURPOSES

The pilot site area is located in Podunajska Lowland at Zitny ostrov, in the territory delineated by towns Samorin, Dunajska Streda and Gabčíkovo. There are favourable geological and hydrogeological conditions with technical tools to regulate the flow in irrigation channels. i.e. creating the recharge dam-type MAR site.

Focusing on pilot site area, PP6 elaborated a desk analysis summarizing relevant available archive data and information. These data were used for pilot site area characterization, mainly characteristic of its geomorphology, climatic conditions, land use, hydrology, geology and hydrogeology. Aspects of the existing infrastructure and regulatory limitations were also considered. More precise information on the hydraulic conductivity of soil in order to evaluate the amount of potentially infiltrated water are needed, so additional soil sampling and soil properties measurements are planned for spring/summer 2021.

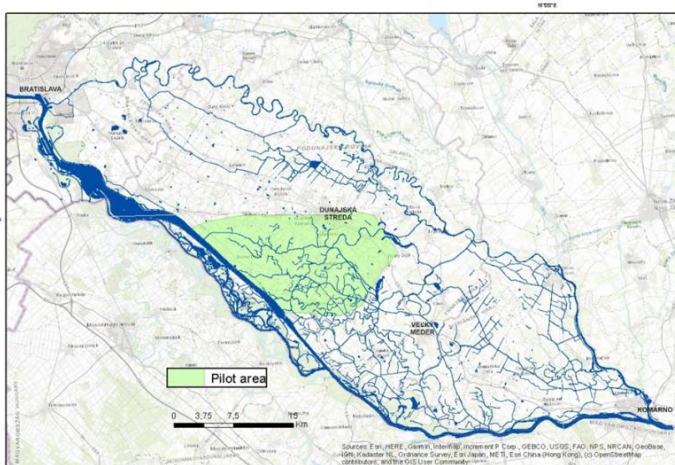
Moreover, mobile sampling equipment will be used for soil sampling and for groundwater level measurements.

Consequently, the soil samples will be taken to a laboratory to measure the hydraulic properties of the soil. The aim of the soil hydraulic conductivity measurements is to investigate the lateral influence of the surface water level fluctuation on the groundwater level and potential volume of infiltrated water from the recharge dam.

All obtained information will be used for modelling to set up boundaries and determine initial conditions for the numerical modelling of the surface and groundwater flows interaction.

They will enter models as input parameters used for calibration of the models (meteorological and climatological data, data on surface water levels, flows in channels, groundwater levels, and soil and rocks hydraulic properties). The HYDRUS 2D and MODFLOW models will predict trends of groundwater level fluctuations for the future. The field work and the modelling are being done by the Water Research Institute in cooperation with the Slovak University of Technology, Bratislava.

The desk analysis is a prerequisite step in proper planning of the work, looking for suitable technical solutions and for successful construction of MAR systems.



Pilot area localization in Slovakia.

Soil sampling and soil properties measurements.





WORK PACKAGE 3

The Pilot Feasibility Study for MAR schemes with integrated environmental approach in karst geological conditions in CROATIA

MAR IN AQUIFERS LOCATED IN SEMIARID KARST AREAS

In WP3, experts from the Split Water & Sewerage Company and the Croatian Geological Survey worked on the development of the report on *The desk analyses of the pilot feasibility studies*, where we have analyzed the existing knowledge and data related to geographic, geological, hydrogeological, climatological, and socio-economic characteristics of the pilot areas and potential pilot sites. Furthermore, we continue our efforts to produce suitability maps for the application of the six methods of managed aquifer recharge in the county of Split-Dalmatia. Maps and accompanying data will be publicly available on the DEEPWATER-CE's official site, social media, as well as on the IGRAC website. The basis and methodology for the development of suitability maps were demonstrated within WP T2, and special considerations were made for karst terrains which are very complex and characterized by extreme heterogeneity, rendering the MAR scheme difficult to investigate or implement.

Regarding the fieldwork and activities, continuous monitoring of groundwater levels goes on, as well as periodical hydrogeological and structural-geological investigations. Acquired data is processed in the Croatian Geological Survey. Based on available data, new findings spring from month to month as we proceed with the feasibility study. All the activities and deliverables from WP T3 will provide an answer whether the operation of a MAR project is feasible, sustainable, and necessary in various geological environments of Central Europe.



Groundwater level measurement.



Hydrochemical measurements of water.



WORK PACKAGE 3

The set of prepared GIS data and Global Groundwater Information System (GGIS) of IGRAC

Within the DEEPWATER-CE project, the decision support toolbox was developed to facilitate identification of **Managed Aquifer Recharge (MAR)** locations in Central Europe (output O.T2.1, DEEPWATER-CE, 2020b).

The methodology chosen for the investigation into potentially suitable MAR locations consisted in the selection of site based on specific climatological, hydrogeological and geological criteria based on archive data and on opinions of experts. **These criteria are spatial and can be depicted on maps.**

As part of Work Package 3, a set of maps for the four partner countries (HU, HR, SK, PL) was created. It contains the **climatological maps** as well as **MAR suitability maps**, representing areas potentially suitable (preferred) for implementing MAR methods.

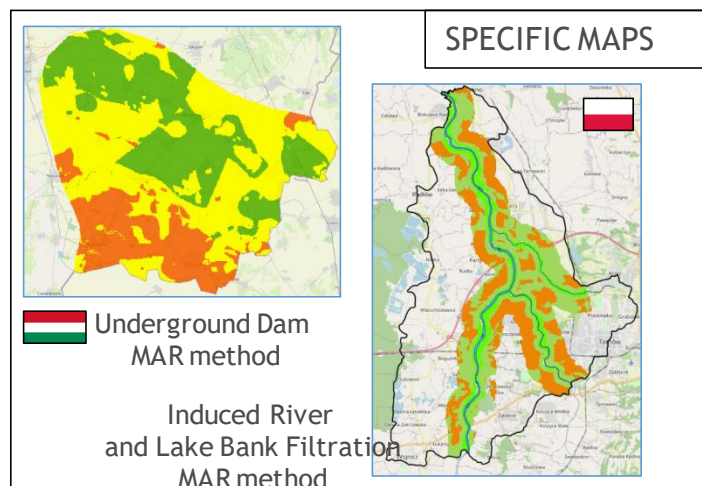
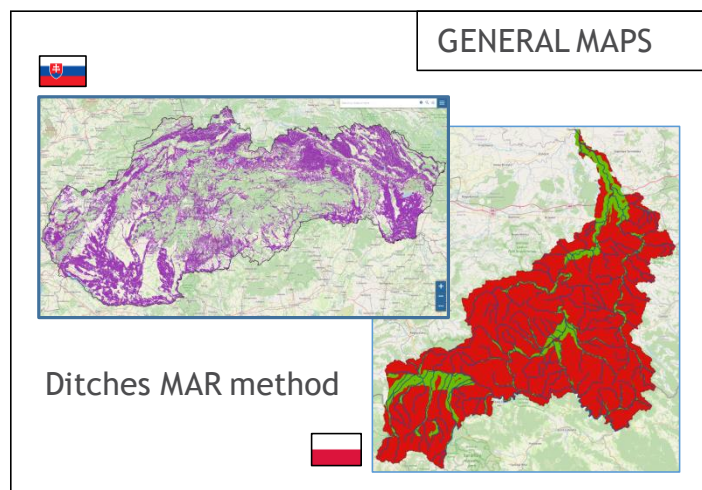
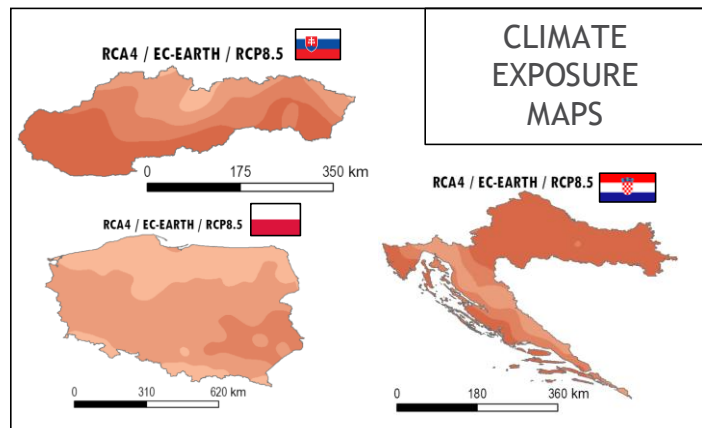
The suitability maps are created in two levels of detail: general and specific.

The general maps include spatial representations of potentially suitable MAR sites in the partner countries, on the country or regional level (with the subdivision into suitable and non-suitable sites).

The specific maps go one step deeper and focus in greater detail (the subdivision into low, moderate and high suitability) i.e. on hydrogeological and geological aspects of the regions, which were identified as potentially suitable during the general mapping.

In order to ensure long-lasting impact of the project and to disseminate the result of our work, the climatological, general and specific maps have been made accessible in the Global Groundwater Information System (GGIS) of IGRAC (<https://ggis.un-igrac.org/>).

Based on these solutions, all the maps are available to for the stakeholders from Central European and other countries interested in the MAR technology via this easily accessible platform.





WORK PACKAGE 3

The set of prepared GIS data and Global Groundwater Information System (GGIS) of IGRAC

MAPS PRODUCED BY THE MODELLING

CLIMATE EXPOSURE MAPS

32 maps in total
8 maps for each country
(HU, HR, SK, PL)

The exposure maps for Central Europe (as defined in the *D.T2.2.1report*) were prepared for 4 simulations (regional climate models run by 2 different global climate models and based on 2 scenarios), for 2 future periods (2021-2050 and 2071-2100).

The reference period of the modelling was 1971-2000.

GENERAL AND SPECIFIC MAPS

30 maps in total.

6 general level maps for each country, representing suitability of the 6 MAR methods: Ditches, Induced River and Lake Bank Filtration, Aquifer Storage and Recovery, Infiltration Ponds, Underground Dam and Recharge Dam.

Two specific level maps for Poland (IRLBF & Ditches), and two for Croatia (ASR & IP).

One specific level map for Hungary (UD) and one for Slovakia (RD).



<https://ggis.un-igrac.org/groups/group/deepwater-central-europe/>



WORK PACKAGE 3

The set of prepared GIS data and Global Groundwater Information System (GGIS) of IGRAC

HOW TO VIEW THE MAPS?

1. Enter the <https://ggis.un-igrac.org/address> in the browser, then:

2.

3.

Search for the maps you are interested in, using different filtering methods, e.g.:

- by keywords (MAR);
- by groups (DEEPWATER - Central Europe);
- by popularity
- by date, regions etc.

4. You can also register and create your own maps!



Activity on the World Water Day!

In connection with the World Water Day, we distributed in our social media and Virtual Square platform a sparkling thought about water using the graphic prepared by UN-Water

<https://www.worldwaterday.org/learn>

(Twitter: [#WATER2ME](https://twitter.com/WATER2ME)).



2021 Valuing water

HUNGARY

Groundwater sampling from a monitoring well on the World Water Day (22nd March) in the Hungarian pilot site between Csanádapáca and Medgyesbodzás.



Groundwater sampling in Hungary.

POLAND

In celebration of the Water Day, we invited journalists to join us during our fieldwork in the Tarnów research area.

The result of the interviews is the recording available in Polish under the link: https://www.tarnowska.tv/wiadomosci/7861_naukowcy-badaja-ujecie-wody-w-tarnowie



Journalists' visit at the field research site in Poland.



CROATIA

During the March fieldwork campaign, we participated in radio interview for local Nautic Radio Komiža station (March 24). Their broadcast series „Pogled s Huma” often hosts scientists and researchers of various disciplines who investigated the island of Vis. We spoke about the big drought that occurred in 2020, water conservation methods, status of investigations within DEEPWATER-CE, and upcoming activities and events.



Other project activities!

THE PRESS CONFERENCE ABOUT PILOTS STUDI

POLAND

Cooperation between the Univeristy of Silesia in Katowice and the Tarnów Waterworks
18/03/2021

As a result of the smoothly developing work in the pilot area, we held a press conference to show the local community of Tarnów the progress of our international research projects they can see for themselves just around the corner from their homes. The recording available in Polish can be found here:

<https://youtu.be/axEd-l13ICo>



The press conference at the pilot site in Poland.

THE JOURNALIST'S ON-SITE VISIT

POLAND

The Univeristy of Silesia in Katowice, in cooperation with the with Tarnów Waterworks invited local media to visit the research site on 22.03.2021. They watched us while we were taking measurements for the project's research.

Recorded material in Polish here:

<https://www.youtube.com/watch?v=3l5AJ5D5tjs&list=PLS8PmiBP4eX9zXdhQLZ1SNlbWmA6wVgDZ>



Journalists and TV at the Tarnów groundwater intake site.

CROATIA

To celebrate the Earth Day (April 22), our Croatian parter also invited a local journalist for a quick tour and an interview in Korita, the main water pumping site on the island.

They summarized ongoing and upcoming activities in DEEPWATER-CE and explained the main principles of karsts aquifer and how groundwater is infiltrated, recharged, and abstracted.

They also elaborated a conceptual model of implementing the infiltration pond and the ASR - the two most promising methods of a MAR project here.

The interview was aired on April 21 by the Nautic Radio Komiža station, in the popular broadcast series that often covers scientific topics - „A view from Hum”.



Journalist on a site visit to Korita.



VIRTUAL SQUARE!

As a part of our activities we have launched the NATIONAL VIRTUAL SQUARE on LinkedIn!

What is a NATIONAL VIRTUAL SQUARE?

The Virtual Square (VS) is a place for everyone who is interested in a hydrogeological topic, who wants to learn more about the Managed Aquifer Recharge (MAR) and who wants to share their opinion and knowledge about MAR systems with us.

The VS is an online platform using LinkedIn, aiming to facilitate cooperation within cross-sectoral stakeholder groups (CSSGs).

A stakeholder can be a person, a group of persons or a representative of an institution interested in DEEPWATER-CE topics and in results that can be implemented locally in the future.

See our publications on the VIRTUAL SQUARE!

- We published the D.T3.2.5 report and information on our progress related to:
THE COMMON METHODOLOGICAL GUIDANCE FOR DEEPWATER-CE MAR PILOT FEASIBILITY STUDIES
The guidance includes three main components:

- (1) guidelines for water demand and supply determination (D.T3.2.1),
- (2) guidelines for technical solutions to characterize a pilot site (D.T3.2.2),
- (3) guidelines for Cost-Benefit Analysis (CBA) of the MAR scheme (D.T3.2.3).

- We have also provided access to our maps in collaboration with IGRAC, on the online platform.
[Maps available here!](#)

National Virtual Squares

HUNGARY



GERMANY



POLAND



SLOVAKIA



CROATIA



Transnational Virtual Square

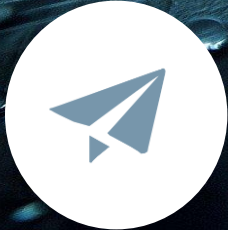




European Union

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DEEPWATER-CE



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Deepwater-ce

At our official webpage you can find more information about the aims of the project, the partners involved, project news and events, and our outputs.



Also on ResearchGate platform includes our main reports and results:
<https://www.researchgate.net/project/DEEPWATER-CE>

<https://www.interreg-central.eu/Content.Node/DEEPWATER-CE.html>

PARTNERS



This newsletter is edited by DEEPWATER-CE PARTNERS.

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PHOTOS: DEEPWATER-CE partners
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FUNDING

Our project is funded by the Interreg Central Europe Programme that encourages cooperation on shared challenges in Central Europe.