Solutions of DEEPWATER-CE project focused on Managed Aquifer Recharge

27 September 2021

EUSDR Thematic Event on Climate Change & Water Management

DANUBE REGION strategy
Prosperity through Diversity

MINISTRY OF INVESTMENTS, REGIONAL DEVELOPMENT AND INFORMATIZATION OF THE SLOVAK REPUBLIC

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Global Water Partnership
Central and Eastern Europe

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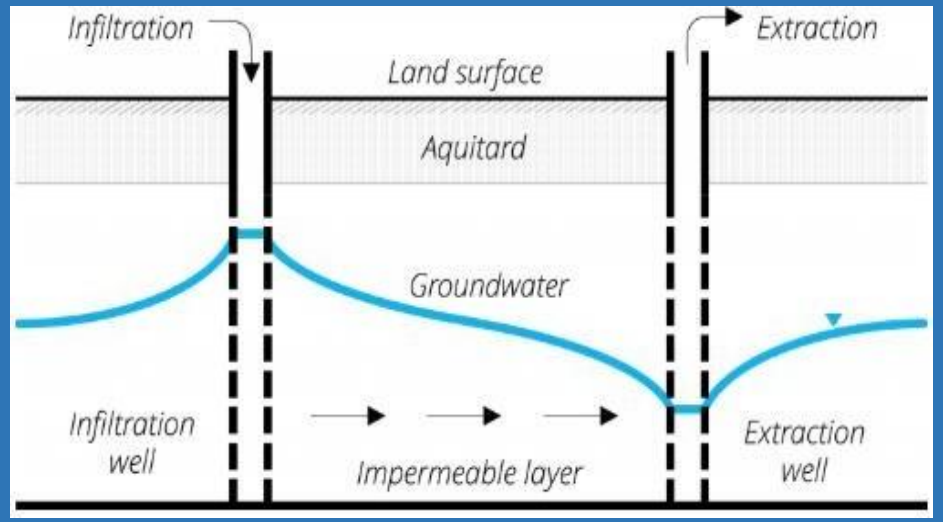
Managed Aquifer Recharge (MAR)

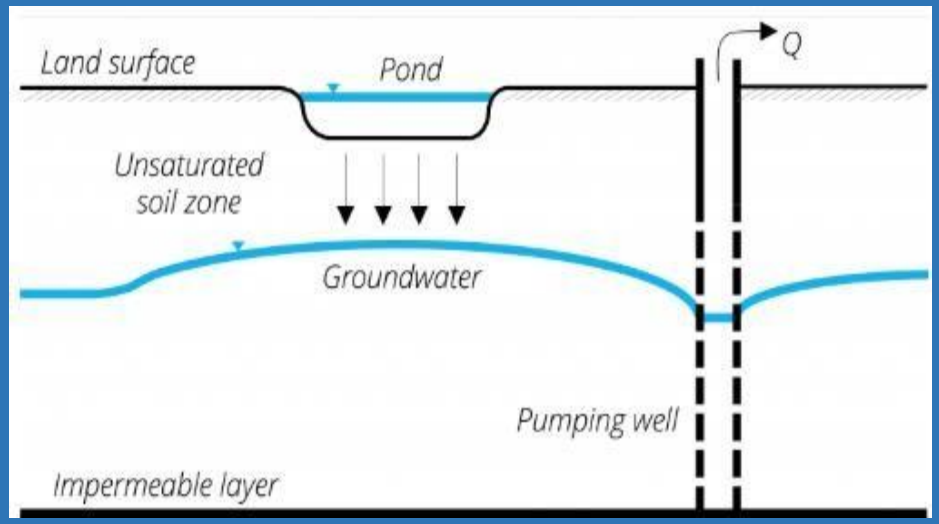
- **Endangered, decreased and unstable water sources due to climate change impacts**
- To prevent and address the arising user conflicts, there is necessity for innovative approaches and technologies in water management
- One of the solutions is **Managed Aquifer Recharge (MAR)** which should play an important role in managing water resources in European countries
- MAR is **an intentional process of directing/infiltrating excessive surface water into the ground** — either by spreading on the surface by using recharge wells, or by altering natural conditions **to increase infiltration in order to replenish an aquifer**.
- This method is used to maintain, enhance and secure groundwater systems under stress

MAR principle

Aquifer storage, transfer and recovery (ASTR)



Infiltration pond



Possible water sources - surface water, rain water, storm water, reclaimed water, groundwater

MAR sites selection criteria

1. **GENERAL SCREENING** – applied on the state or region
2. **SPECIFIC SCREENING** – applied on the areas considered as suitable after general screening

Criteria to be considered:

- ✓ **Climatological selection criteria** - to find out where MAR schemes are needed or will be needed in the future
- ✓ **Geological and hydrogeological selection criteria -** to identify areas where MAR is possible
- ✓ **Analyze the sensitivity of MAR systems to climate extreme events -** to evaluate where and how MAR schemes can be applied if extreme climatic situations occur (i.e. dry or wet periods) and to identify related potential risk

Decision-Support Toolbox comprising the checklists in order **to choose suitable locations for MAR**.

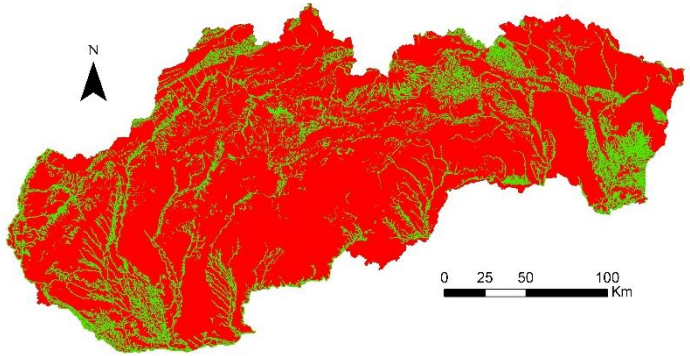
6 selected MAR types

DEEPWATER-CE: Decision-support toolbox for identifying the suitability of MAR (Slovak subtitles) - YouTube

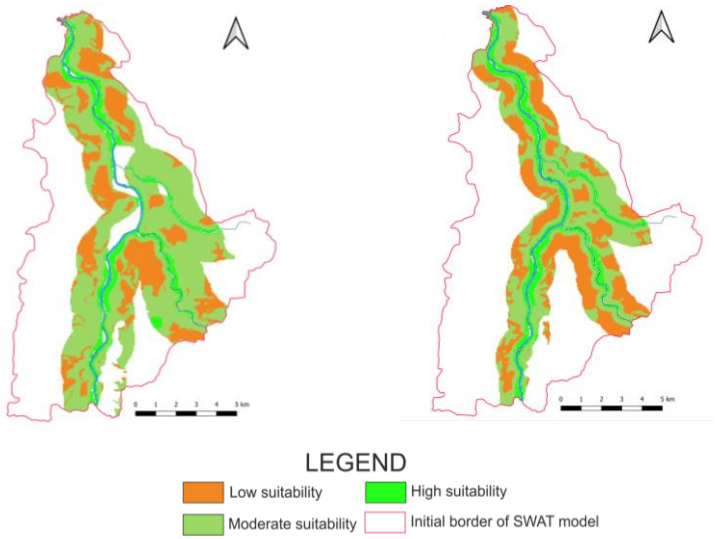
Maps for 6 selected MAR types

Maps for general and specific criteria applied in Hungary, Croatia, Poland and Slovakia:
https://ggis.un-igrac.org/maps/2171/embed

General mapping – Slovakia
Recharge dam

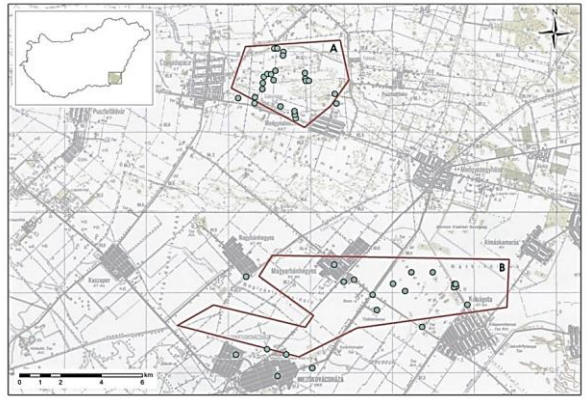


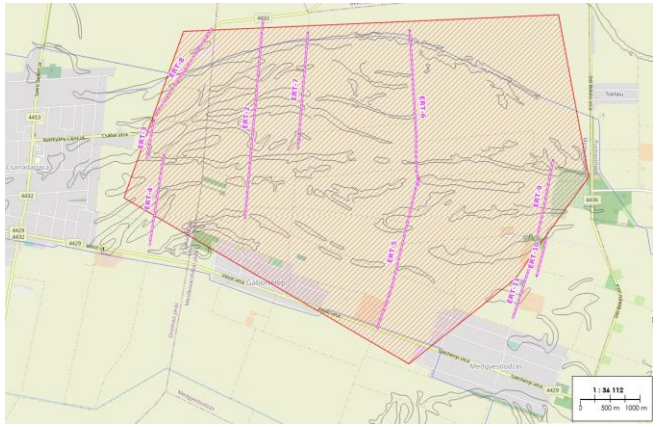
Specific mapping – Dunajec Catchment (Poland)
Ditches **Induced bank filtration**



Pilots: Hungary - Maros alluvial fan

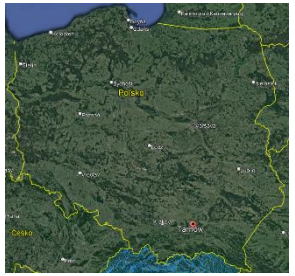
- ✓ Pilot study on the covered paleo-channels of the Maros River. (SE part of Hungary between two major rivers: Körös and Maros)
- ✓ Aim of the pilot study - to select a suitable area **for underground dam MAR solution** (i.e. construct a subsurface wall to interrupt groundwater flow resulting in an accumulation of groundwater)
- ✓ To find an optimal location for underground dam - apply a two-step GIS based site selection methodology
- ✓ Detailed investigation of the pilot site aquifer - **field measurements** (geophysical measurements, groundwater sampling, pumping tests), and consequently **conceptual and numerical groundwater flow models**

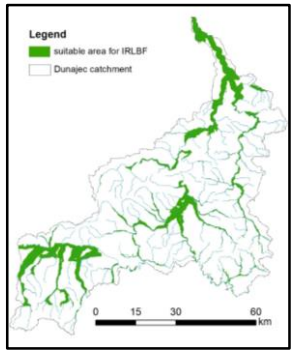




Pilots: Poland - Tarnów Waterworks

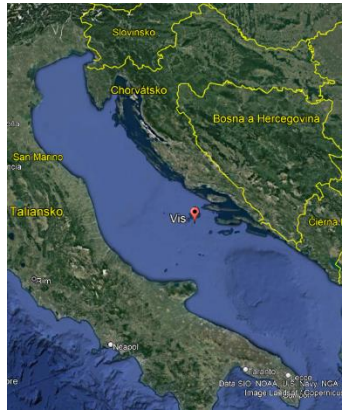
- ✓ **porous aquifers located near industrial sites** ➡ pose a serious threat for the quality of water in shallow aquifers
- ✓ **Tarnów Waterworks** (Dunajec catchment) - supply the Tarnów agglomeration (200 000 inhabitants) with drinking water
- ✓ **Świerczków pilot site** - groundwater is extracted from the **unconfined Quaternary porous aquifer** (average thickness of 4-6 m, average hydraulic conductivity is $3x10^{-4}$ m/s, static water level is approximately 3,5–5 m below surface, wells yield about 86,7 L/s)
- ✓ Aim of MAR systems implementation **– to improve groundwater quality by reducing the inflow of water from the industrial zone** (i.e. to use additional water supplies in order to avoid deterioration of groundwater quality due to neighboring industrial plants)
- ✓ Field works - geophysical, hydrological and hydrogeological measurements, water and soil sampling for laboratory tests.



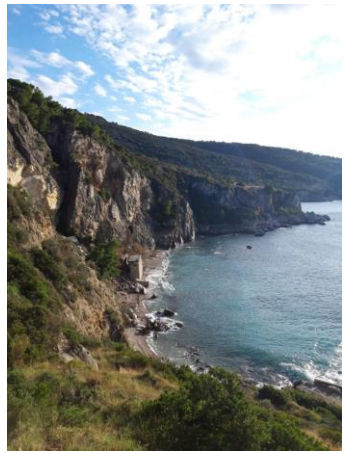


Pilots: Croatia – Vis Island

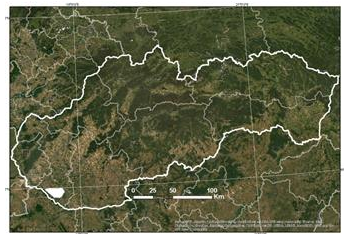
- ✓ **Karst semiarid hydrogeological conditions** of Dinaric karst region (karstified carbonate rocks formed excellent karst aquifers)
- ✓ **Public water supply from its own karst aquifer** - drilled wells in location Korita (40 L/s) and costal spring Pizdica (3.3 L/s)
- ✓ **Main problem - high possibility of seawater intrusion**, but karst poljes serve as a barrier to seawater intrusion from southern direction and volcanic-sedimentary-evaporite rocks form western barrier
- ✓ MAR will include **well/basin infiltration into karst aquifer** from accumulation structure on the surface.



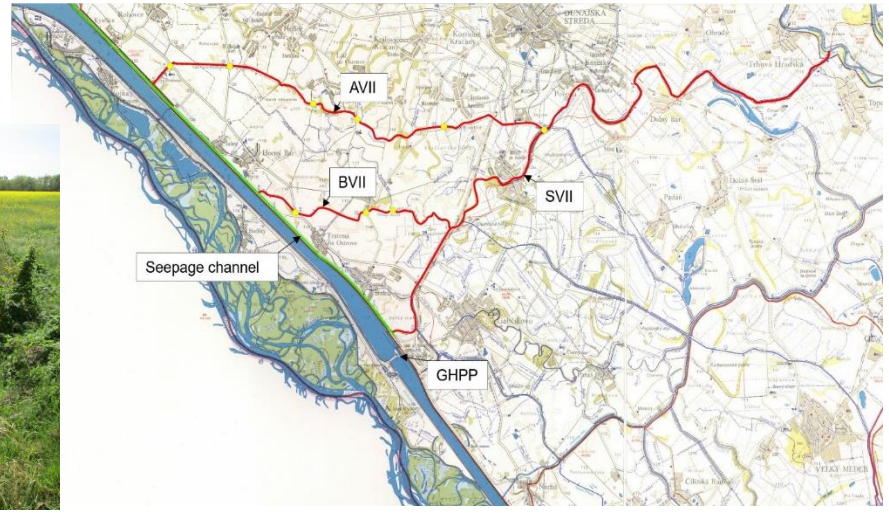
- ✓ **Further the research of aquifer** - geophysical research (seismic, magnetotelluric and electrical resistivity tomography methods), structural measurements (fault and fracture network analyses), determination of hydraulic parameters of the karst aquifer, hydrochemistry (EC, pH, temperature, oxygen content, basic ion composition), monitoring of salinity and water levels
- ✓ **3D conceptual model**



Pilots: Slovakia – Žitný ostrov



- ✓ Žitný ostrov area is located in the SW Slovakia, geographically it is the part of **Podunajska Lowland**
- ✓ **fluvial Quaternary sediments** (prevailing sandy gravels) – porous aquifers, with a thickness up to 200–500 m; hydraulic conductivity of aquifers about 10^{-3} to 10^{-5} m.s^{-1}; Danube River constantly replenishes groundwater supplies.
- ✓ **Gabčíkovo Water Structure** (hydropower plant) – influences hydrological conditions of the area
- ✓ **Hrušov Reservoir** (upper part of Gabčíkovo Water Structure) causes new possibilities of water uptake from **left-hand seepage channel** (supplies the channel network of Žitný Ostrov)
- ✓ pilot site area is delineated by **3 channels** Gabčíkovo-Topoľníky (S7), Vojka-Kračany (A7) and Šuľany-Jurová (B7) with technical possibilities (sluices) for water flow control
- ✓ **agricultural use** of the area



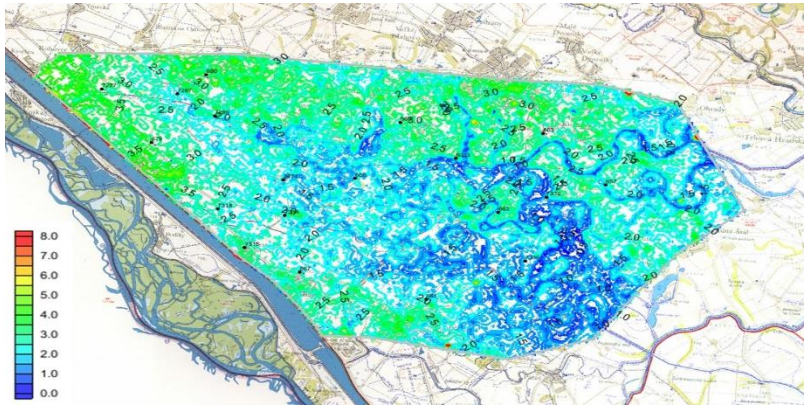
Pilots: Slovakia – Pilot site measurements

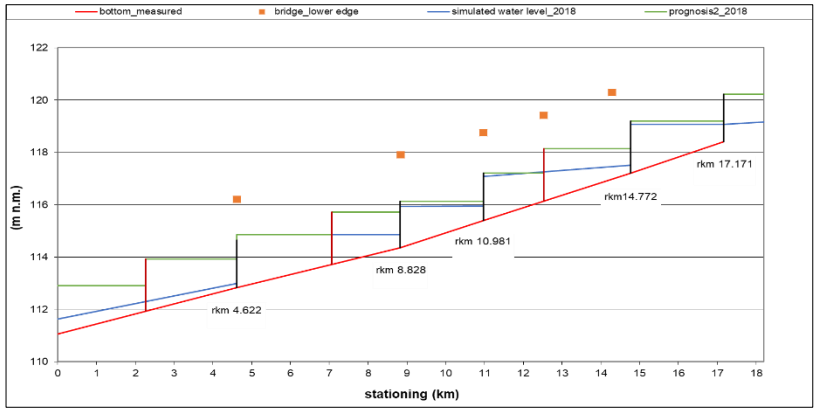
Aim: - to investigate the hydraulic properties of rocks to assess the relationship between surface water and groundwater, and lateral range of this influence

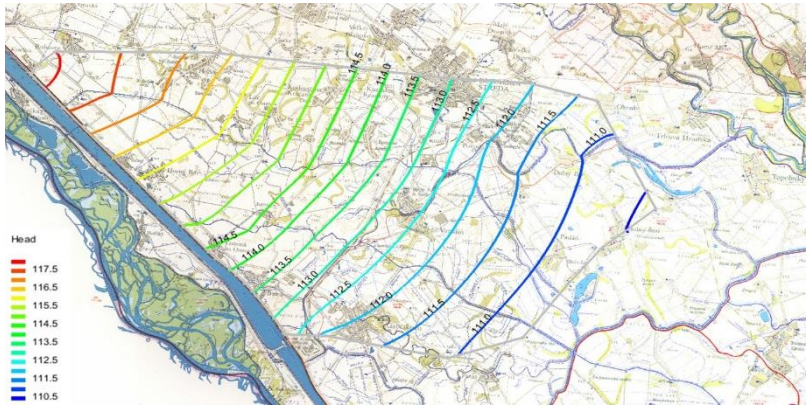
- to propose scenarios for technical regulation of water flow in channels to ensure groundwater recharge in pilot area

Field/laboratory measurements - water flow in canals, geometry of canals, soil sampling in the zone of canals and adjacent aquifers to measure physical and hydro-physical characteristics of soil, field and laboratory methods to measure hydraulic conductivity of soils

Measurements results - input data to calibrate mathematical models – **HYDRUS 2D and MODFLOW**

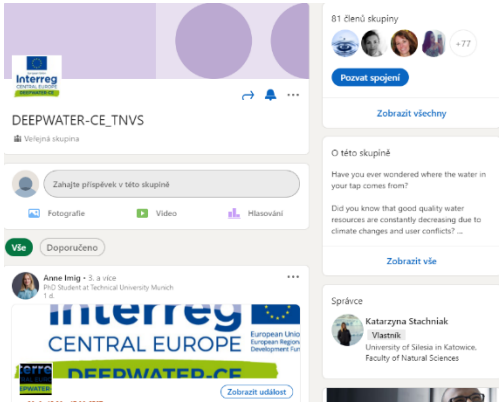






Supportive activities

- ✓ **Feasibility assessment** of establishing MAR schemes in CE
- ✓ **Development of policy recommendations** and national action plans for adopting MAR solutions in national water resource management schemes
- ✓ **Dissemination of project outputs** – trainings for target groups, web, Transnational/National Virtual Squares, social media



14.09.2021
NEWS

TRAINING

The time is approaching for our autumn training events organised in partner countries.
The first training will be held online on **29th September 2021** by our colleagues from Germany, who will be hosting meeting in ENGLISH!

We warmly invite all interested participants to take part in the online training.

- More information about the objectives of the event can be found **HERE**
- Meeting agenda **HERE**

02-03.06.2021
NEWS

MEETING

At the beginning of June the 4th online Project Coordination Meeting took place.

Two years of the DEEPWATER-CE project have already passed. During the meeting, we summarized the activities to this day and discussed plans for the next six months.

Read more

26.04.2021
NEWS

THE CLIMATE EXPOSURE MAPS

We are pleased to present the climate exposure maps created by the Lead Partner (Hungary), uploaded on the IGRAC's GGIS platform.

As part of the work on WP T3, a set of maps for the four partner countries (HU, HR, SK, PL) was created.

All 8 scenarios for 4 partner countries can be viewed and analyzed in the DEEPWATER-CE project Map Viewer available at:
https://ggis.un-igrac.org/maps/2171/embed

PAST NEWS ARCHIVE

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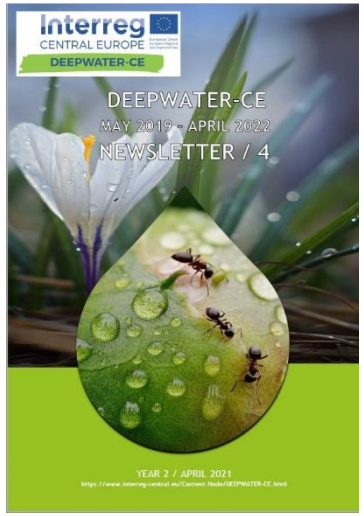

https://www.interreg-central.eu/Content.Node/DEEPWATER-CE.html

Thank you for your kind attention