FREEWAT
Free and Open Source Software Tools for Water Resource Management

SI-AT EVROPSKO TERITORIALNO SODELOVANJE

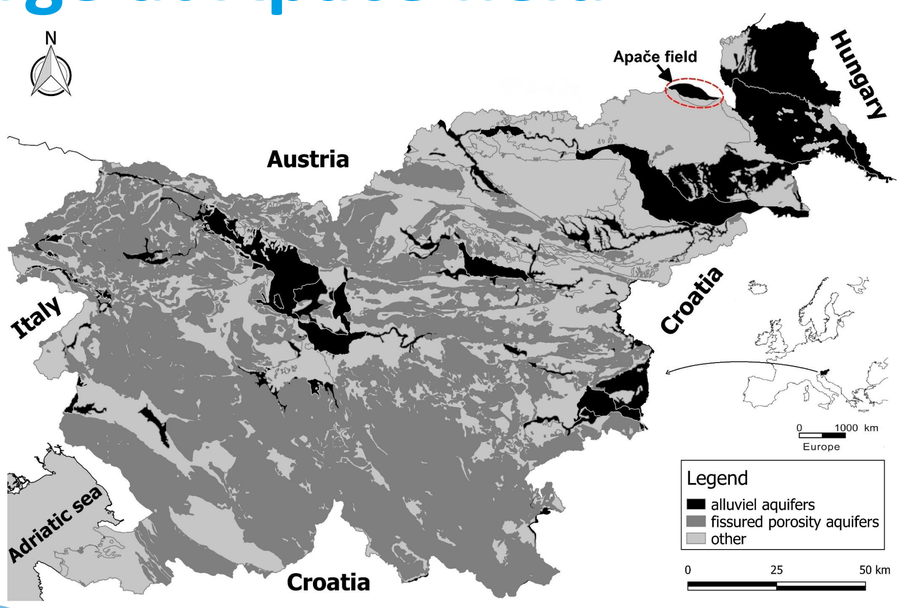
SI-MUR-AT

Managed artificial groundwater recharge at Apače field

Introduction

Under the project GEOHIDRO (Vremec et. al., 2017) and SI-MUR-AT (V-A Interreg SI-AT) and two master thesis (Kolar T. 2018, Vremec M.) an efficiency analysis of a newly constructed artificial groundwater recharge system (MAR) with induced riverbank filtration (IRBF) was conducted. The MAR system is located at the Aquifer of Apaško polje, which is one of the main drinking water resources for the Pomurje region. The analyses included the calculation of the groundwater recharge using hydrotopes or hydrological response units (HRUs), which are areas with unique land use, soil, management and climate attributes, and the establishment of a steady-state and transient groundwater model, which was used to analyse the efficiency of the MAR system against possible contamination from a nearby lake used for sports fishing.

The groundwater recharge was calculated using the Soil and Water Assessment Tool SWAT, which results were used to create a transient model using the water management tool FREEWAT.



Aquifer of Apače field

- Part of the groundwater body of Murska kotlina
- Artificial groundwater recharge with riverbank filtrate of river Mura

Pumping station Segovci

- Average daily pumping quantity: 10,4 l/s,

Pumping station Podgrad

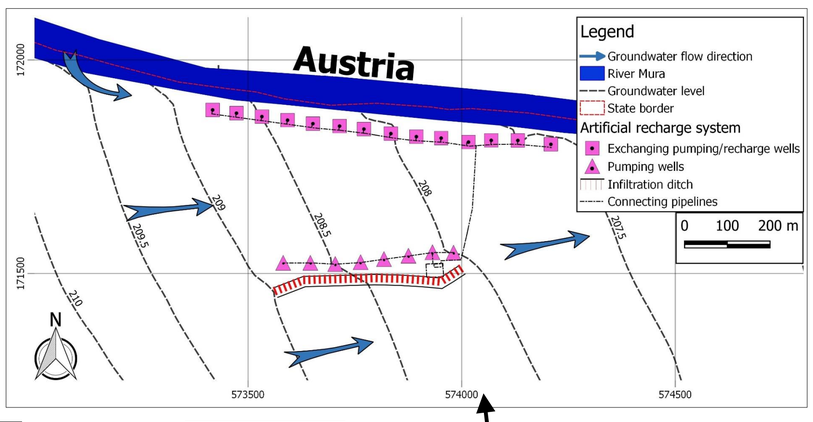
- Average daily pumping quantity: 52,2 l/s,

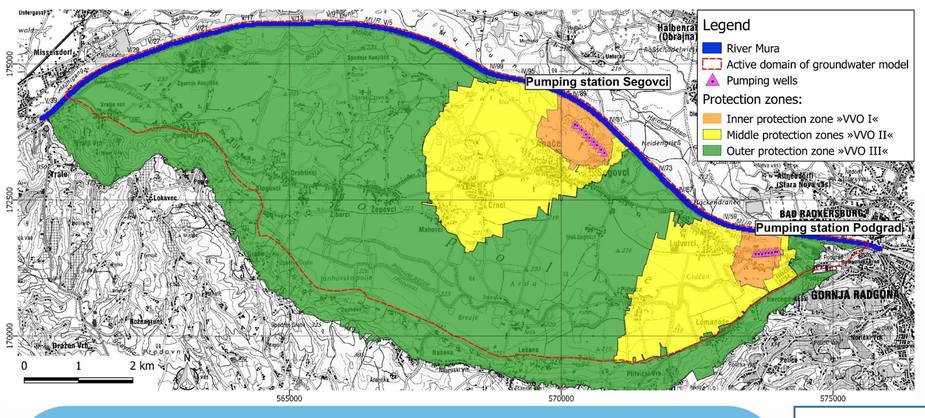
MAR system with IRBF

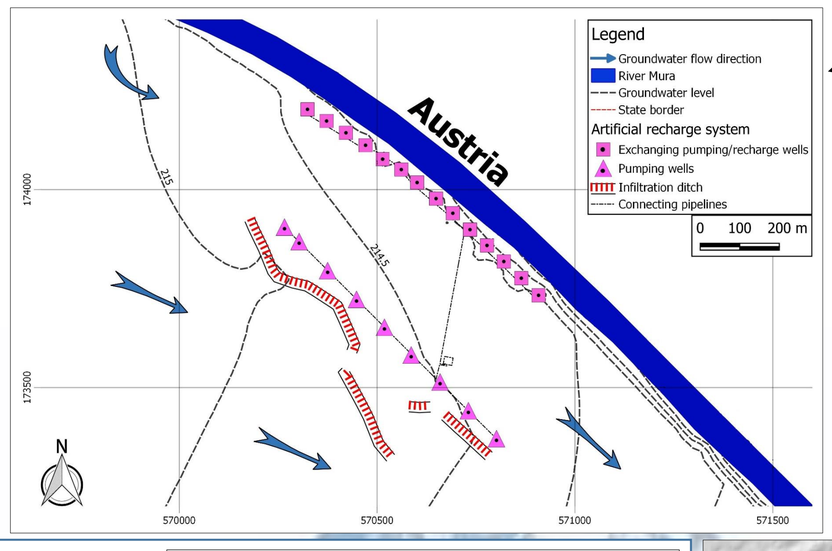
- Construction finished in 2016.

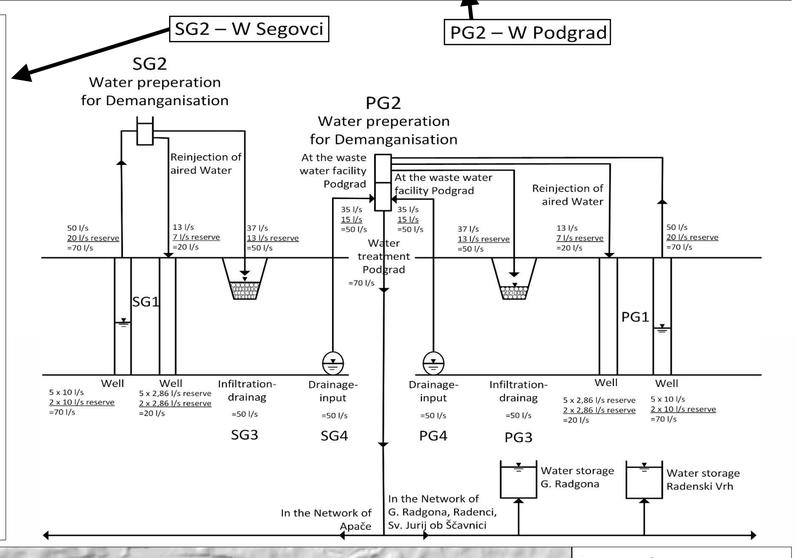
MAR system with IRBF

- Pumping riverbank filtrate of river Mura
- Active protection against nitrate polluted hinterland water
- Prevention of water scarcity in the summer period
- The capacity of the pumping station is independent of climate conditions (drought)
- Deferrization and demanganization



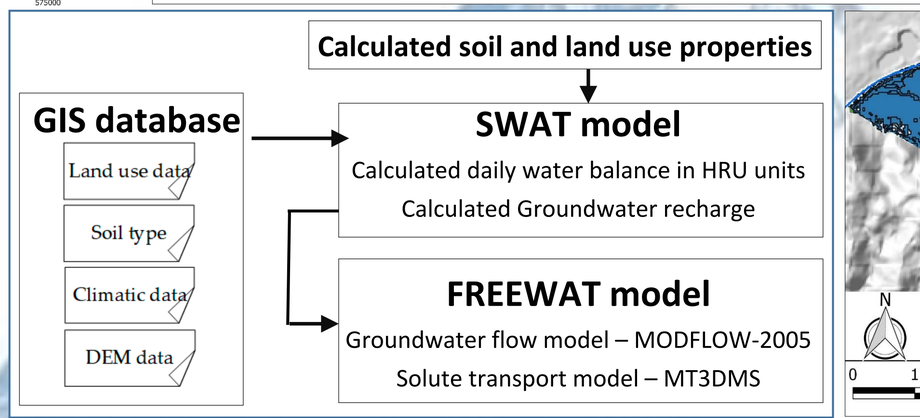


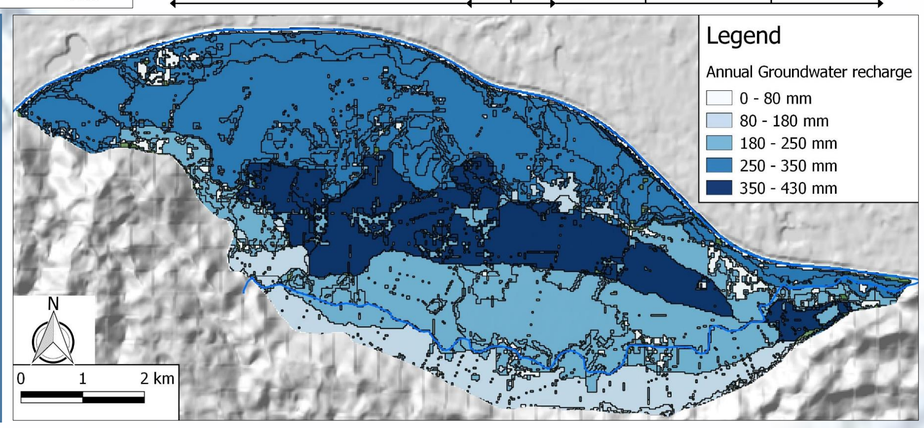




SWAT model

Alongside the climate data, the SWAT model also requires geospatial data of land use and soil type to reproduce the HRUs needed for the water balance calculation. The input data for the soil characteristics were determined with the SPAW model, which was based on soil profiles (Saxton, K.E., 1986) and the crop characteristics based on ALLEN et al. (1998).

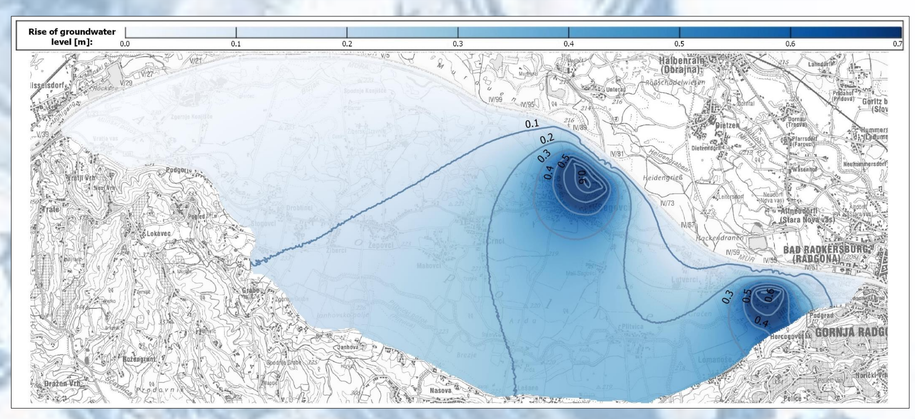




FREEWAT Groundwater model

In the projects, a flow direction analyse, within an established groundwater model, was conducted to inspect if the contaminated water from the nearby lakes used for fishing will flow towards the newly constructed MAR system. The flow of contaminated groundwater was observed with the MODPATH particle tracking method (Borsi et. al., 2017) in 2 different scenarios:

1. Scenario (high water level): increased precipitation values, increased level of river Mura
2. Scenario (low water level): decreased precipitation values, decreased level of river Mura

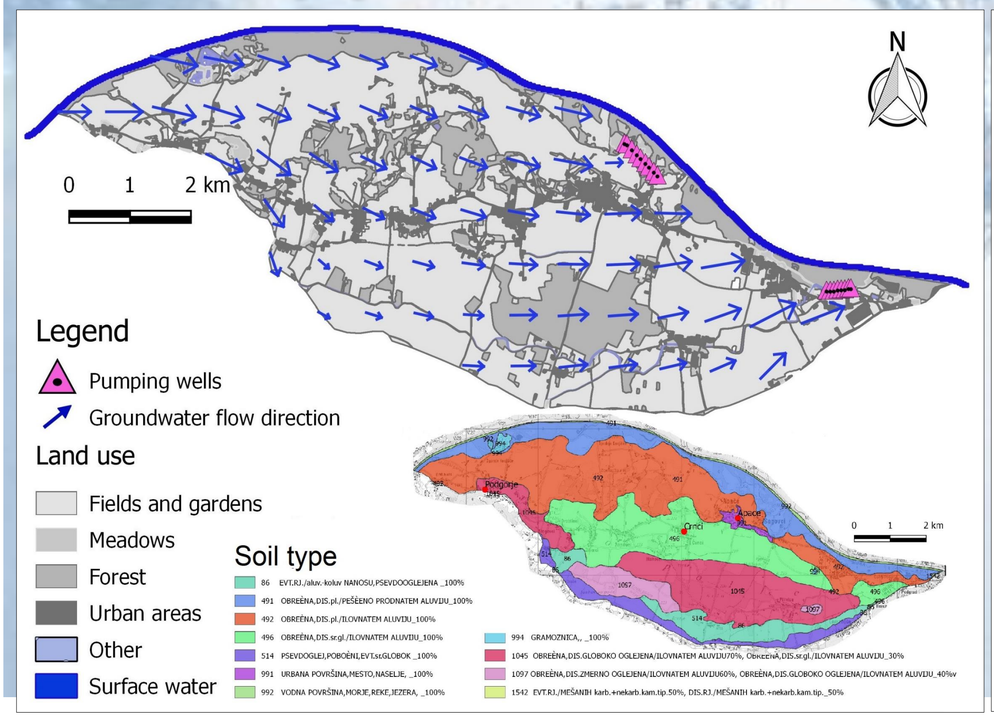


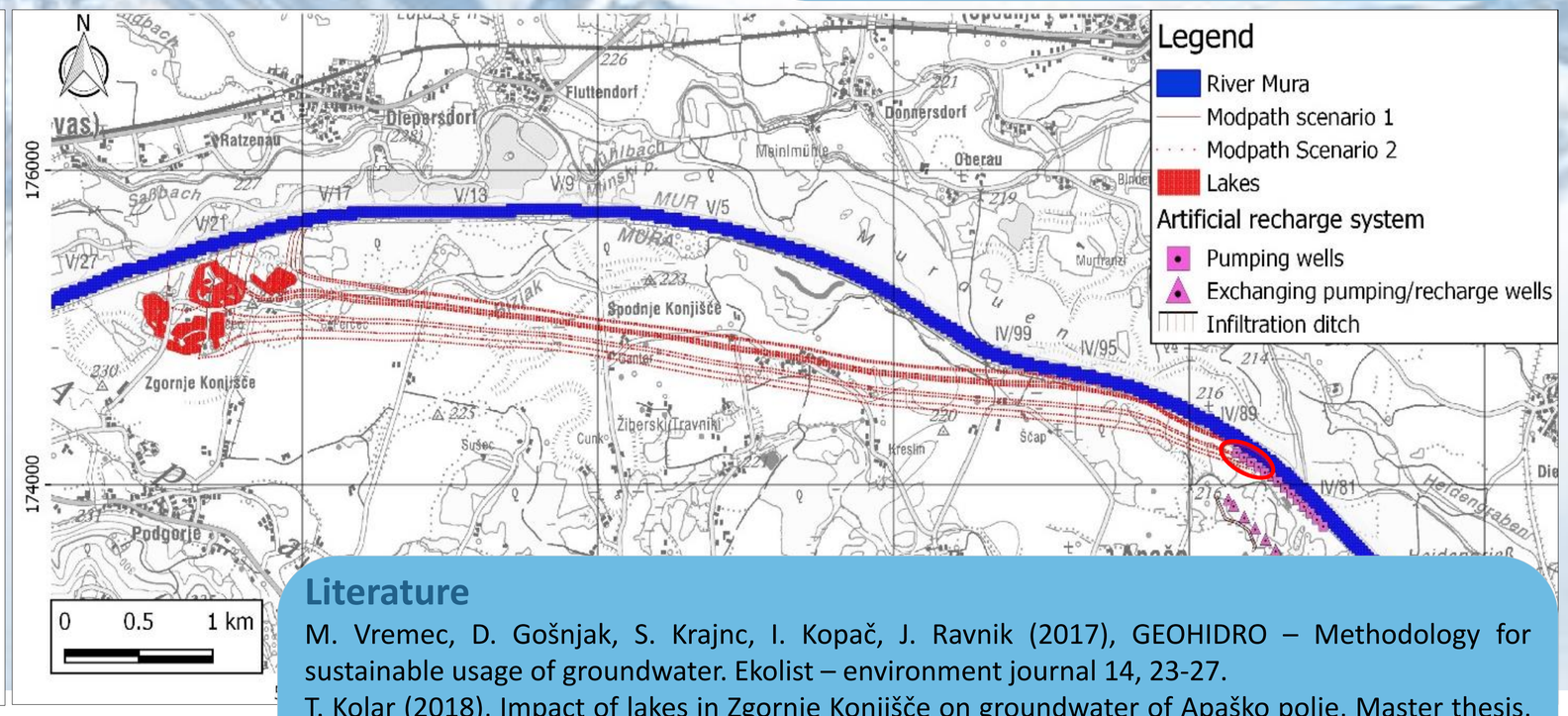
Conclusion and future tasks

The rise of the groundwater level drastically reduces the exposure to polluted water from river Mura and the area with intensive agriculture from the east.

Due to the established MAR system with IRBF, which pumps the riverbank filtrate of river Mura, the drinking water supply of the Pomurje region is also safe from drought.

Due to fact that the area of the aquifer of Apaško polje is exposed to extensive agriculture, an establishment of a transport model simulating nitrate leaching is foreseen.





Literature

M. Vremec, D. Gošnjak, S. Krajnc, I. Kopač, J. Ravnik (2017), GEOHIDRO – Methodology for sustainable usage of groundwater. Ekolist – environment journal 14, 23-27.

T. Kolar (2018), Impact of lakes in Zgornje Konjišče on groundwater of Apaško polje, Master thesis, University of Maribor, Faculty of Mechanical Engineering.

Allen et al. (1998): Crop Evapotranspiration. FAO Irrigation and Drainage Paper No. 56.

Borsi., I. Kopač, M. Vremec, Tutorial on particle tracking; c. 2. s.1.: FREEWAT, EU HORIZON 2020 Project, 2017.

Saxton, K.E. et al. (1986): Estimating soil water characteristics from texture, Trans. ASAE.

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