# Managed Aquifer Recharge as a Source of Emerging Pollutant in Groundwater


Authors

**Ms. Hafsa Mahmood**

**Dr. Serena Caucci**

**Dr. Olfa Mahjoub**

**Mr. Fritz Kalwa M.Sc.**

**Ms. Amel Jemai el Nasri**

**Prof. Dr. Rudolf Liedl**


Presented by:

**Ms. Hafsa Mahmood**

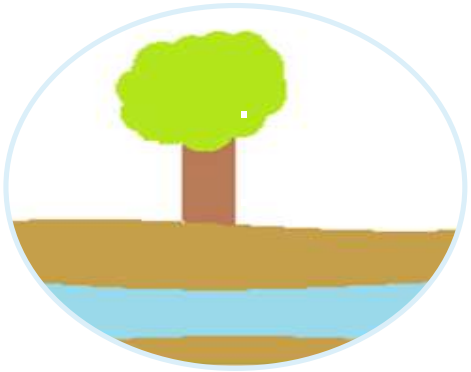
# Motivation

Key Issues

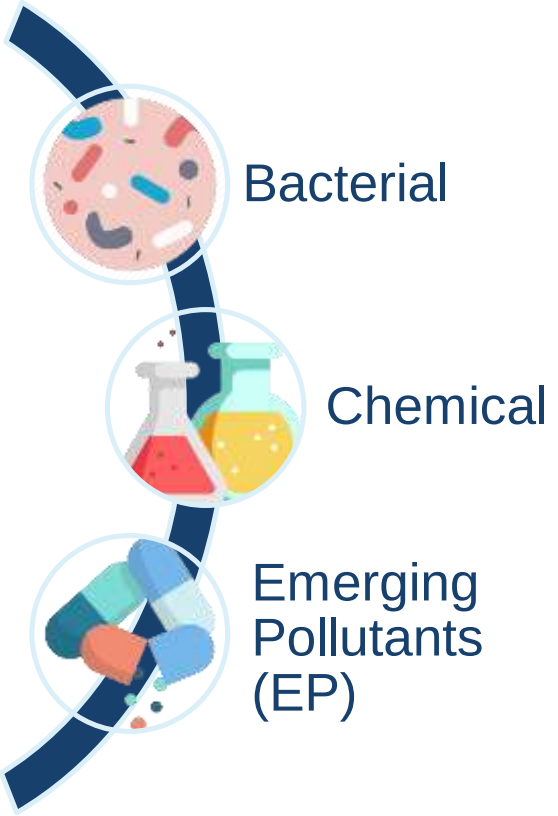
Water Scarcity

Climate Change

Treated Wastewater



Groundwater a crucial resource



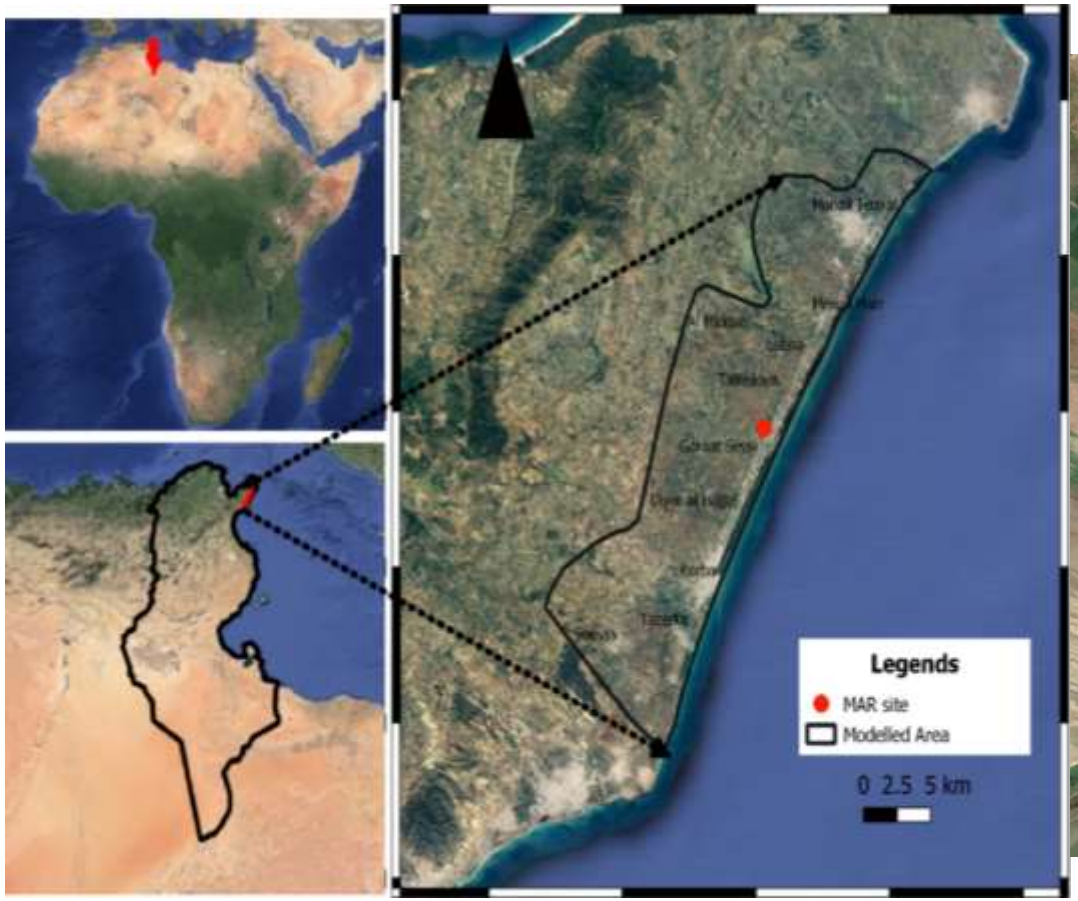
Bacterial

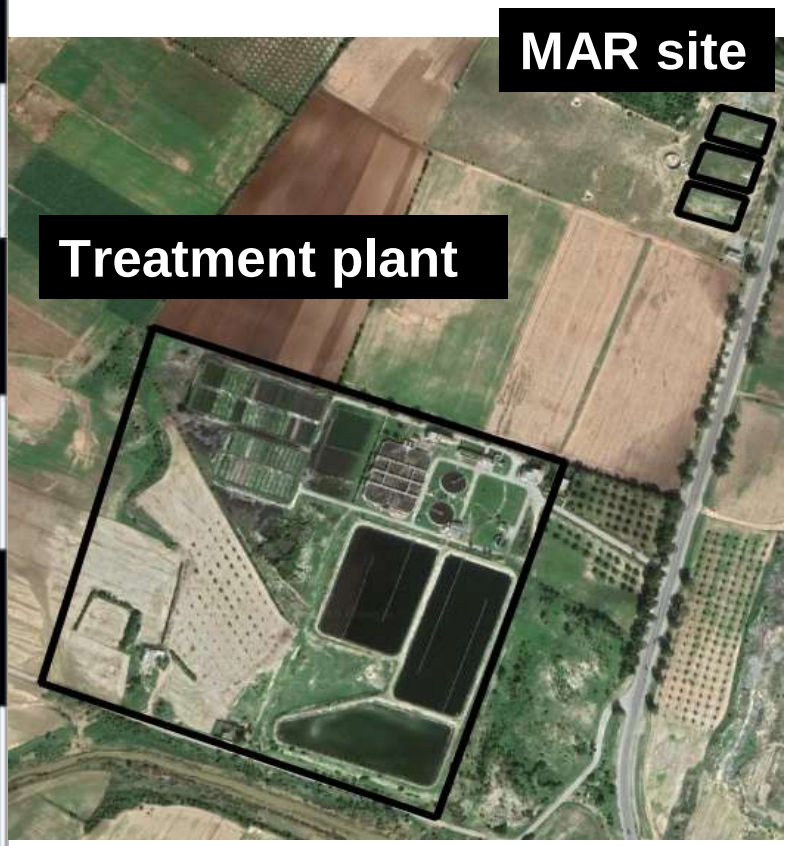
Chemical

Emerging Pollutants (EP)

Monitoring of groundwater is essential

# Study Area and problem statement




Moslah et al. (2017)

(Cherif et al. 2013), (Caucci et al., 2017)

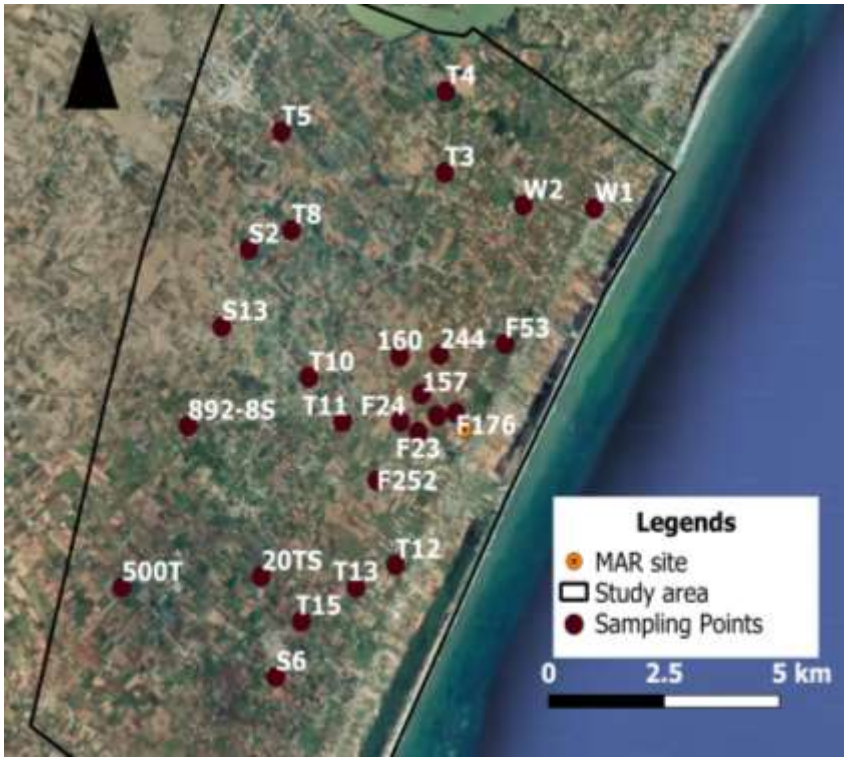
# Objective of the study

- To Evaluate the effectiveness of MAR in Korba aquifer
- To identify current risks imposed by MAR of EP in phreatic Korba aquifer

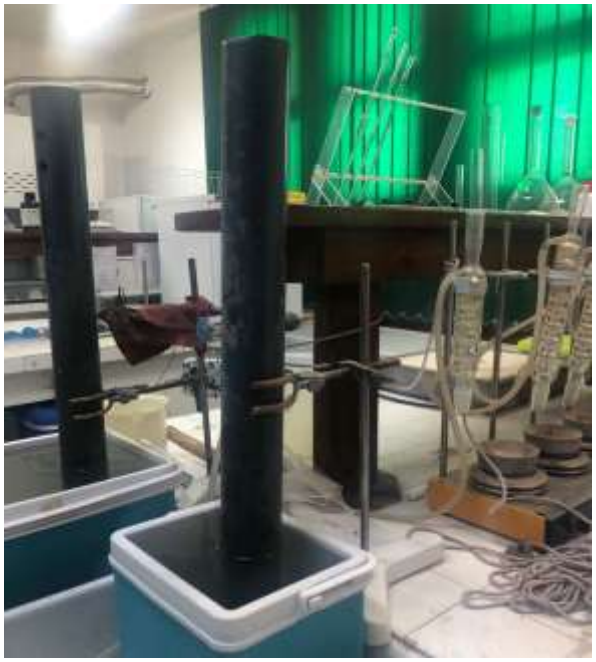
# Research Process

Pharmaceutical Analysis (SPE-RP-HILIC/MS) → Groundwater flow modelling (MODFLOW-NWT) → Conservative solute transport modelling (MT3D)

- Roxithromycin
- Atenolol
- Sulfamethoxazole
- Caffeine → low degradation rate
- Carbamazepine



# Field work

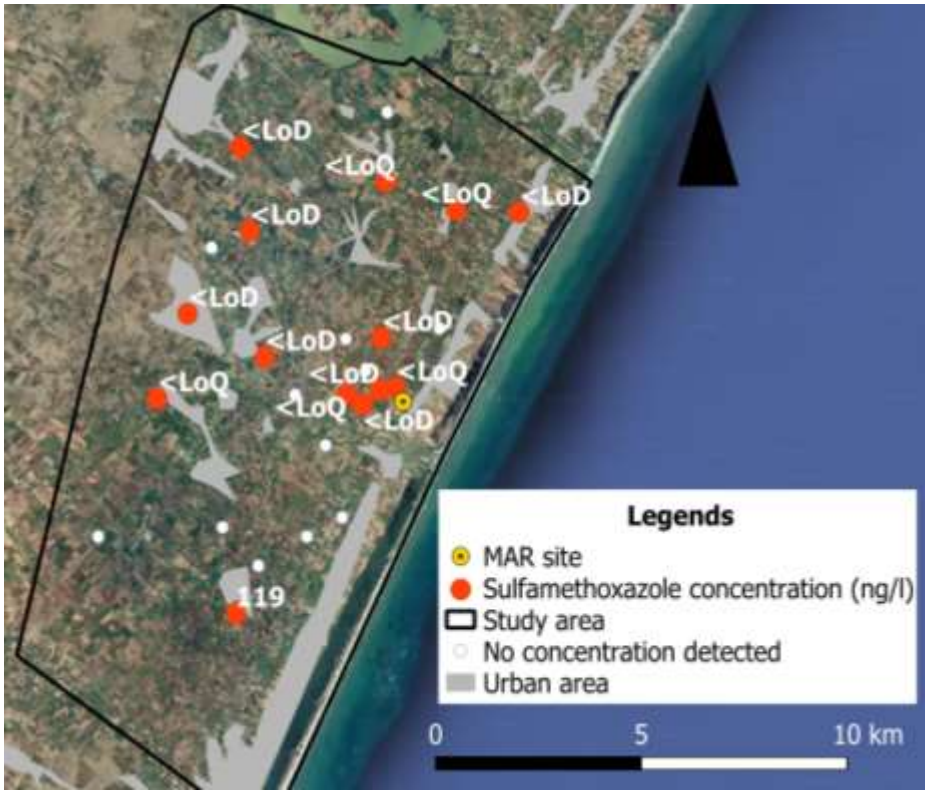


# EP quantified in treated wastewater

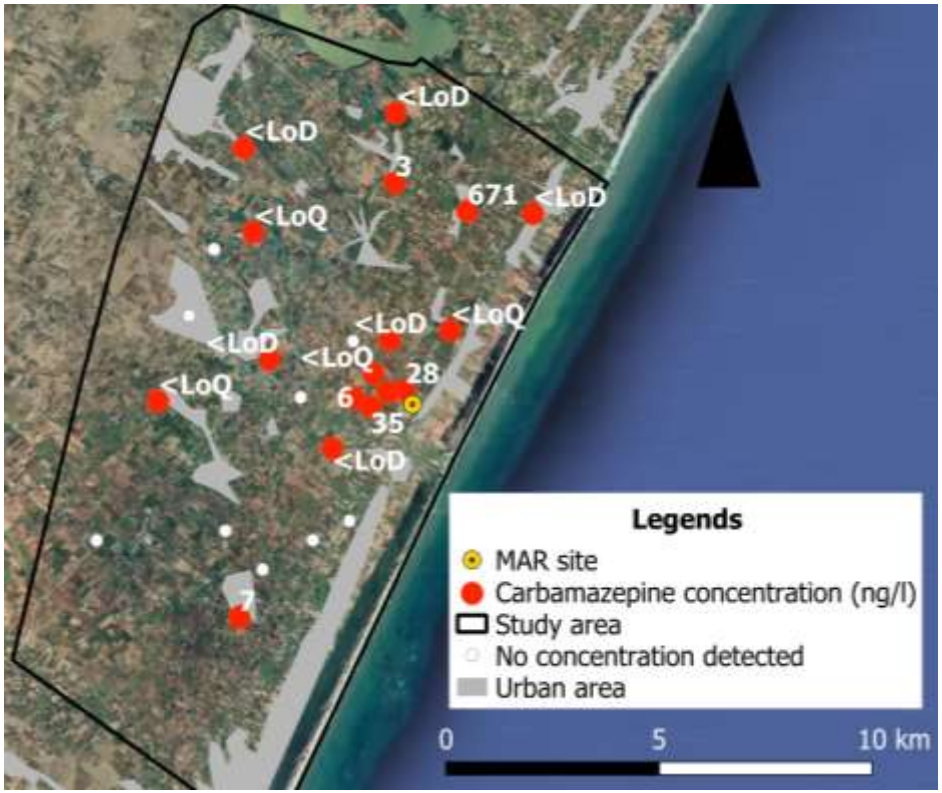
| Compounds | $LoD_{S/N=3}$ (ng/L) | $LoQ_{S/N=10}$ (ng/L) | Average (ng/L) |
|---|---|---|---|
| Atenolol | 10 | 30 | 116.2 |
| Roxythromycin | 1.1 | 3.8 | <LoQ |
| Carbamazepine | 0.4 | 1.2 | 635.1 |
| Caffeine | 250 | 750 | <LoD |
| Sulfamethoxazole | 5.1 | 17.1 | ND |

# Emerging pollutants analysis in groundwater

Sulfamethoxazole



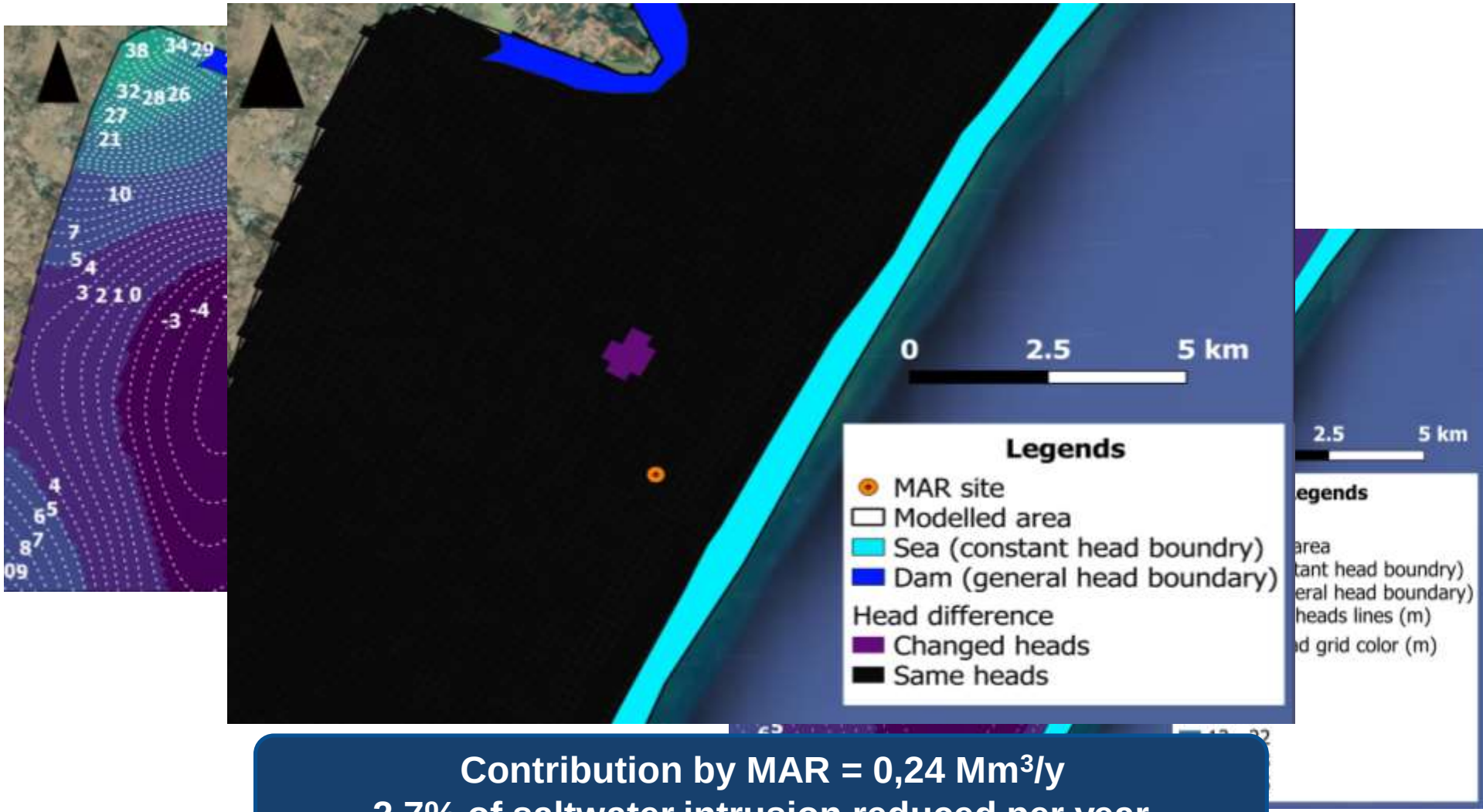

Carbamazepine




Sulfamethoxazole indicates past pollution by MAR and urban pollution sources

Carbamazepine concentrations were ten-fold lower indicating adsorption on soil as low solubility in water

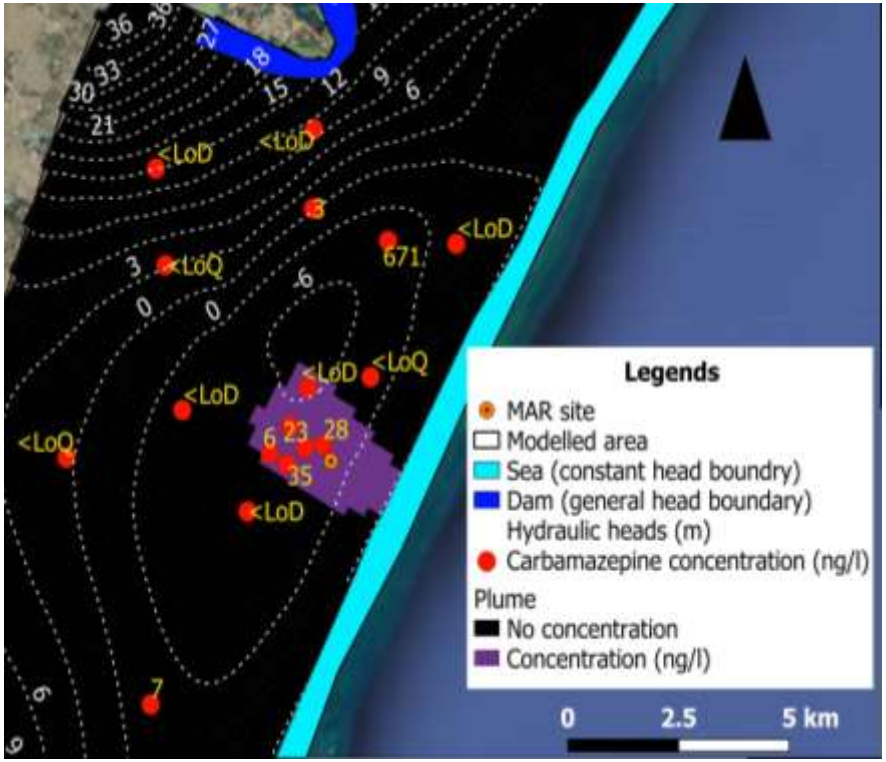
# MODFLOW Results of hydraulic heads before and after MAR



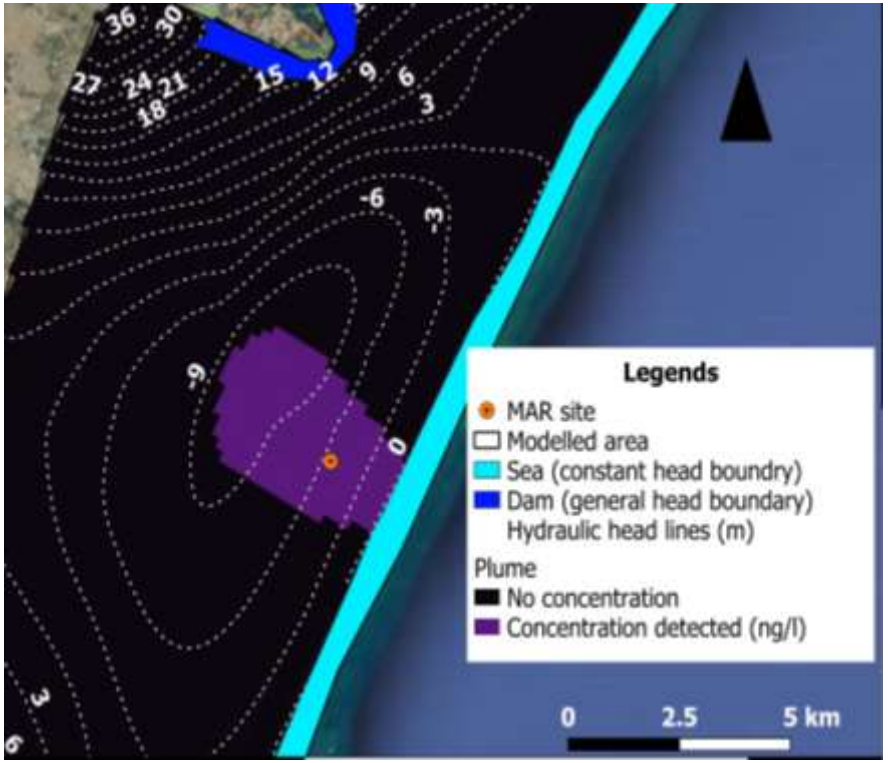

**Contribution by MAR = 0,24 Mm³/y**
**2.7% of saltwater intrusion reduced per year**

# Conservative solute transport modelling using MT3DMS

Current plume spread




2100 year plume spread



# Concluding remarks



- MAR contributes in replenishing the aquifer and seawater intrusion but expansion of MAR on larger scale is required

- Concentrations of emerging pollutants in groundwater were overall ten-fold lower than those of the treated wastewater

- Adsorption and degradation are potentially dominant processes in MAR so Focus on soil EP concentrations in research projects

- Development of reactive solute transport modelling to understand better the adsorption and degradation processes in the aquifer

# Acknowledgements


- Research teams and staff at the chemistry laboratory and irrigation laboratory at INRGREF
- Research team, Waste Management Unit at UNU-FLORES
- Research team at TU-Dresden

TECHNISCHE UNIVERSITÄT DRESDEN

UNITED NATIONS UNIVERSITY

UNU-FLORES

TÉCNICO LISBOA

UNESCO

IHE DELFT

GroundwatCH

Groundwater / Global Change

# Thank You
# Any Question?