



# FREEWAT

Free and Open Source Software Tools for Water Resource Management  
EU HORIZON 2020 Project



 **ict4water.eu**

# Il progetto EU H2020 FREEWAT: open source open data e approccio partecipato per la gestione dell'acqua

## DARE VALORE ALL'ACQUA

### La piattaforma EU H2020 FREEWAT per la gestione della risorsa idrica

### Scuola Superiore Sant'Anna

### 12 Luglio 2017

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Scuola Superiore Sant'Anna (Italy)

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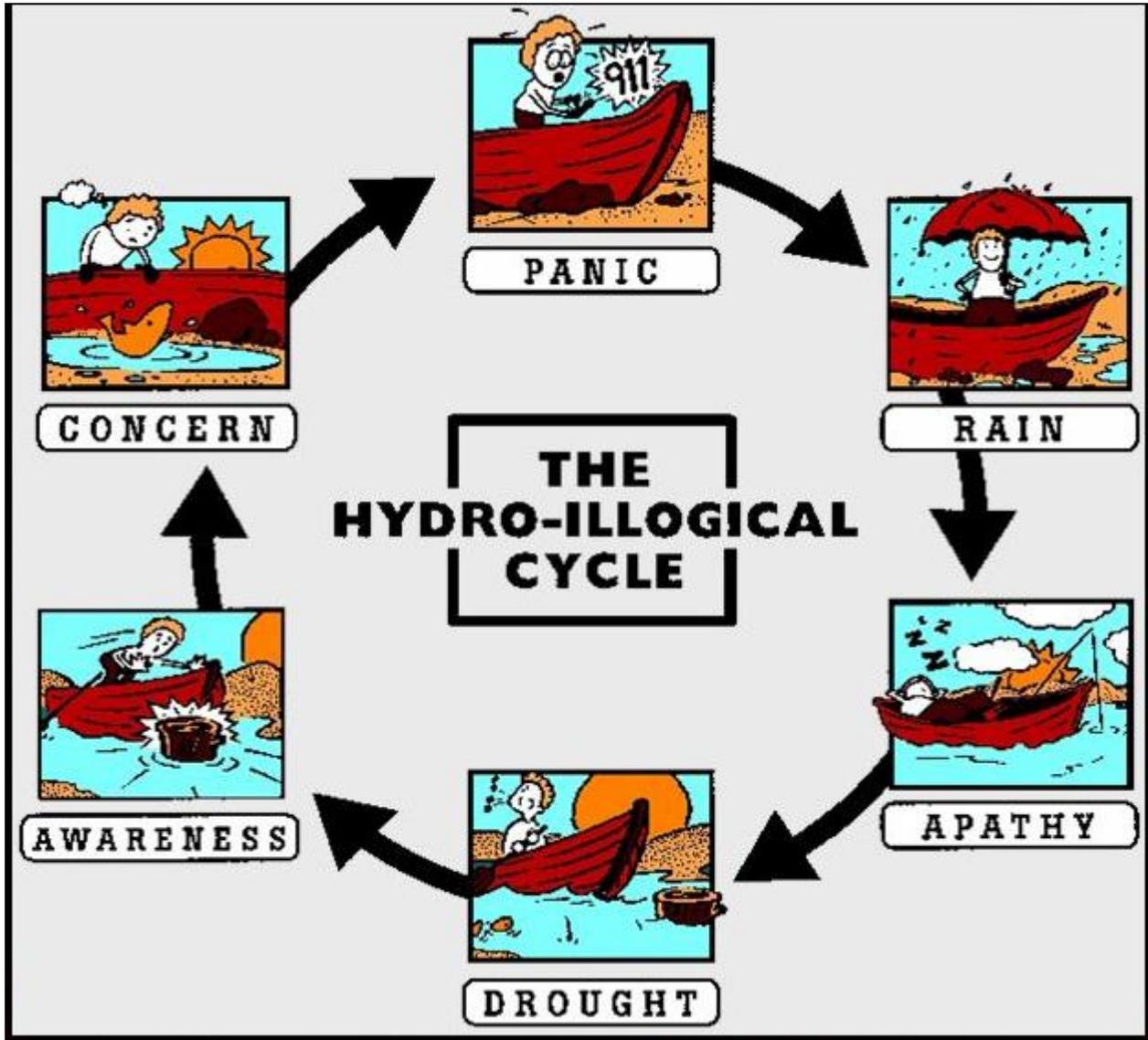
**EIP Water** Online Market Place  
Matchmaking for water Innovation  
**MAR Solutions - Managed Aquifer  
Recharge Strategies and Actions  
(AG128)**

**WiRE**  
Water & Irrigated agriculture Resilient Europe  
EIP Water Action Group  
Pooling resources - Innovating water

INSTITUTE  
OF LIFE  
SCIENCES



Scuola Superiore  
Sant'Anna



# water resource management and planning

Although a lot of science is produced on water resource management (especially in the ICT sector)

**WRM is still today poorly addressed via scientific means**

## REASONS

- underrated importance given at political and decision maker level
- low-capacity of the research environment to transfer the results to the real world
- missing digital capacity at agencies and governing authorities

# data water data water data water data water

Many countries are now producing water related data:

- in EU countries :

>>>>> *large amount*

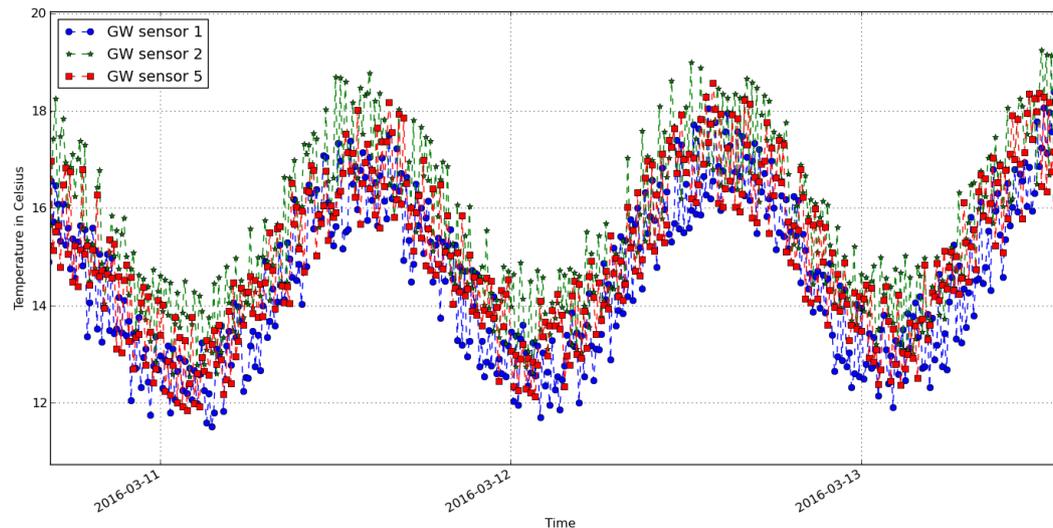
- in other countries

>>>>> *maybe less data are available*

Actions		idsgw_1	date	time	level	temperature	ph	ces
Edit	Delete	4968	2015-04-22	09:26:24	8.01714	9.68442	1	489.071
Edit	Delete	4969	2015-04-22	09:41:25	8.02453	9.74725	1	478.441
Edit	Delete	4970	2015-04-22	09:56:26	8.06199	9.69709	1	491.116
Edit	Delete	4971	2015-04-22	10:11:26	7.96673	9.76323	1	484.021
Edit	Delete	4972	2015-04-22	10:26:27	8.06777	9.70175	1	492.287
Edit	Delete	4973	2015-04-22	10:41:27	8.00311	9.68582	1	491.066
Edit	Delete	4974	2015-04-22	10:56:28	8.06094	9.76796	1	492.797
Edit	Delete	4975	2015-04-22	11:11:29	7.94177	9.75494	1	483.606
Edit	Delete	4976	2015-04-22	11:26:30	7.94677	9.63806	1	478.603
Edit	Delete	4977	2015-04-22	11:41:30	7.9409	9.60817	1	478.644
Edit	Delete	4978	2015-04-22	11:56:30	7.94111	9.72637	1	477.618
Edit	Delete	4979	2015-04-22	12:11:31	8.05931	9.7782	1	484.018
Edit	Delete	4980	2015-04-22	12:26:31	8.00855	9.718	1	477.45
Edit	Delete	4981	2015-04-22	12:41:33	7.99031	9.69059	1	483.874

Information CONTENT of this data not fully exploited as today

ICT tools would allow



FREEWAT is a EU H2020 ICT project for *improving* Water Resource Management by *simplifying* and *strengthening* the application of EU water related Directives and non-EU water related regulations

## MAIN RESULT

Open source and public domain GIS-integrated modelling platform allowing data storage and analysis and simulation of several processes for WRM

## FREEWAT expected main impact →

help producing scientifically and technically sounding decision and policy making based on:

- data and innovative data analysis tools
- participatory approach



**Partners**

INSTITUTE OF LIFE SCIENCES  
Scuola Superiore Sant'Anna

Coordination: Rudy Rossetto - r.rossetto@sssup.it  
Institute of Life Sciences, Scuola Superiore Sant'Anna (Italy)

TEASISTEMI

TECHNISCHE UNIVERSITÄT DARMSTADT

CSIC

idæa

OSLANDIA

INESCO

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

METCENAS  
Methodology Centre for Environment Assessment

REGIONE TOSCANA

zeta

amalteia

IEI

BROOKER UNIVERSITY

1976

INMGA

INTERNATIONAL NATIONAL WATER

2008

UNIVERSITÄT DILI

1632

UNIVERSITAS TRARUMENSIS

igrac  
International Groundwater Resources Assessment Centre

NATIONAL TECHNICAL UNIVERSITY OF ATHENS  
INSTITUT FÜR WASSERBAU UND KANALISATION

LAVRIN TECHNOLOGICAL CULTURAL PARK

PARAGON EUROPE  
"WEALTHING EXCELLENCE"

Universität Bremen

SUPSI  
University of Applied Sciences and Arts of Southern Switzerland

## **SOFTWARE DEVELOPMENT**

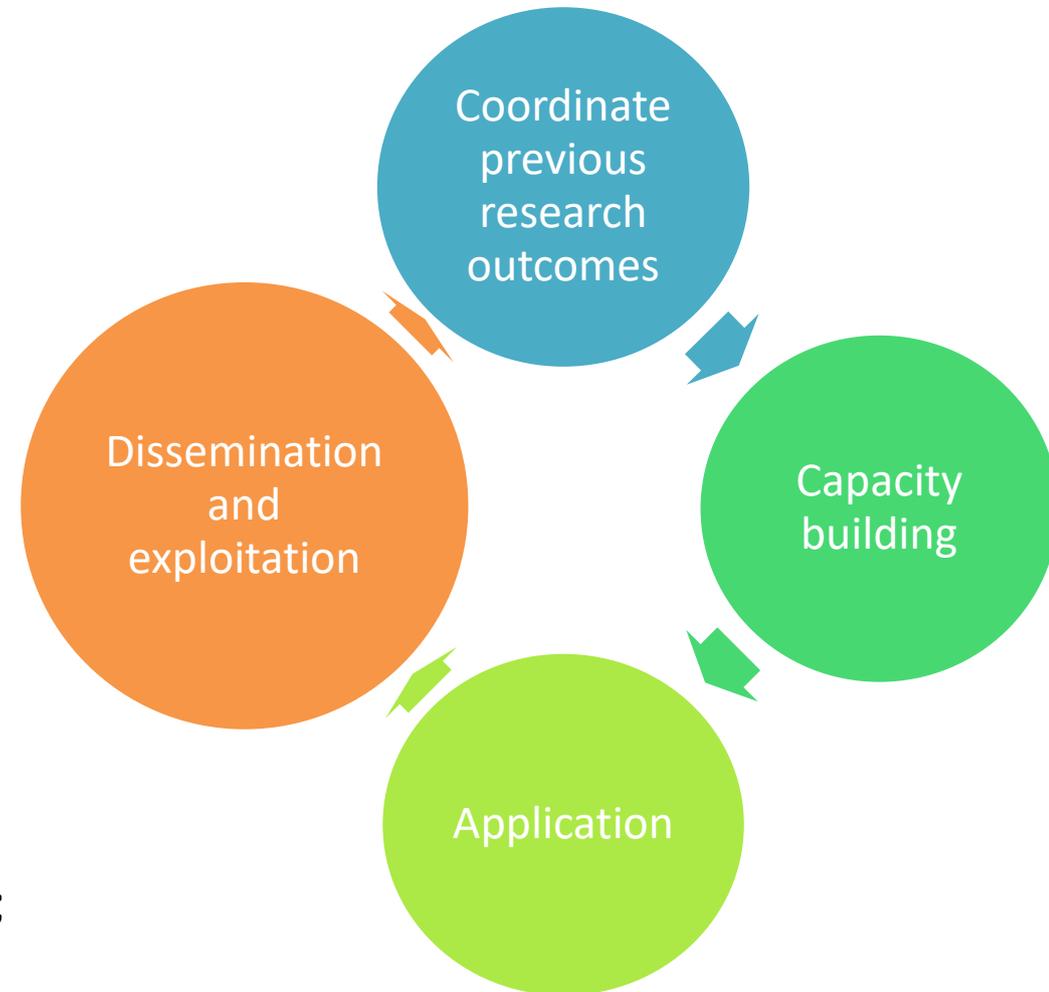
- Building the software platform (WP2)

## **CAPACITY BUILDING**

- Intensive training (WP3)

## **APPLY THE FREEWAT PLATFORM**

- **Postulate your WRM goal;**
- Involve the stakeholders during FREEWAT application;
- Apply FREEWAT for solving your problem;
- Produce tailored policies!





# WHAT IS FREEWAT TODAY?



## A QGIS integrated modelling environment in its v0.4 age along with User Manuals and tutorials

The screenshot shows the QGIS 2.18.4 interface with the FREEWAT menu open. The menu items are:

- Data-Preprocessing (akvaGIS)
- Model Setup
- MODFLOW Boundary Conditions
- Solute Transport Process
- Water Management and Crop Modeling (FARM PROCESS)
- Calibration/Sensitivity
- Tools
- DataBase
- Program Locations
- Run Model
- Post-processing
- About

The 'Create Transport Model' dialog box is open, showing the following fields:

- Flow Model Name: ex\_mt3d
- Set a name for Transport Model: mymodel
- Mass Unit: KG
- Insert information on chemical species:

species_name	mobile
s1	yes

Below the dialog box, there are three plots and a code block:

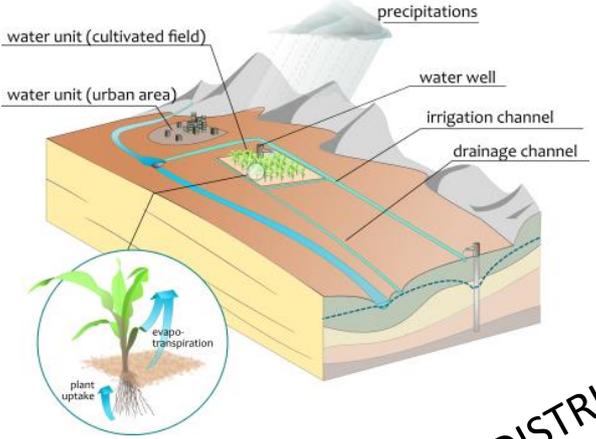
- Plot 1: Original data showing data (blue line) and quality (green line) over time.
- Plot 2: Processed data showing data (blue line) and quality (green line) over time.
- Plot 3: Hydrograph separation showing base (blue line) and runoff (red line) over time.
- Code block: Python code for calculating exceedance time.

```
In [25]: #Exceedance values from exceedanc
A = CUC2.process(method.Exceedance(perc=[10, 50, 95]))
print "Percentage: %s%%" % A[0][0]
print "Value\t\t: %s\tm3/s" % A[0][1]
print A
-----
Percentage : 5.0 %
Value      : 1.967 m3/s
[[ [ 5., 1.967]
  [ 50., 2.761]
  [ 95., 4.968]]]
```

Free download at [www.freewat.eu](http://www.freewat.eu)



# FREEWAT architecture

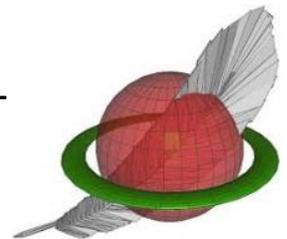


MODFLOW and Related Programs (MT3DMS, SEWAT, UCODE, etc.)

SPACE AND TIME DISTRIBUTED DATA



GIS AND SPATIAL DATABASE



Observation Analysis Tool

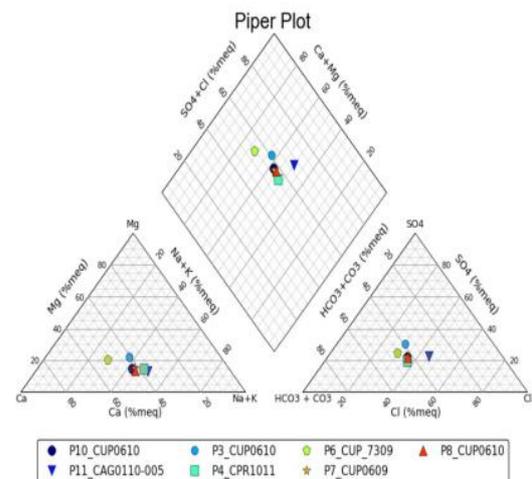
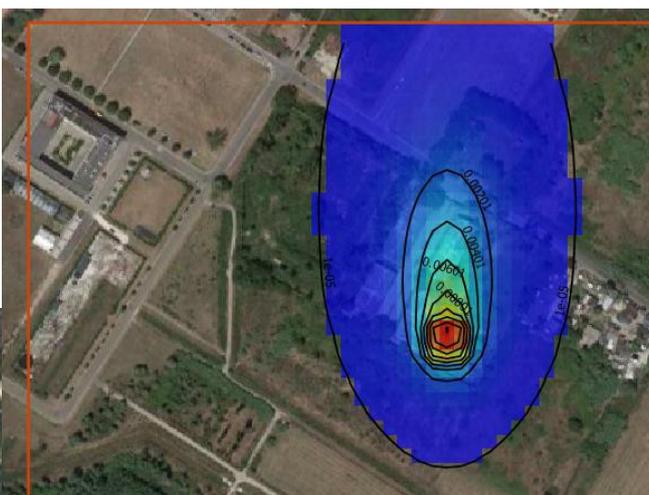
Surface and Groundwater Flow Simulation

Water quality simulation and analysis tools

Rural water management module

Calibration Sensitivity Analysis Parameter estimation

UPSCALING from cell results  
WATER MANAGEMENT AND PLANNING MODULE





# FREEWAT CAPACITY BUILDING

Large stakeholders involvement (>>>220 stakes involved )

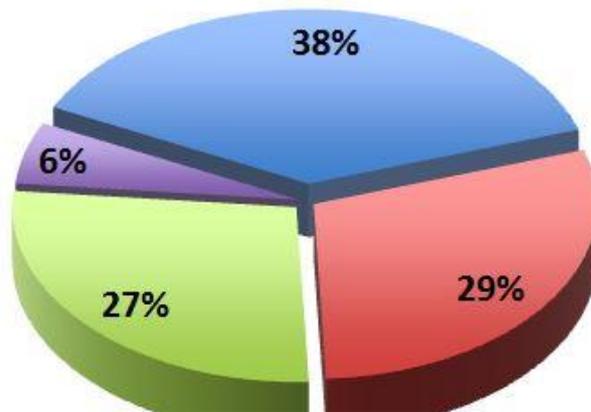
Web social and professional networks

(linkedin group >660 followers – twitter: >650 followers @h2020freewat)

About 900 downloads so far (from 15<sup>th</sup> april 2017)

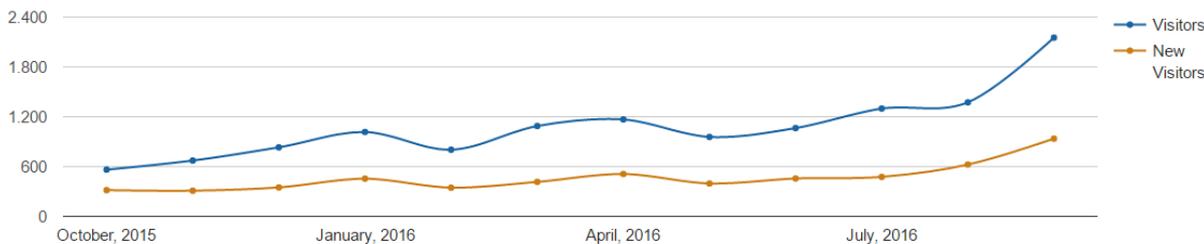
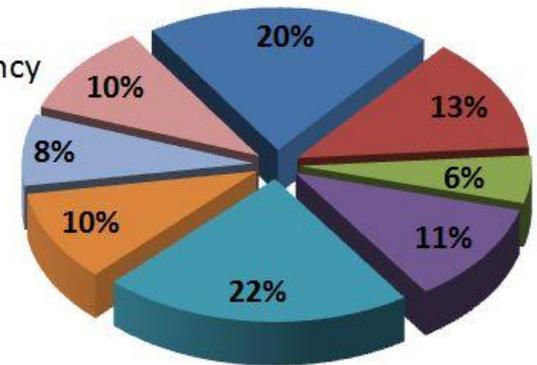
**Area of interest**

- Water quality
- Water policies
- Contaminated site remediation
- Other

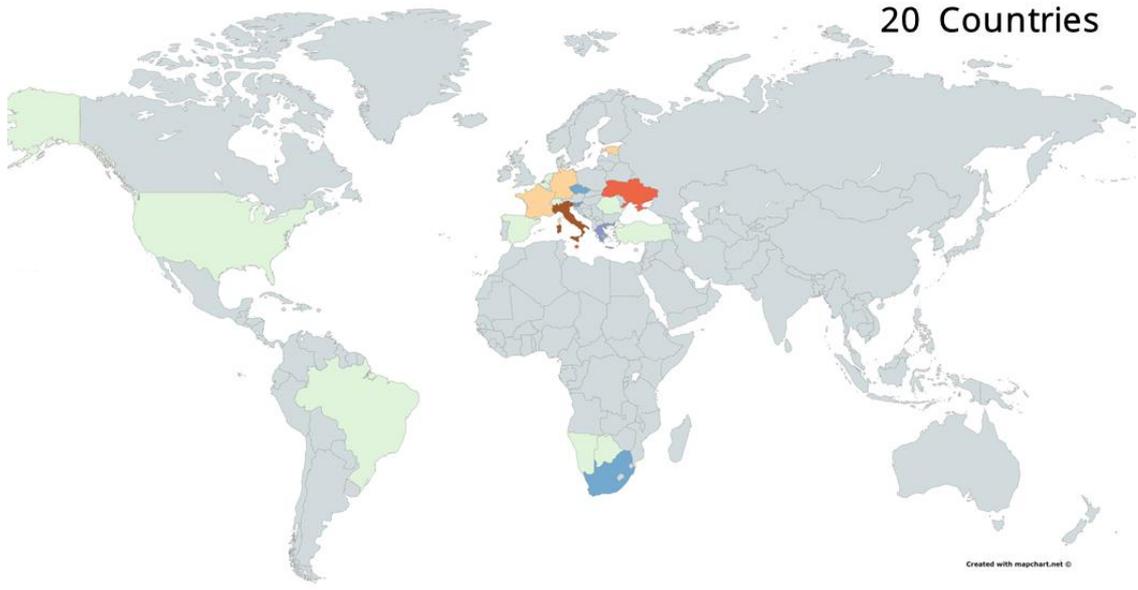


- Research
- River basin authority
- Environmental protection agency
- Water utility
- National authorities
- Local authorities
- Geoenvironmental company

**Type of Institution**



# CAPACITY BUILDING





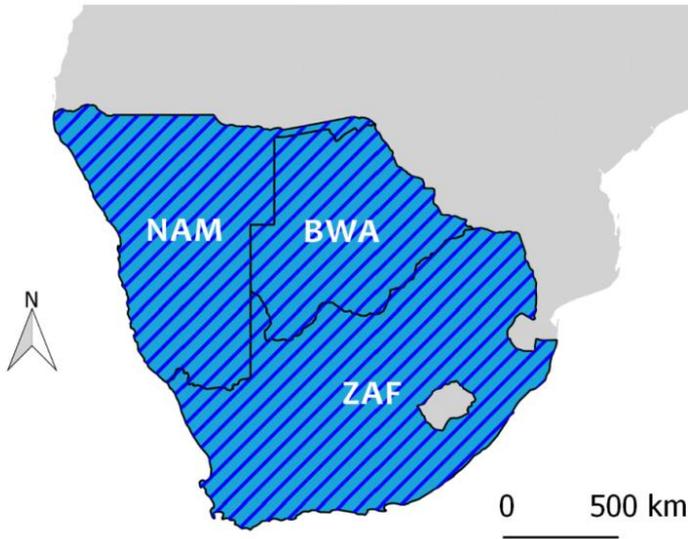
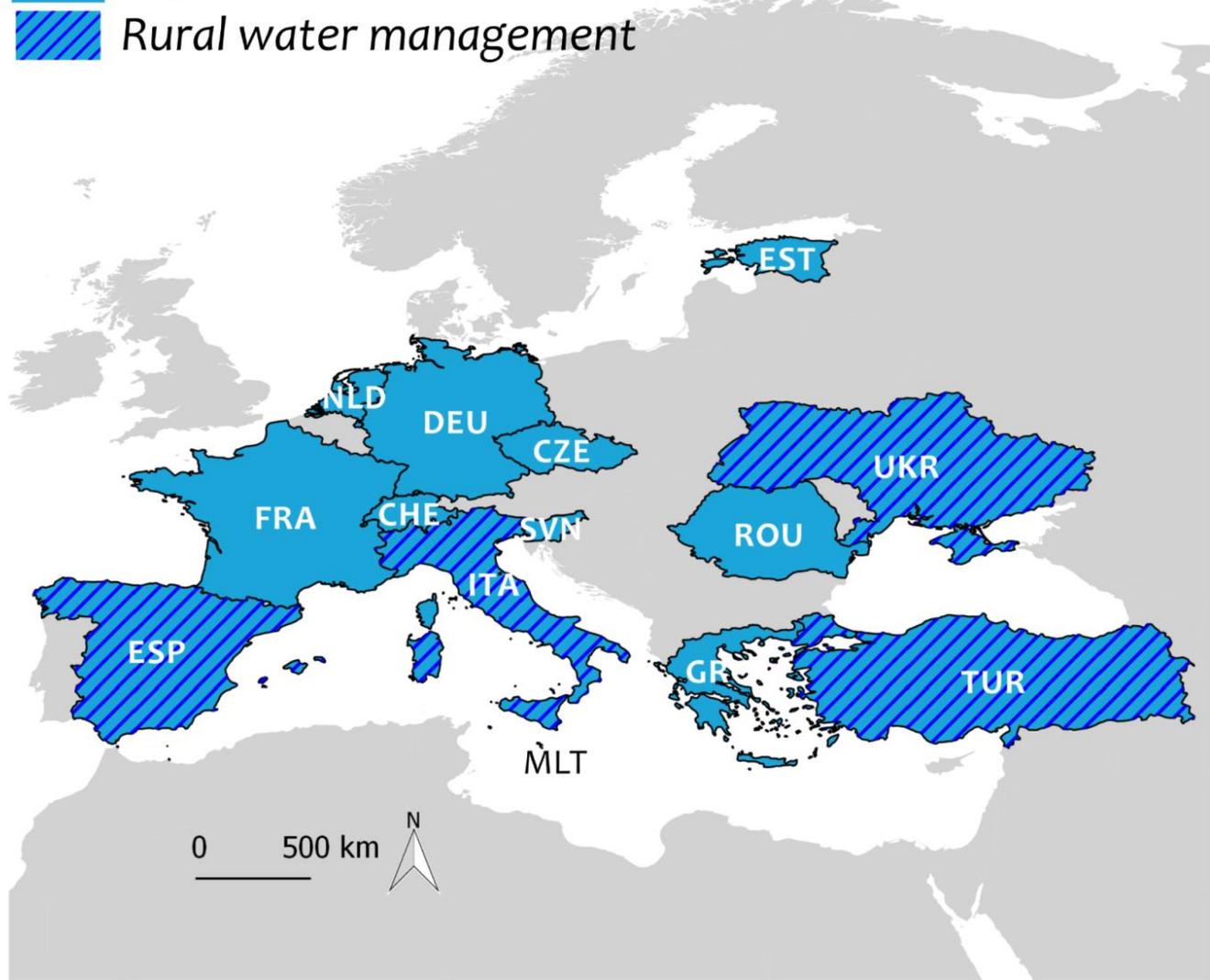
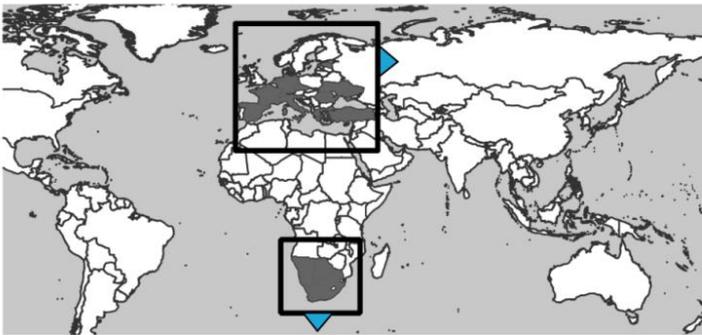
# TUTORIALS AVAILABLE so far...

- Groundwater modelling exercises (3 tutorials)
- AkvaGIS tutorial (Hydrogeological and Hydrochemical Analysis Tools)
- Calibration and parameter estimation
- Unsaturated zone solute transport (2 tutorials)
- Seawater intrusion
- Water Resource Management in Rural Environment
- Lake package
- Observation Analysis Tools (OAT)

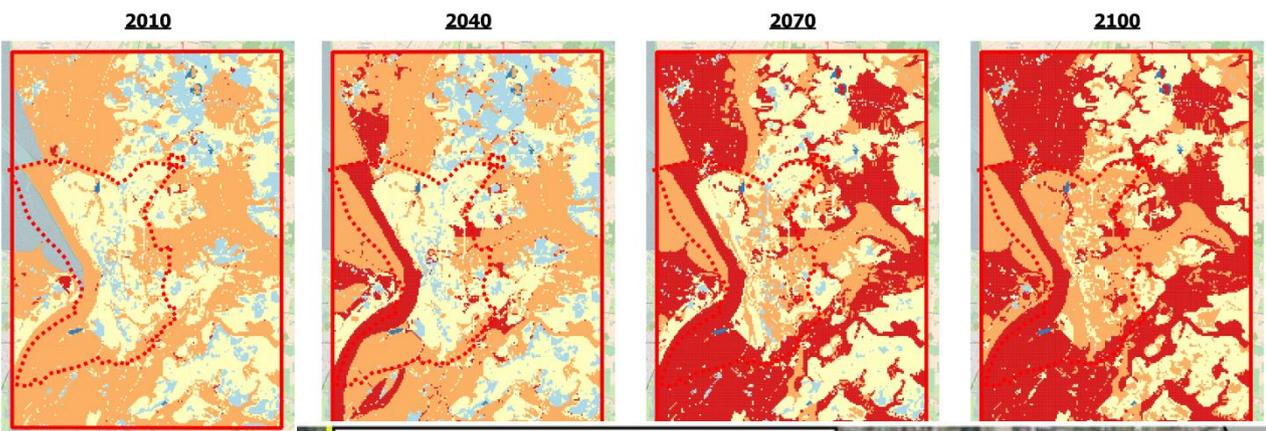


# FREEWAT CASE STUDIES

 Implementation of the Water Framework Directive  
 Rural water management



# Analysing water supply issues

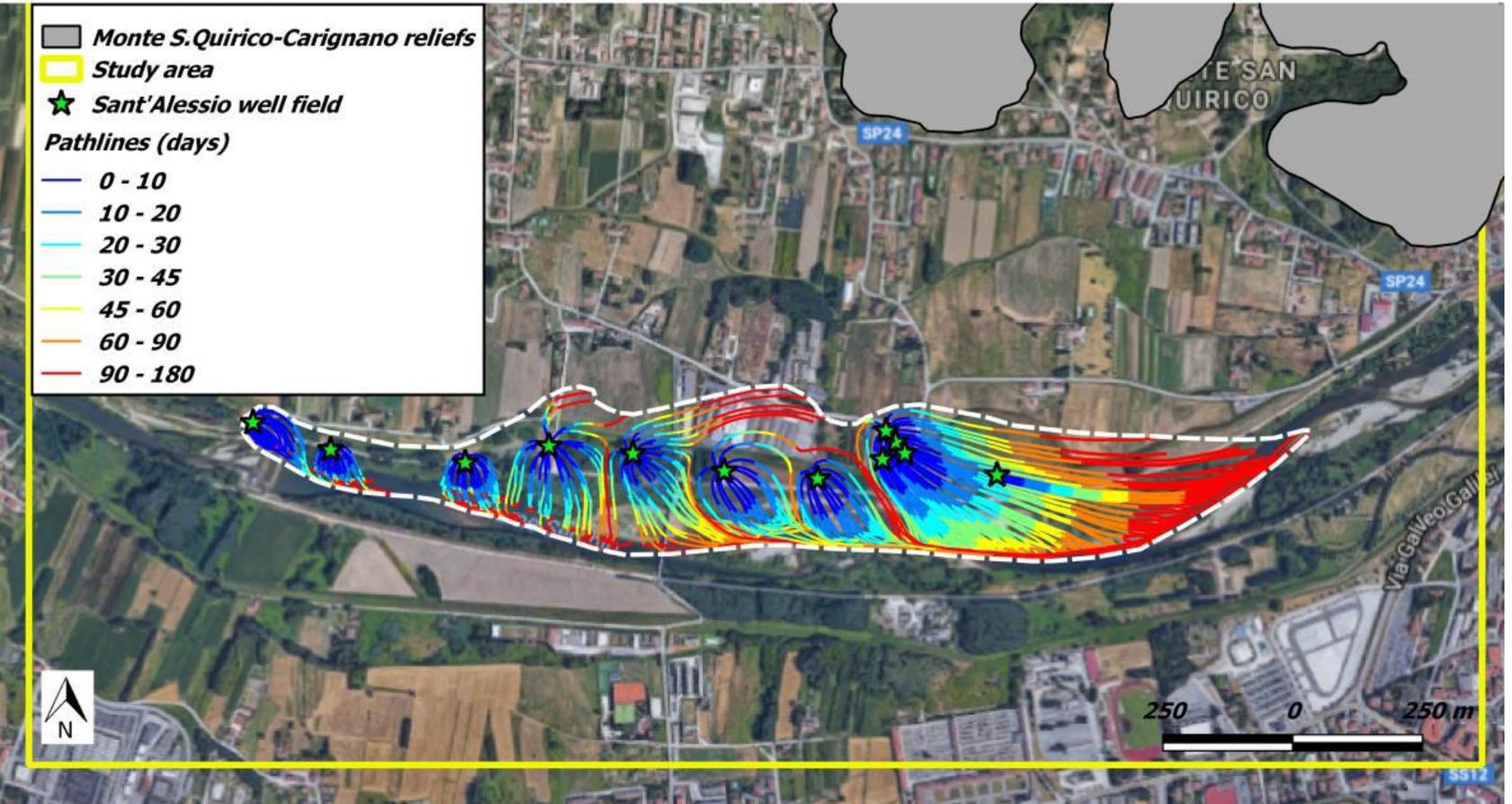


Legend

- model area
- Bremerhaven city border
- Monte S. Quirico-Carignano reliefs
- Study area
- ★ Sant'Alessio well field

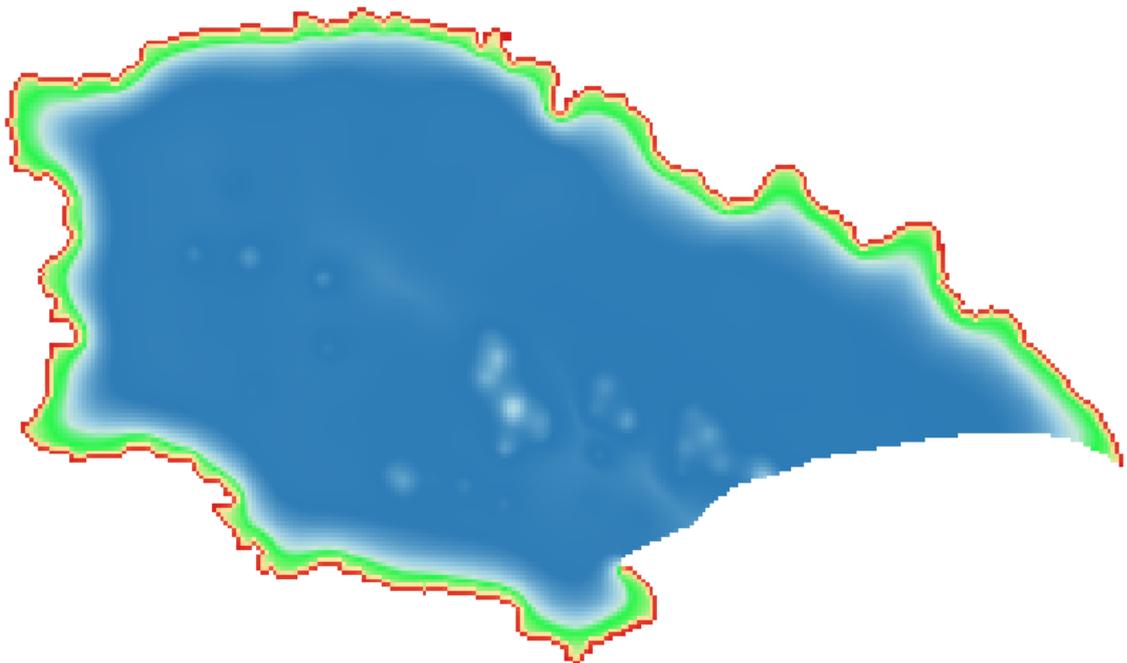
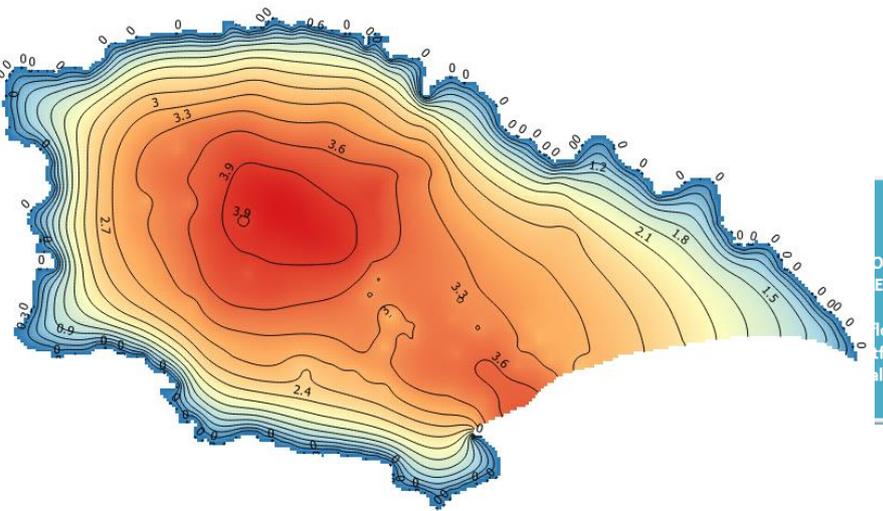
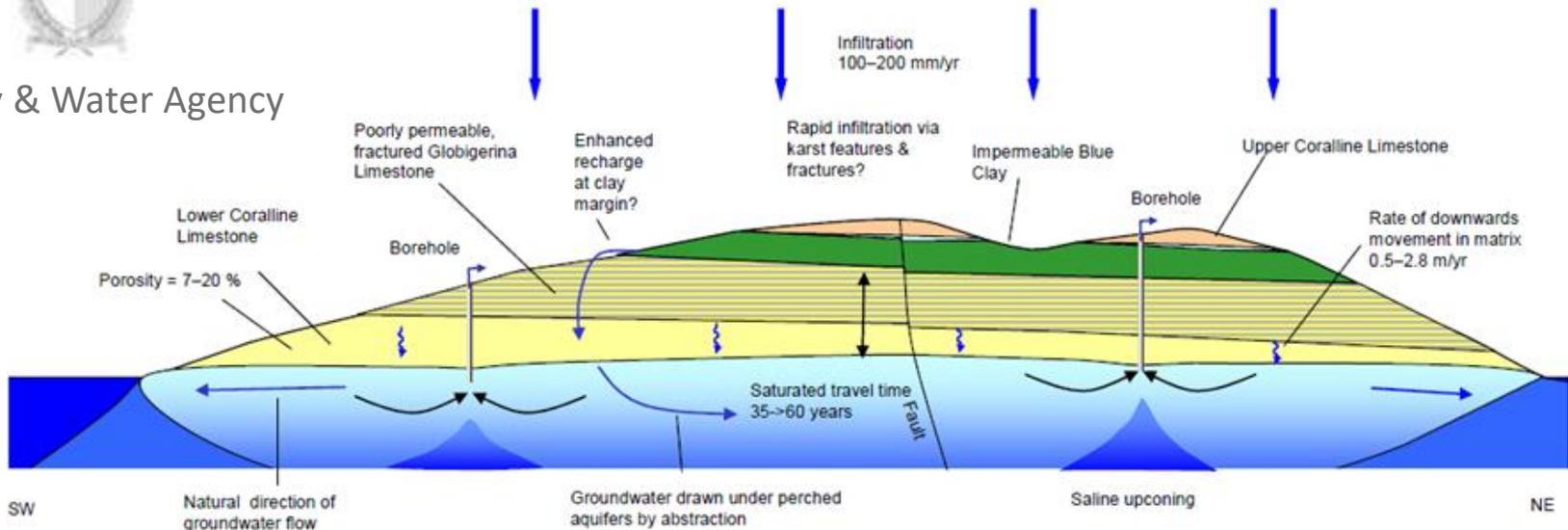
**Pathlines (days)**

- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 45
- 45 - 60
- 60 - 90
- 90 - 180

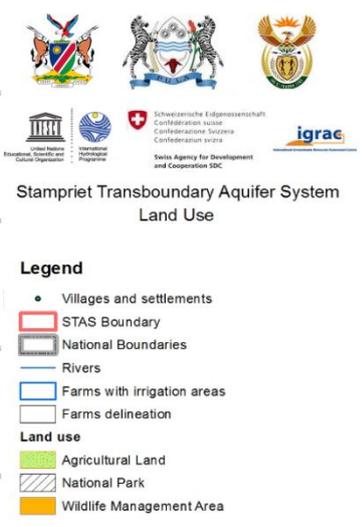
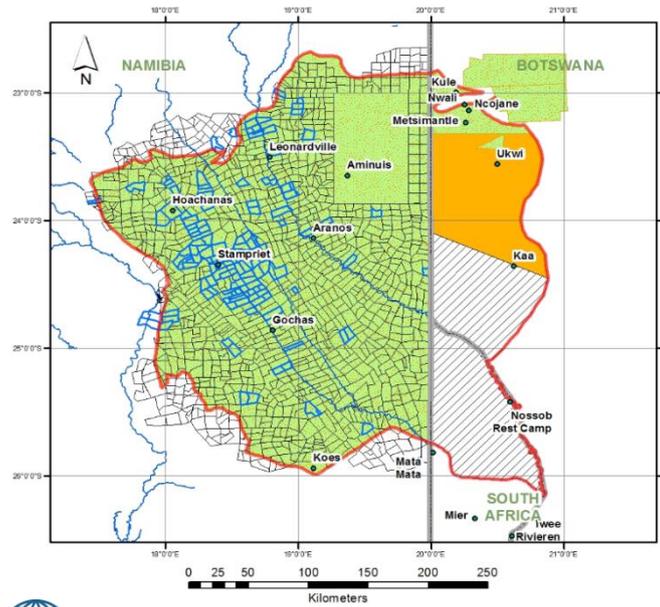
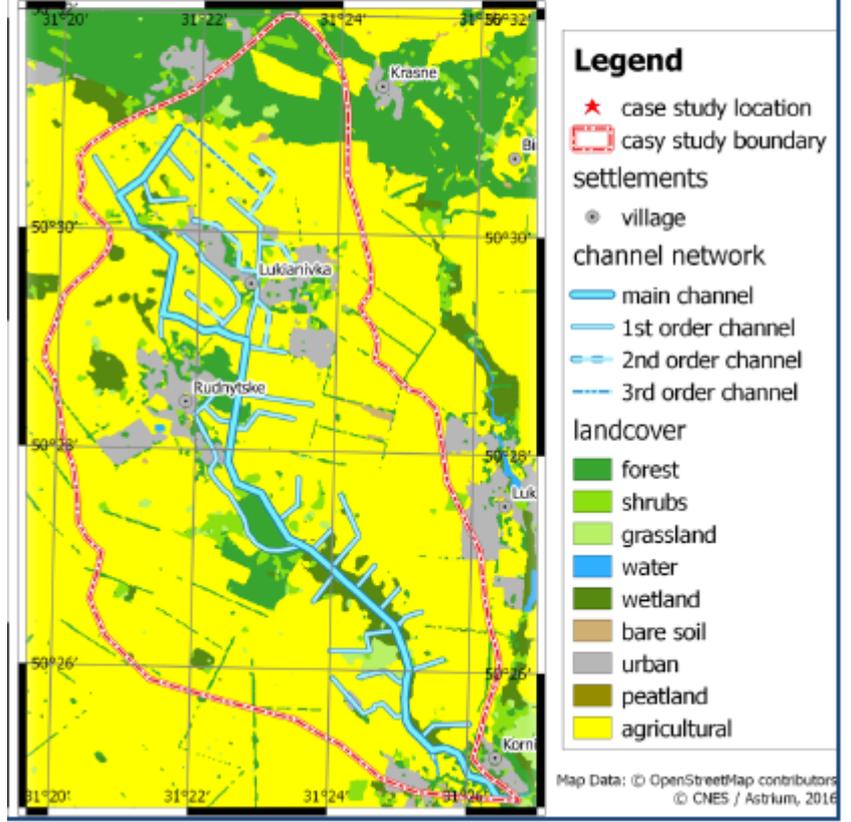
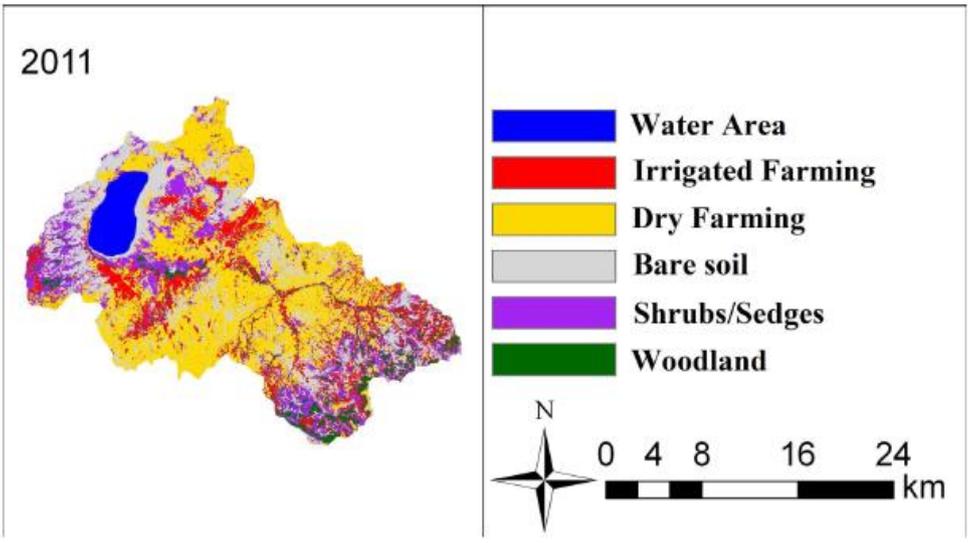


# GOZO mean sea level aquifer

The Energy & Water Agency



# Addressing rural water management



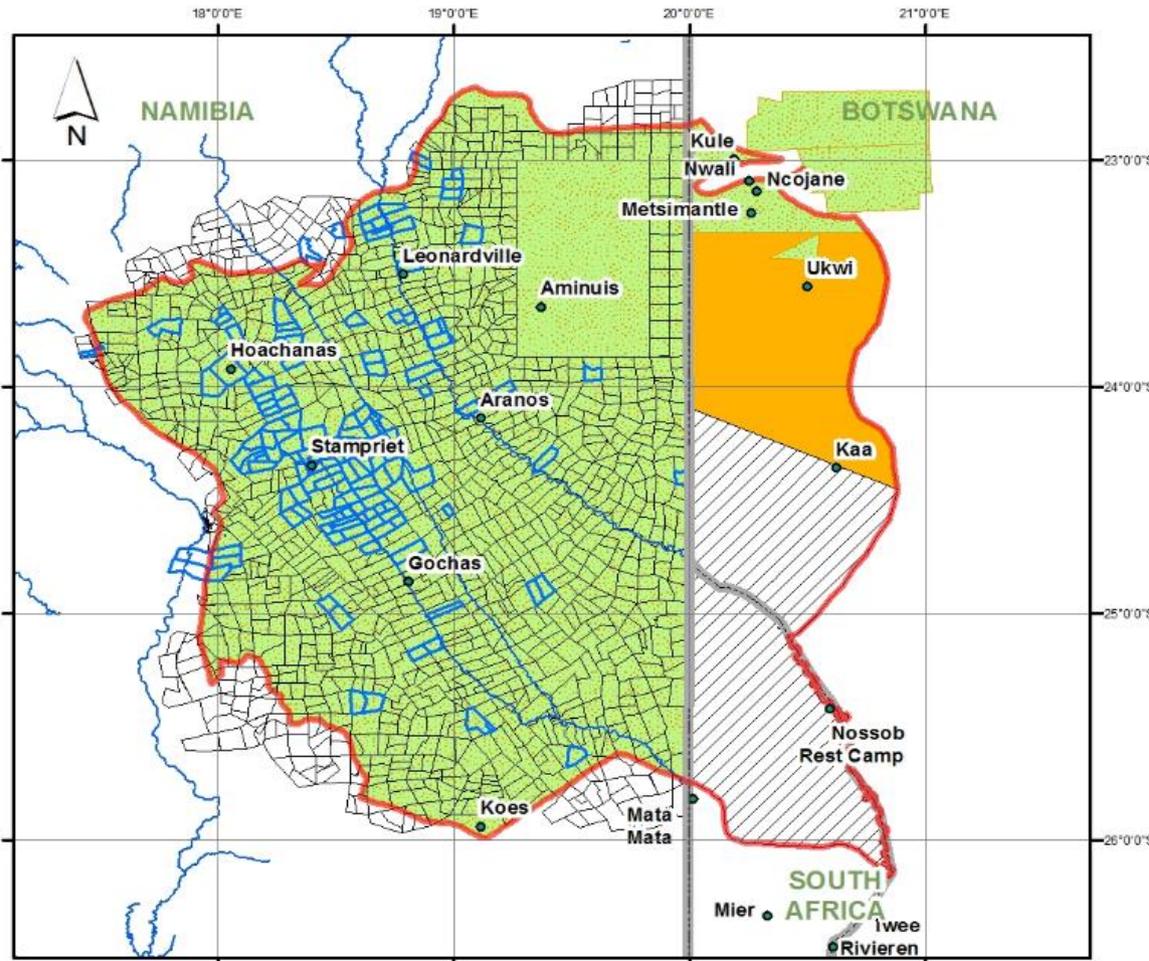
# USING FREEWAT FOR WATER GOVERNANCE PURPOSES ON TRANSBOUNDARY WATER RESOURCE

The STAS is a large farming area with approximately 1200 farms (mostly in Namibia)

Groundwater use: 52% irrigation, 32% stock watering, 16% domestic use

No mining and industrial activities

Annual groundwater abstraction: 20Mm<sup>3</sup> (around 70% in the Stampriet area)



Stampriet Transboundary Aquifer System  
Land Use

- Legend**
- Villages and settlements
  - ▭ STAS Boundary
  - ▭ National Boundaries
  - Rivers
  - ▭ Farms with irrigation
  - ▭ Farms delineation
  - Land use**
  - ▭ Agricultural Land
  - ▭ National Park
  - ▭ Wildlife Management



# EU LIFE REWAT 2015 -2019

sustainable WATER management in the lower Cornia valley through demand REduction, aquifer REcharge and river REstoration

Coordinatore:  
Consorzio di Bonifica 5 Toscana Costa



Partners:



Regione TOSCANA  
Aeropoli di Populonia -  
Necropoli di San Cerbone

Scuola Superiore Sant'Anna – Istituto di Scienze della Vita



ASA spa



Parchi Val di Cornia  
Google



# PARTICIPATORY APPROACH

Relevant part of the FREEWAT approach

At each case study a FOCUS GROUP is set

These aim at including the society in the technical part of the game.

Aim also at demonstrating at a general level that water resource management and planning may be performed with open source and public domain sw

A common space for the participants to bring their experience and values to generate a shared knowledge on the value of water.





# FREEWAT Synergies



- H2020 sister projects
- FP7 MARSOL
- LIFE projects
- non-EU countries (SADC, Egypt, South America)



**EIP Water** Online Market Place  
 Matchmaking for water Innovation  
**MAR Solutions - Managed Aquifer Recharge Strategies and Actions (AG128)**

**WIRES**  
 Water & Irrigated agriculture Resilient Europe  
**EIP Water Action Group**  
 Pooling resources - Innovating water

## UNESCO's Hydro free and/or Open-source software Platform of Experts (HOPE)





# FREEWAT CONCLUSIONS FREEWAT

- Unite the power of GIS geo-processing and post-processing tools in spatial data analysis to that of simulation software
- Public authorities have the chance to build high informative and dynamically growing SHARED representation of hydrologic systems where performing planning analysis
- No cost for licences (money can be moved to development of client tailored applications>>>> *new companies and jobs*>>>SDG8)





# FREEWAT

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EU HORIZON 2020 Project



# ict4water.eu



# Thank you!



## FREEWAT - Free and Open Source Software Tools for Water Resource Management

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 642224

