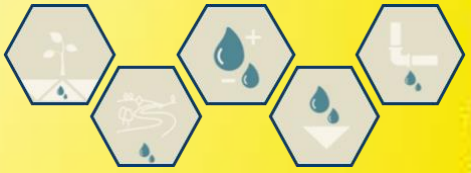
2nd International LIFE REWAT Summer School

Digital water management and water-related agroecosystem services: geostatistics, hydroinformatics and groundwater flow numerical modelling

September 9th—20th, 2019
Scuola Superiore Sant'Anna
Pisa, Italy



2nd FREEWAT International Workshop

Free and open source tool for water quantity and quality management

Rotman Criollo

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Spanish National Research Council (CSIC)
Barcelona, Spain
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AkvaGIS

Free and open source tool for water quantity and quality management

Rotman Criollo

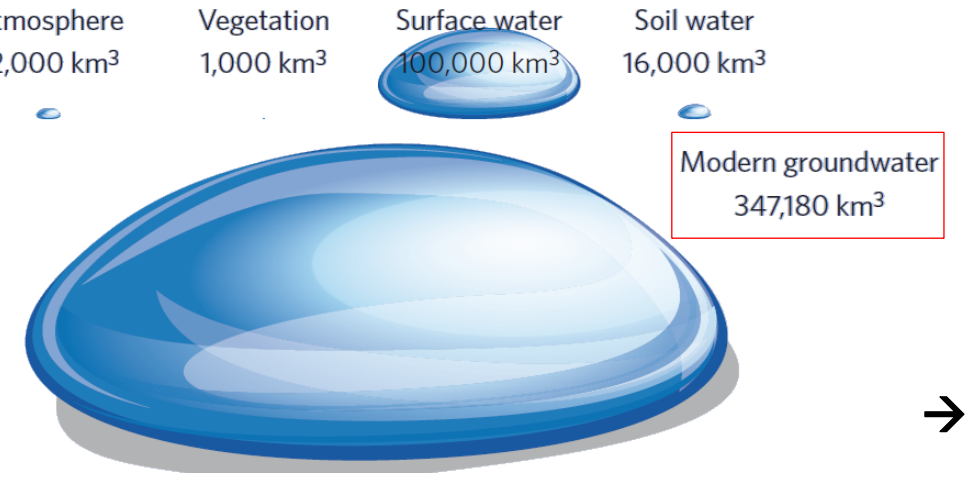
2nd International LIFE REWAT Summer School
2nd FREEWAT International Workshop

SEPTEMBER 17th 2019. Pisa

idaea CSIC Consejo Superior de Investigaciones Científicas

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

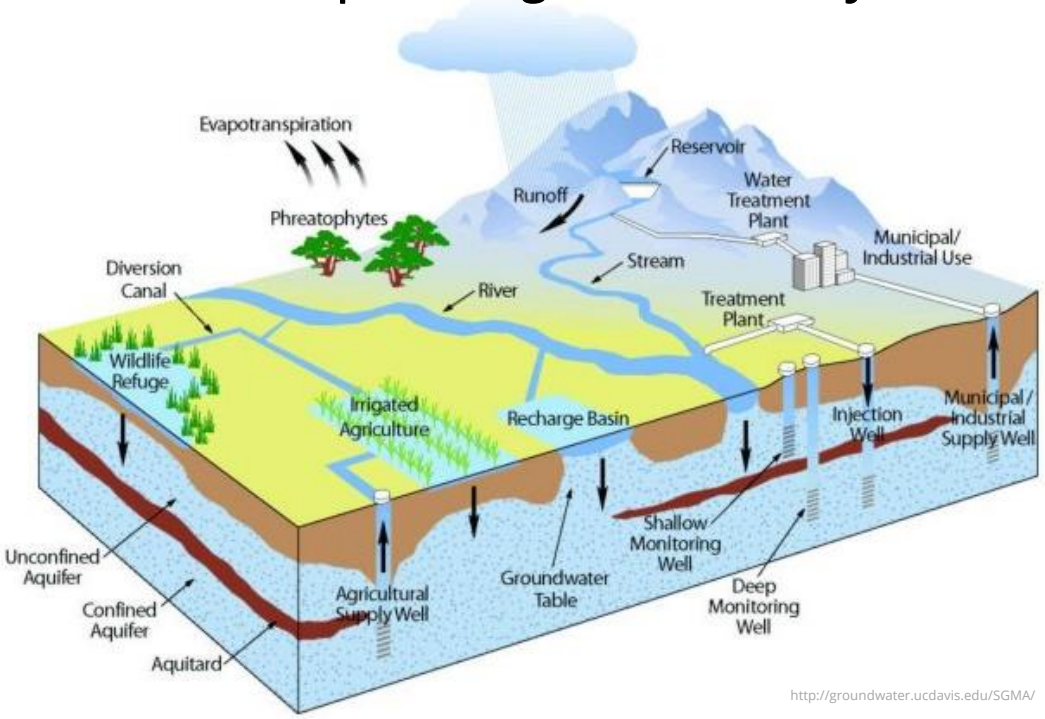
Greatest resource of water



Gleeson et al., 2016. Nature Geosc.

Anthropic Actions →

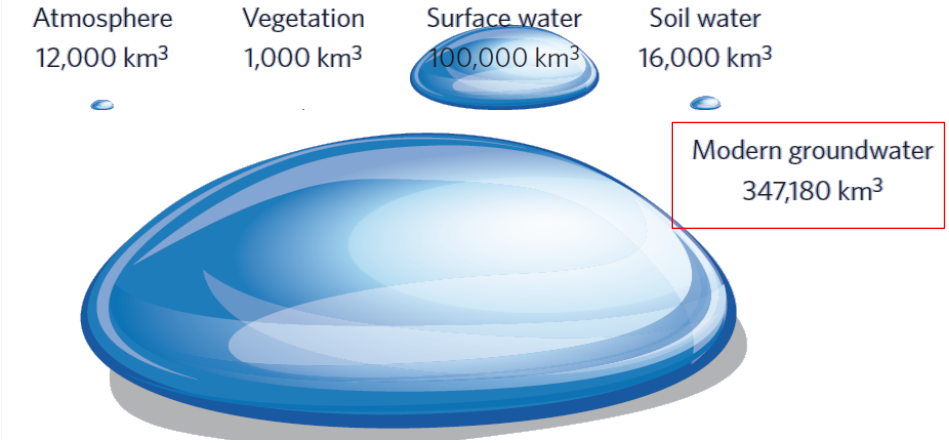
→ Impacts in groundwater systems!!



http://groundwater.ucdavis.edu/SGMA/

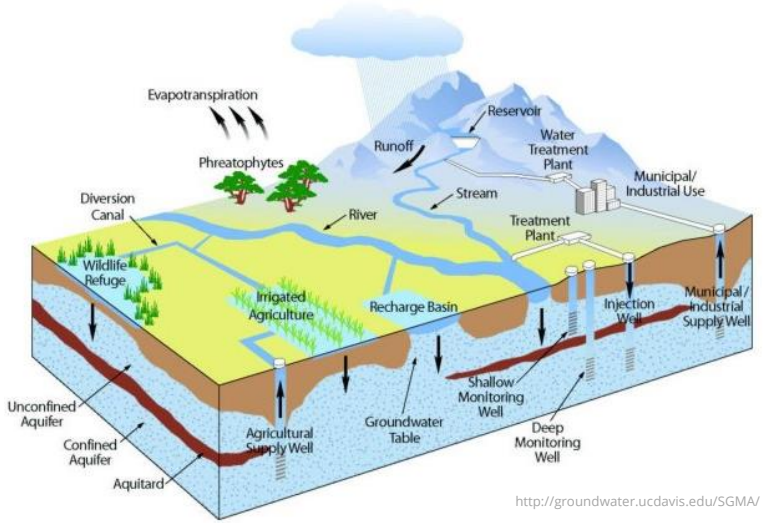
Introduction

Greatest resource of water → Complex System



Gleeson et al., 2016. Nature Geosc.

+ Anthropic Actions → Complexity ↑



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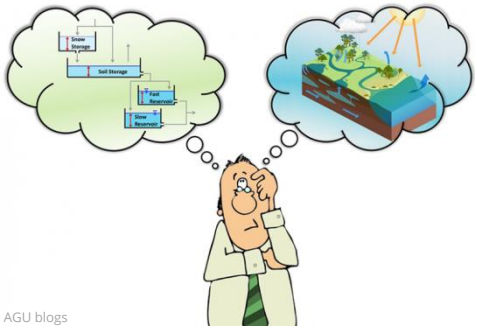
Ensure Groundwater Sustainability

Conceptual Model

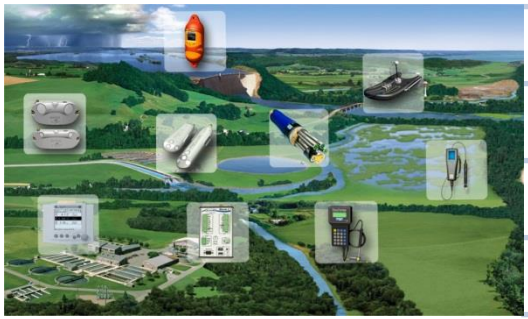


AGU blogs

- Geology
- Aquifer Geometry
- Hydraulic Parameters
- Heads
- Concentrations

Time & Space Dependant

Monitoring



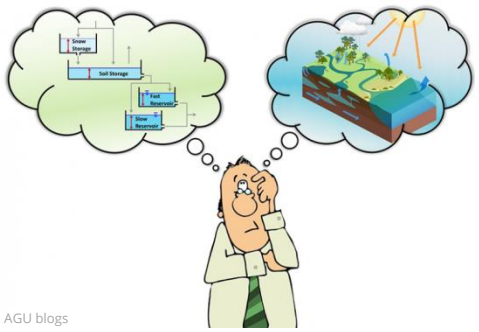
https://www.sontek.com

- Design Mon. Network
- Instrumentation
- Measurements
- Data Management
- Data “Uses”

Monitoring Process Management

Introduction

Conceptual Model

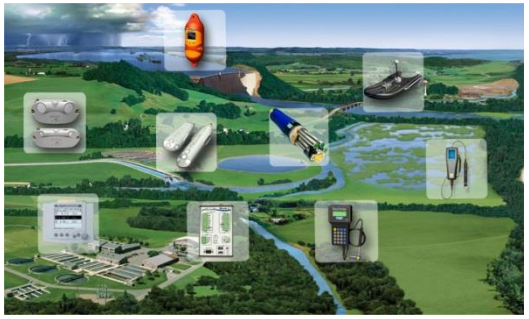


AGU blogs

Time & Space Dependant

GIS
Geospatial Information System

Monitoring



https://www.sontek.com

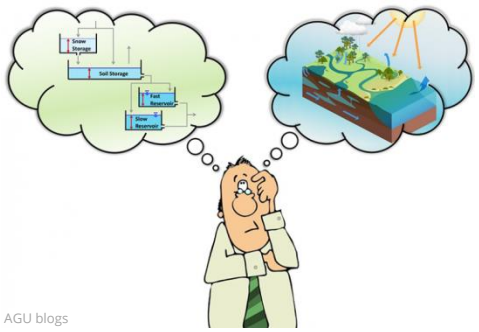
Monitoring Process Management

ICT
Information & Communication Tools

- Control Devices
- Handle Data
- Share and Communicate Information
- Find Smart Information
- Simulate Events (App)

Introduction

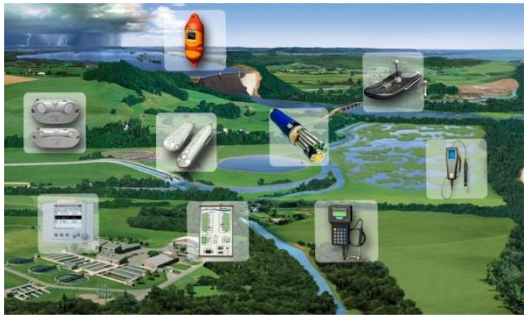
Conceptual Model



AGU blogs

Time
&
Space
Dependant

Monitoring



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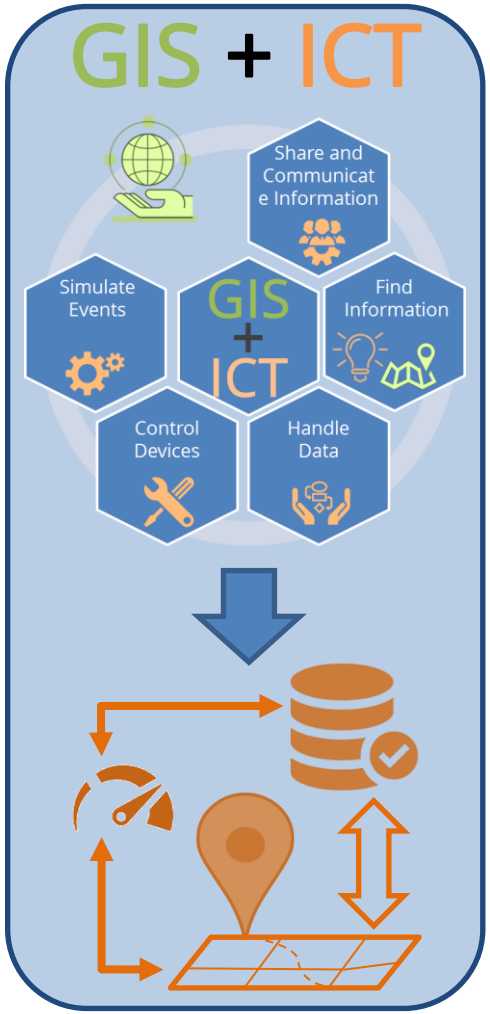


Introduction & Background

Reference	Spatial DataBase	ICT GIS-based tools (geology, hydrochemistry, head levels, ...)	ICT GIS-based tools for analysis of Hydraulic Parameters
Radu et al., 2001	✓	✓	-
Cabalska et al., 2005	✓	✓	-
Strassberg, 2005, 2011	✓	✓ ArcHydro	-
De Dreuzy et al., 2006	✓	-	-
Yang and Lin, 2010	-	✓ uWater-PA	✓ uWater-PA*
Chesnaux et al., 2011	✓	-	-
Wodja et al., 2013	✓	-	-
Velasco, 2013	✓	✓ HEROS/QUIMET	-
Alcaraz, 2016	-	✓ MetroGeotherTools	-

(*) Only Theis method disregarding other aquifer characteristics (e.g., boundaries, anisotropy, well losses...)

Introduction & Background

Reference	ICT GIS-based tools	Numerical Model coupled in the same GIS platform	Open source
Radu et al., 2001	✓	-	-
Cabalska et al., 2005	✓	-	-
Strassberg, 2005	✓	-	-
De Dreuzy et al., 2006	-	-	-
Yang and Lin, 2010	✓	-	
Chesnaux et al., 2011	-	-	-
Wodja et al., 2013	-	-	-
Velasco, 2013	✓	-	-
Alcaraz, 2016	✓	-	-
Wang et al., 2016	✓	✓ GIS-Groundwater (ESRI)	-

New developments required

To **ADAPT** ICT tools to specific institutions and / or third - party databases

To ensure data **VALIDATION**

To **ANALYSE** further hydrogeological processes and obtain aquifer parameters from field measurements

To **ENABLE** the groundwater community to use these platforms

AkvaGIS: An open source tool for water management

Motivation

- ICT GIS-based tools to **boost the application of Water** related **Directives**;

- **Share** free and open source tools, numerically based, GIS integrated to perform spatial and temporal analysis on water quantity and quality issues; use effectively data provided by the extensive monitoring required by the WD;

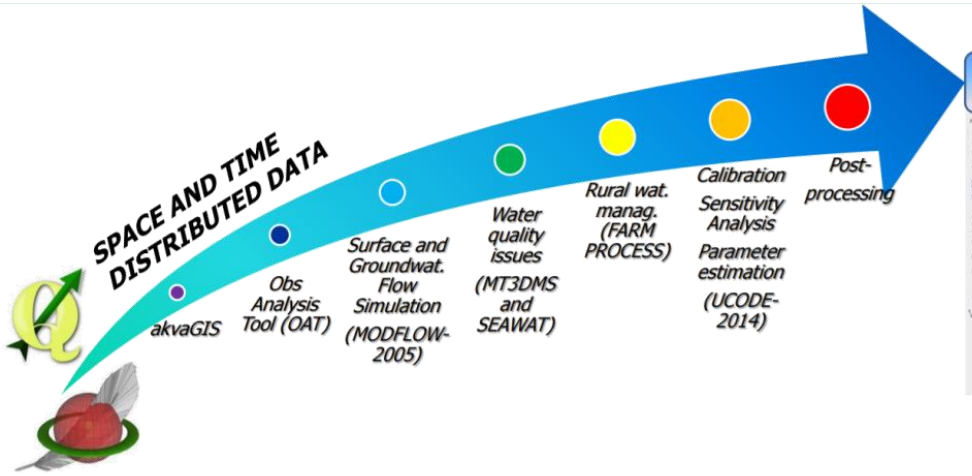
- Including **participatory approach** earlier than the results discussion;

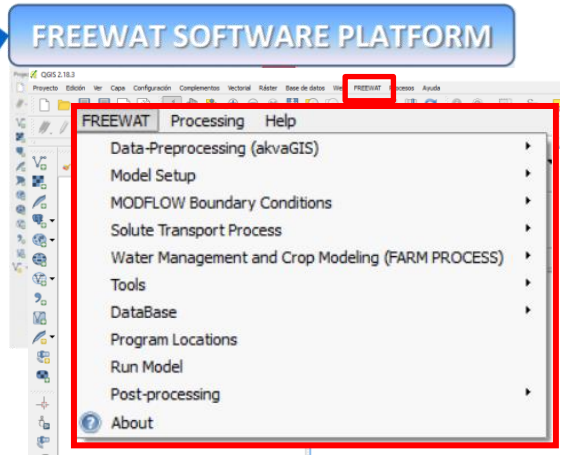
- **Training** technical staff at authorities and private companies on the use of state-of-the-art innovative software for water management; capacity building within the EU water sector

AkvaGIS: An open source tool for water management

Motivation. H2020 FREEWAT platform

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





AkvaGIS: An open source tool for water management

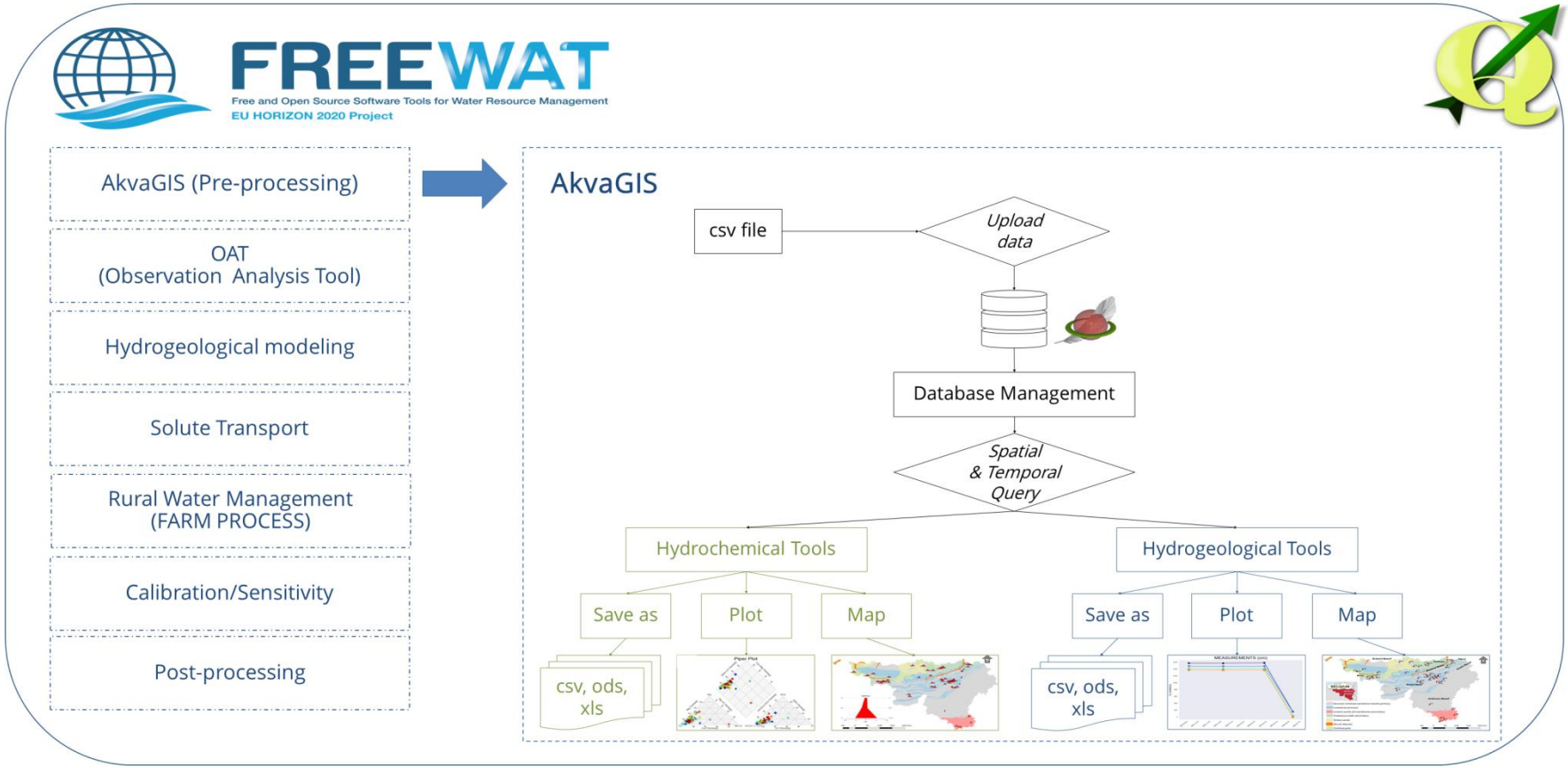
Objectives

- It is essential **open source** tools to fulfil the needs **for**:
  - **Managing** and **visualizing** hydrogeological and hydrochemical **standardized data** with different temporal and spatial scales to facilitate development of the environmental conceptual model
  - **Preparing** hydrogeological **input files** for any groundwater **numerical model** in all of the available formats in QGIS
  - **Simplifying** the **application** of water directives

- **Capacity building** within the EU water sector (training technical staff at authorities and private companies) including **participatory approach** before starts discussion of results obtained (more than 1200 people)

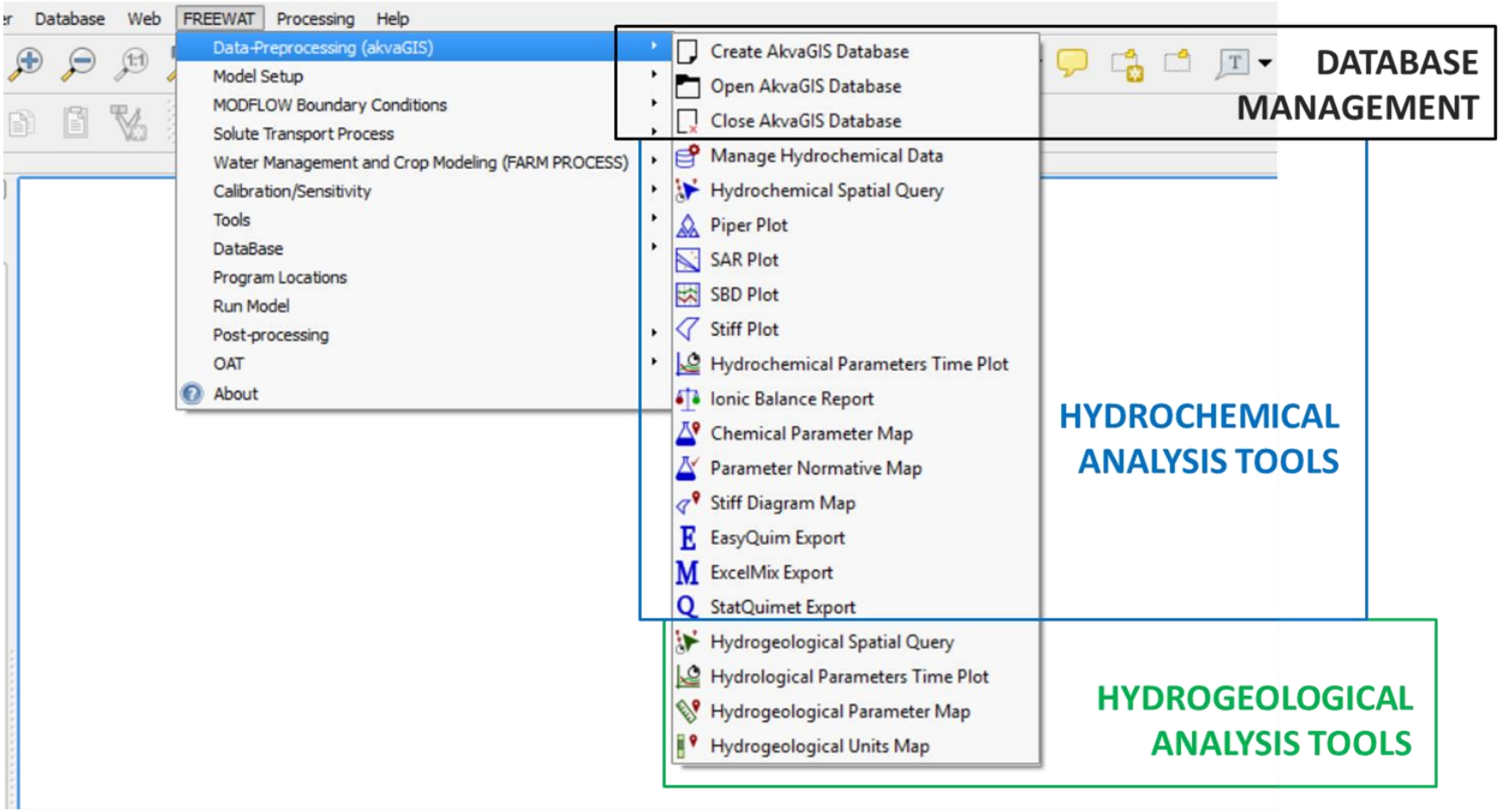
AkvaGIS: An open source tool for water management

AkvaGIS is a novel, free and open source module **included in** the **FREEWAT** plugin for QGIS that supplies a standardised and easy-to-use workflow for the **storage**, **management**, **visualisation** and **analysis** of hydrochemical and hydrogeological data



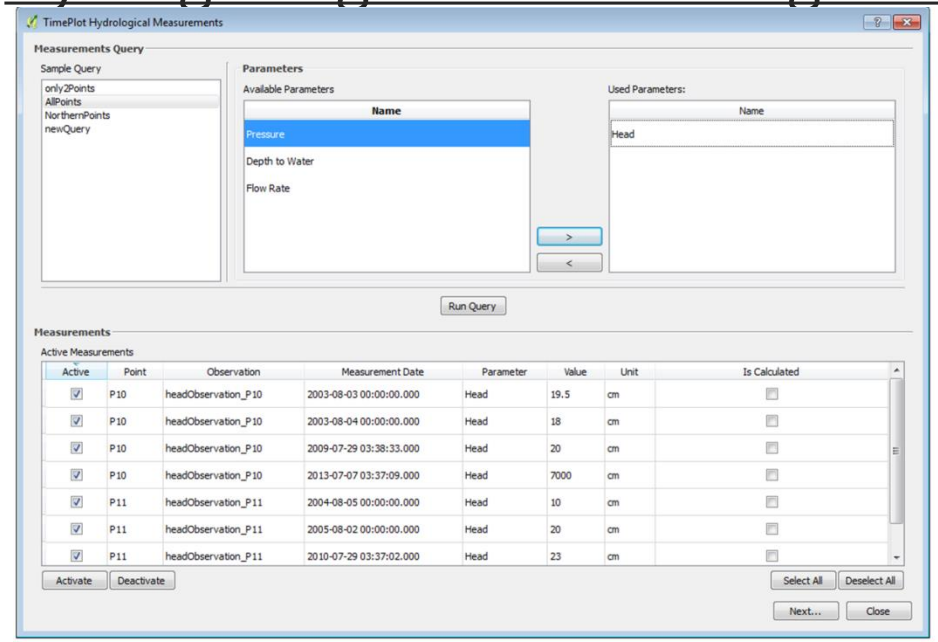
AkvaGIS: An open source tool for water management

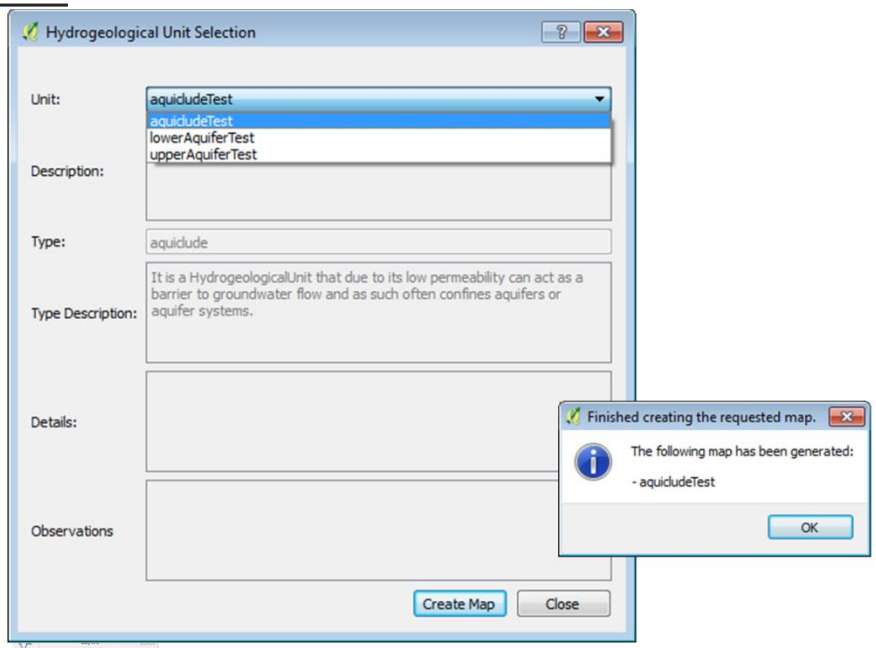
Commands developed cover a wide range of methodologies **for querying**, **interpreting**, and **comparing** groundwater quantity and quality data and **facilitate** the **pre-processing analysis** for being used in the realization of groundwater modelling

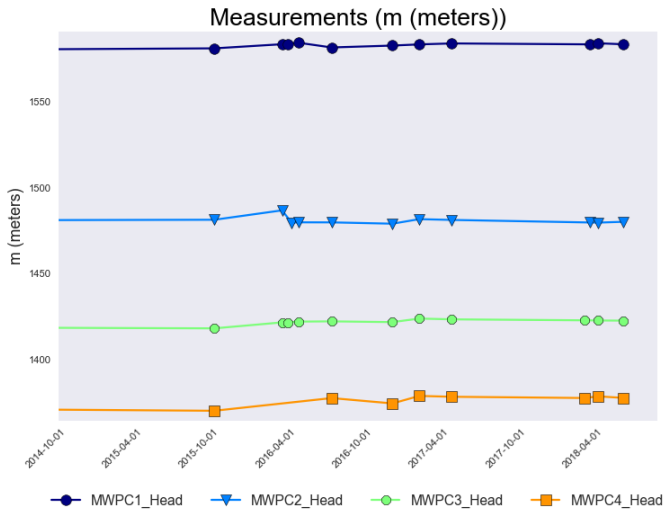


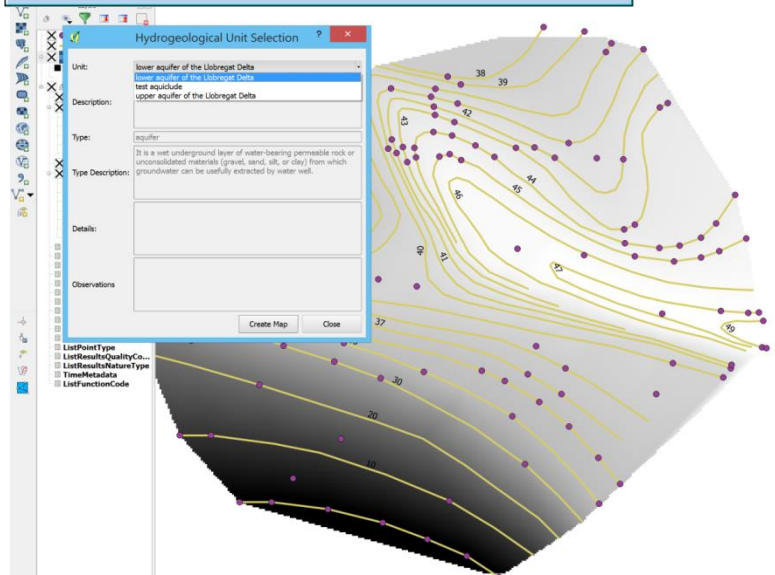
AkvaGIS: An open source tool for water management

Hydrogeological data management



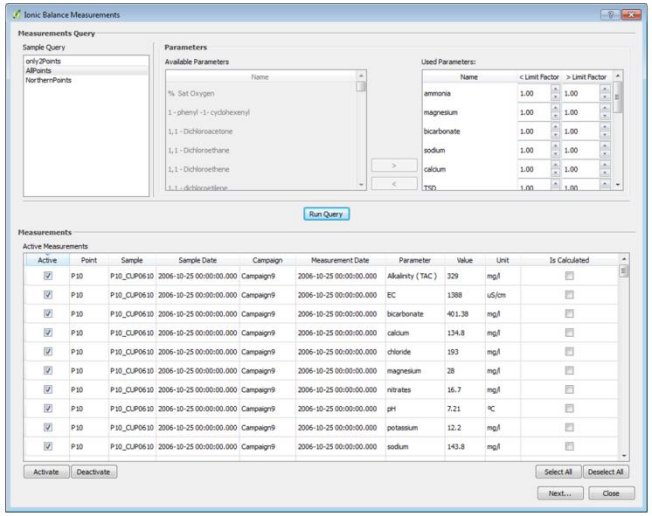


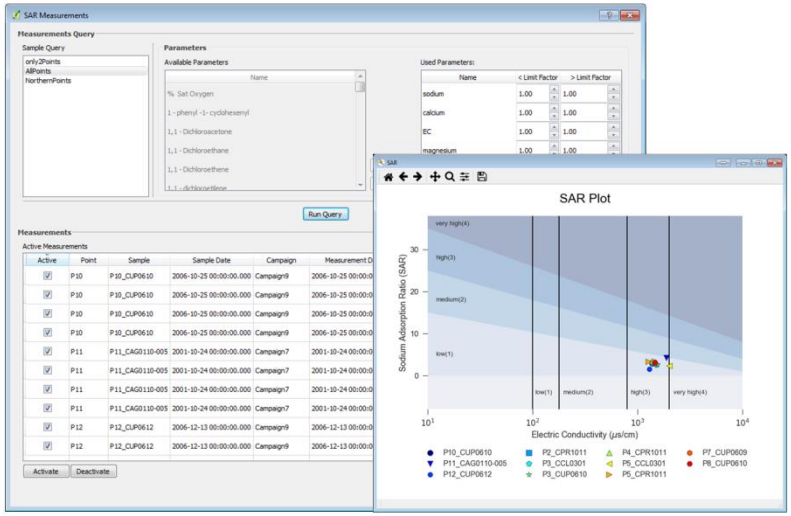


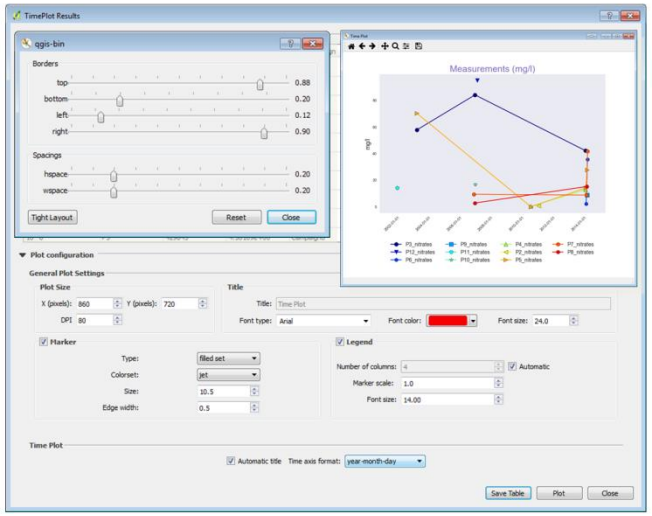


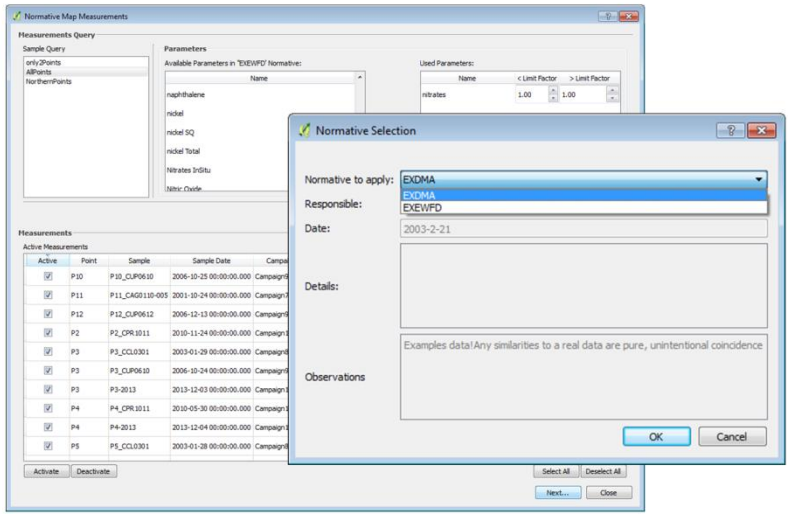
AkvaGIS: An open source tool for water management

Hydrochemical data management



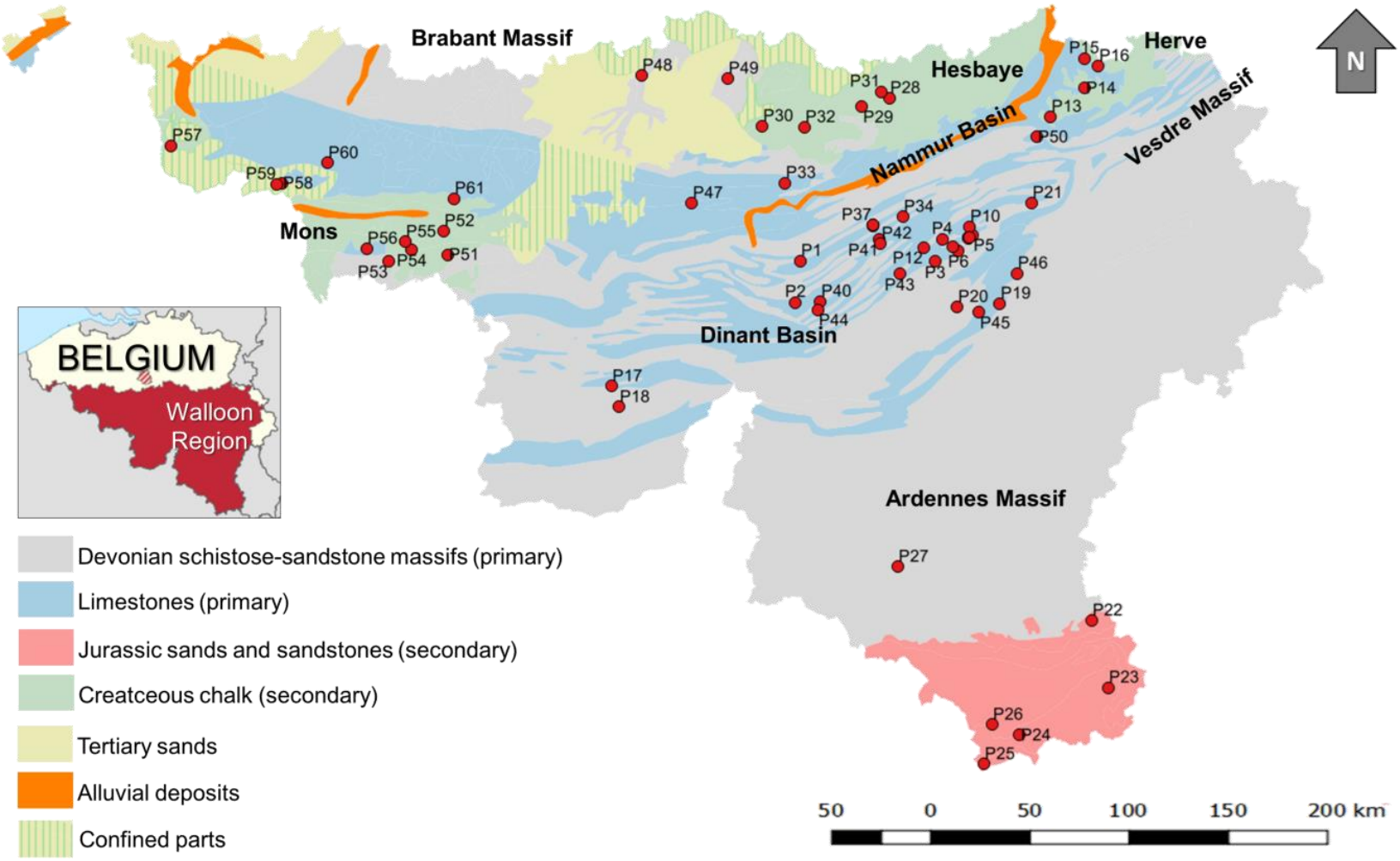






AkvaGIS: An open source tool for water management

Application. Walloon Region (Belgium)



Groundwater abstraction

- Limestones (51%)
- Chalky formations (21%)

For water supply purposes (80% of the water volumes collected)

AkvaGIS: An open source tool for water management

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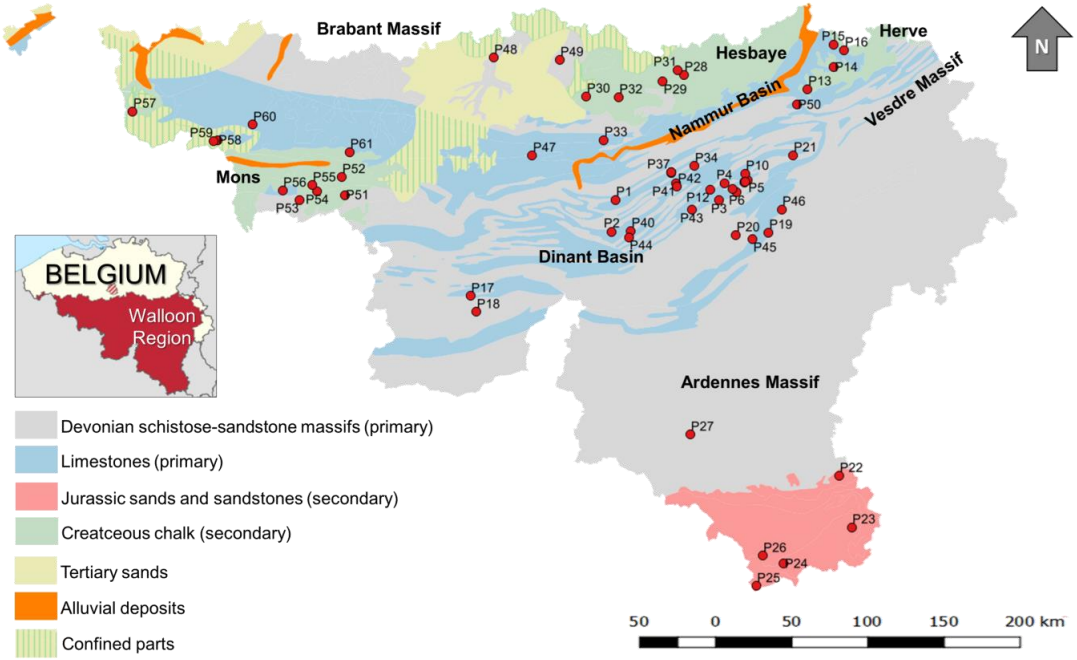
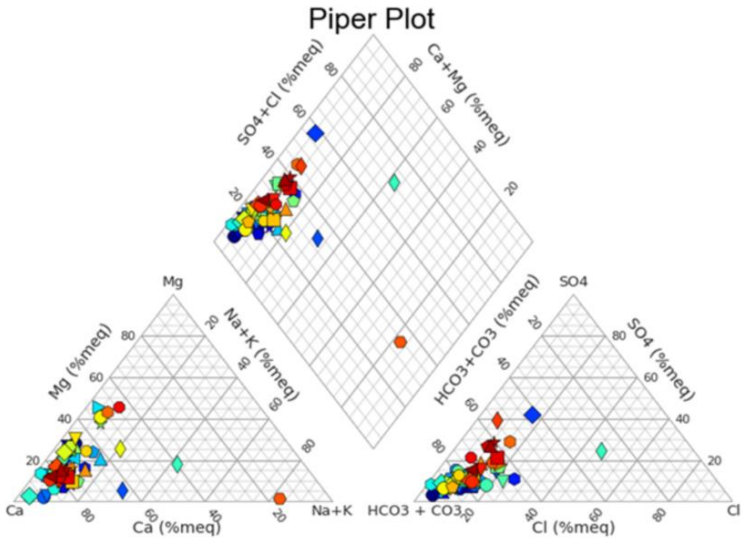
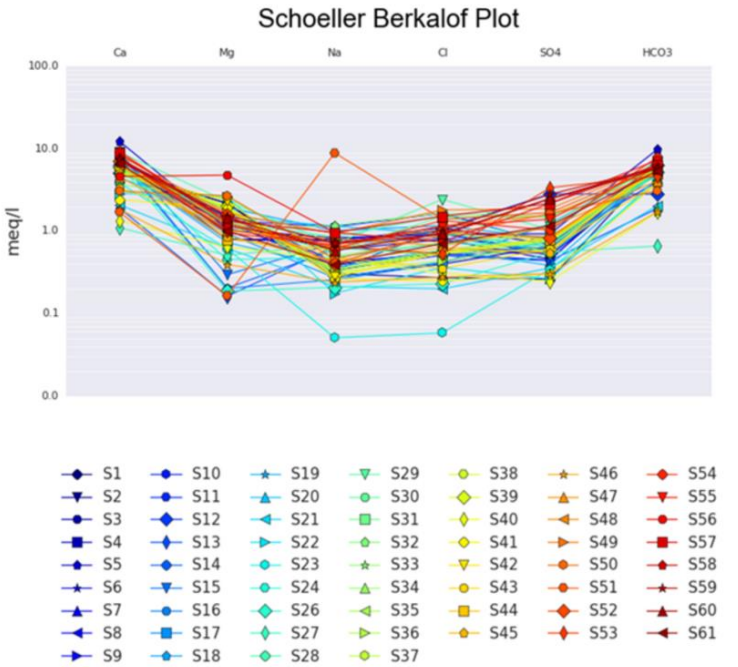




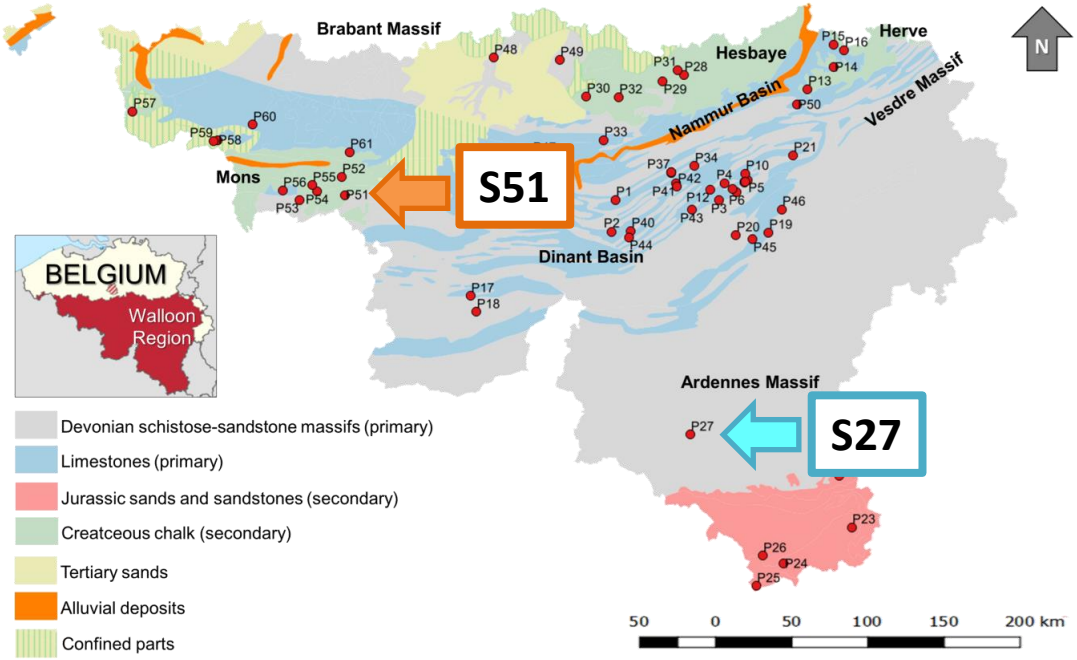


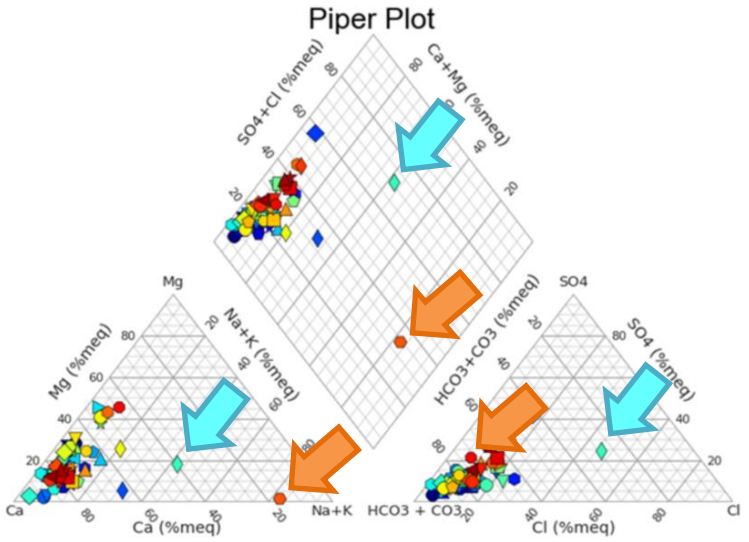
Spring 2016.
64 groundwater points sampled
Ca-HCO_3 type mainly

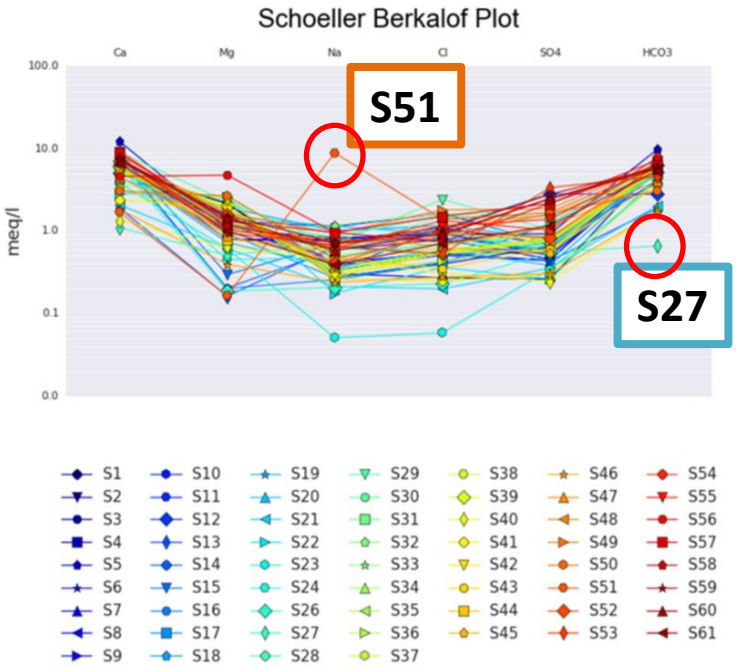
Note.
Database created for this study can be found in Criollo et al. (2019)

AkvaGIS: An open source tool for water management

Application. Walloon Region (Belgium)







Ca-HCO_3 type mainly

S51 Na-HCO_3

S27 Na-K-Cl

Note.

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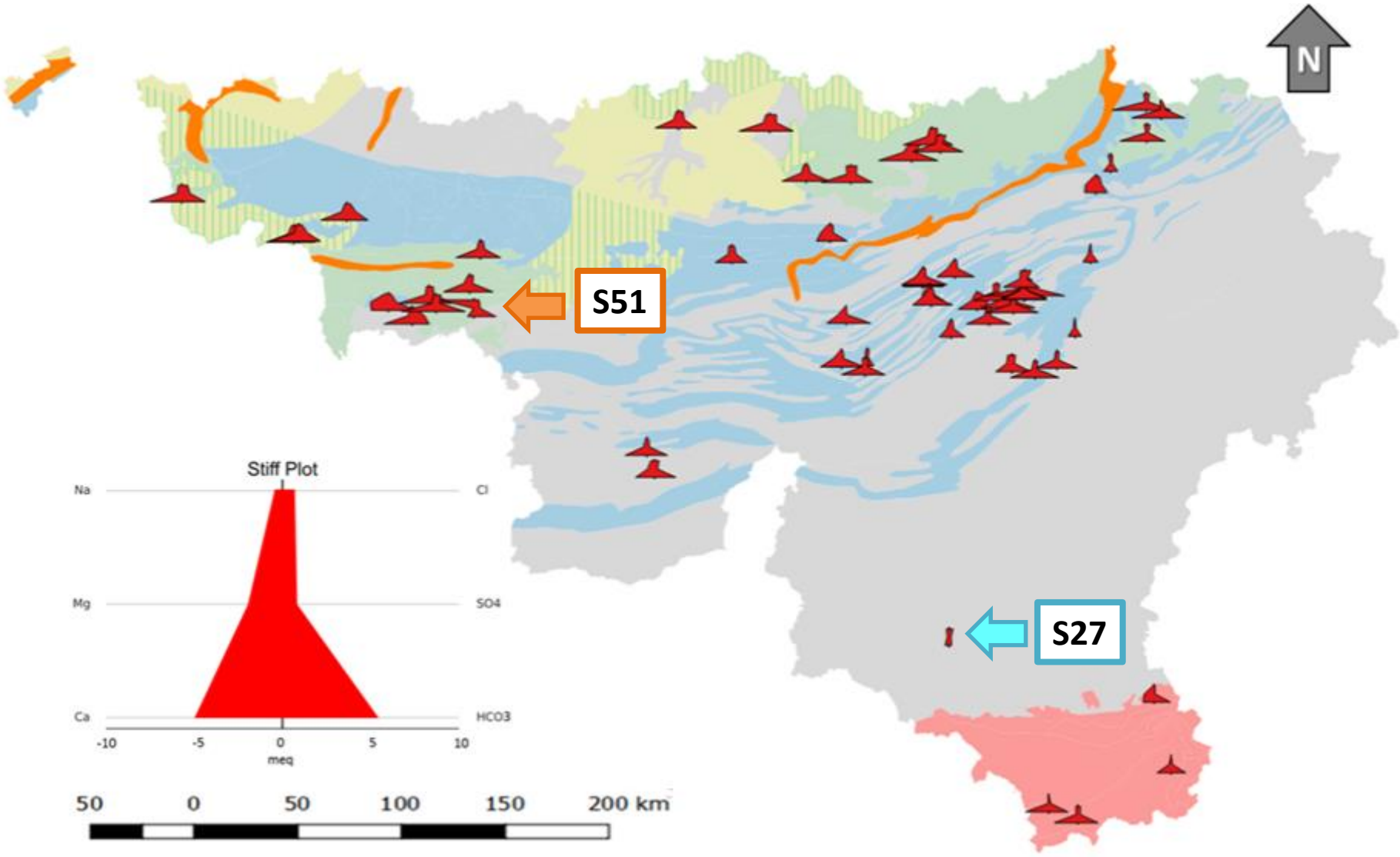
AkvaGIS: An open source tool for water management

Application. Walloon Region (Belgium)



AkvaGIS: An open source tool for water management

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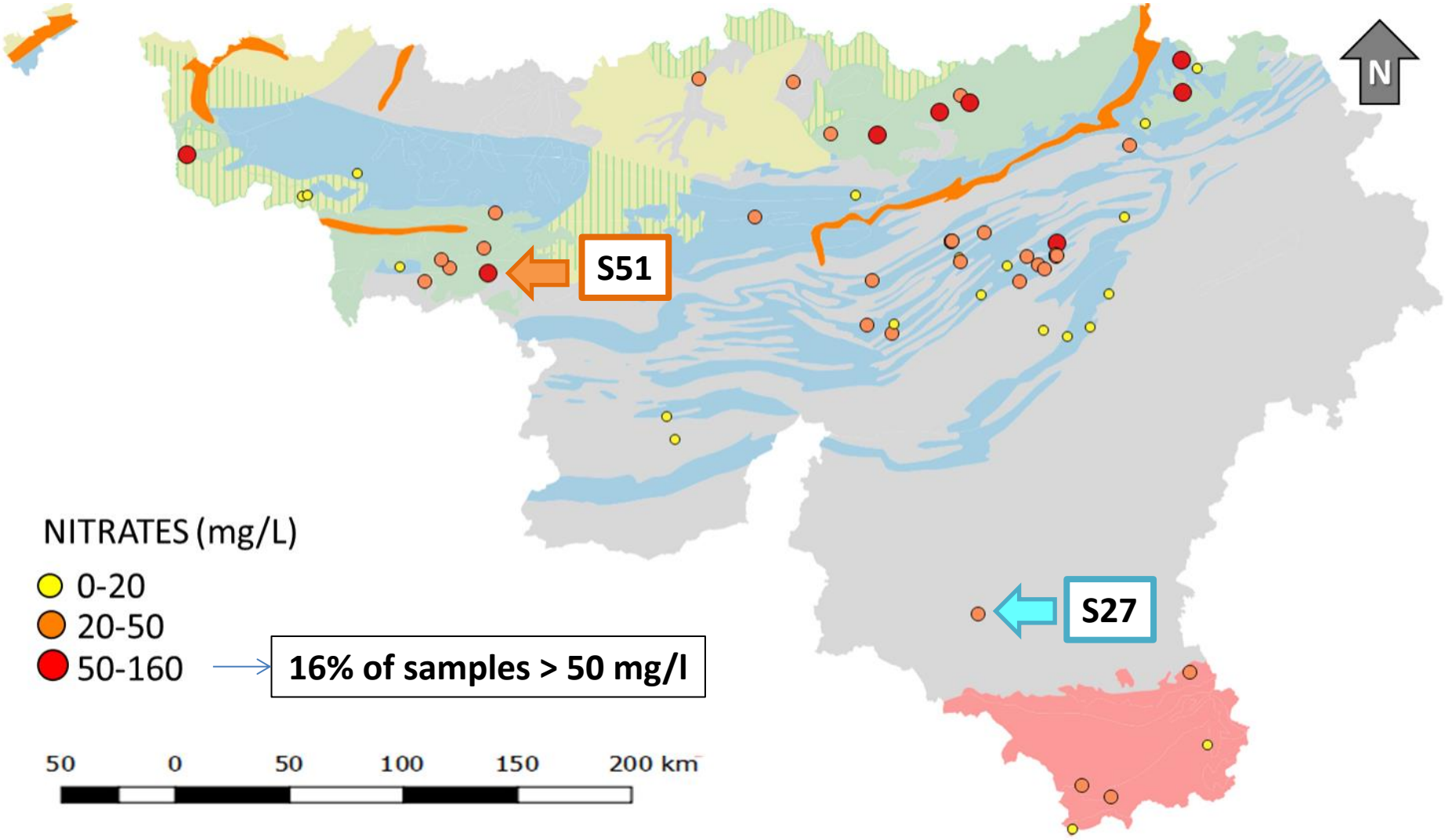
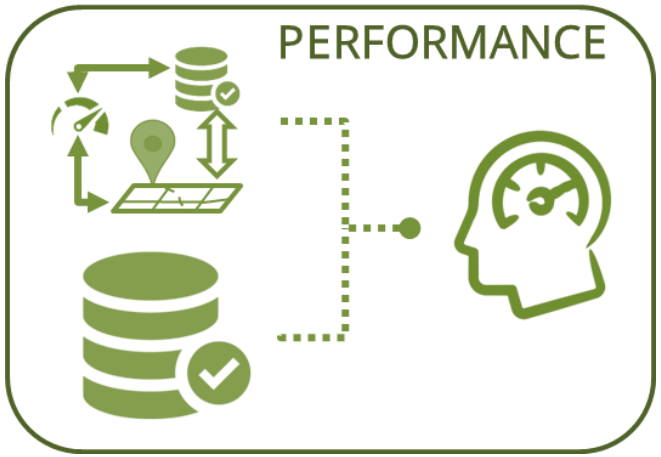


AkvaGIS: An open source tool for water management

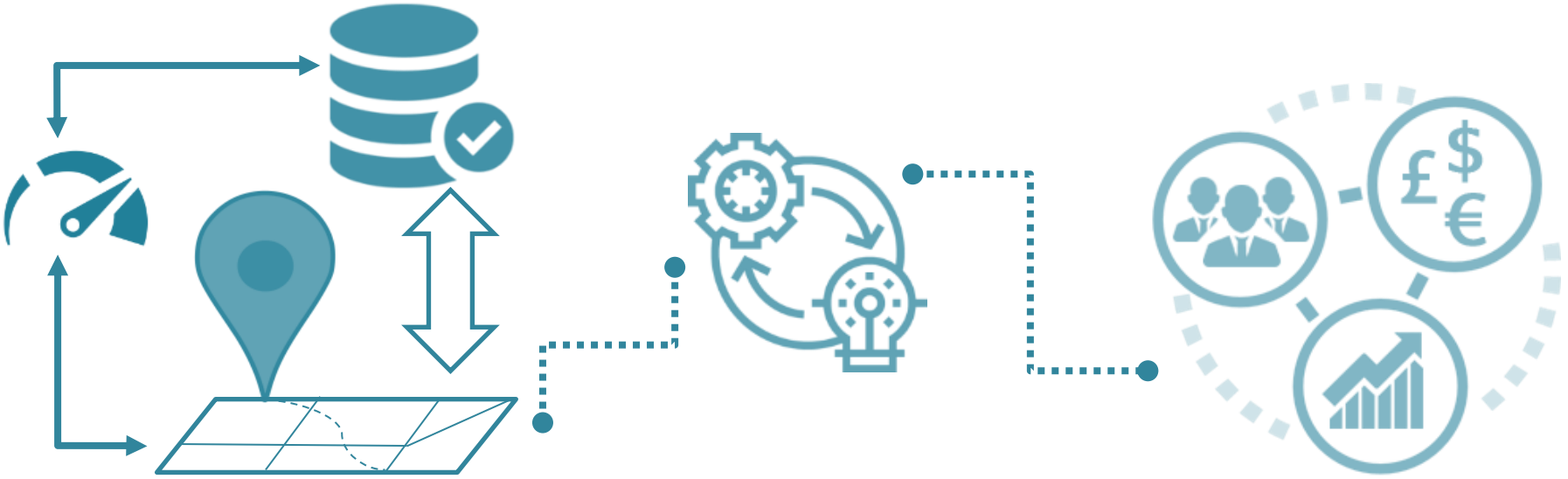
Conclusions

- **AkvaGIS** aims to endorse water management and planning by **simplifying** the **application** of **water-related directives**
- The scientific **community**, water resource authorities, and the private sector **might benefit** from using AkvaGIS
- Due to its **open-source architecture**, AkvaGIS can be **updated** and **extended** depending on the **tailored applications** by any advanced user



AkvaGIS: An open source tool for water management

- AkvaGIS is **free and open-source** → **reducing** the **costs** of commercial software and **improving** open sharing of hydrochemical and hydrogeological data and its interpretations in the **water governance process**



Thank you for your attention!

Rotman Criollo

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www.idaea.csic.es

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

LIFE REWAT project partners

Supported by

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Patronage

This presentation is given within the framework of the EU LIFE REWAT project. The REWAT project has received funding from the European Union's Life Programme LIFE 14 ENV/IT/001290.

AkvaGIS: An open source tool for water management

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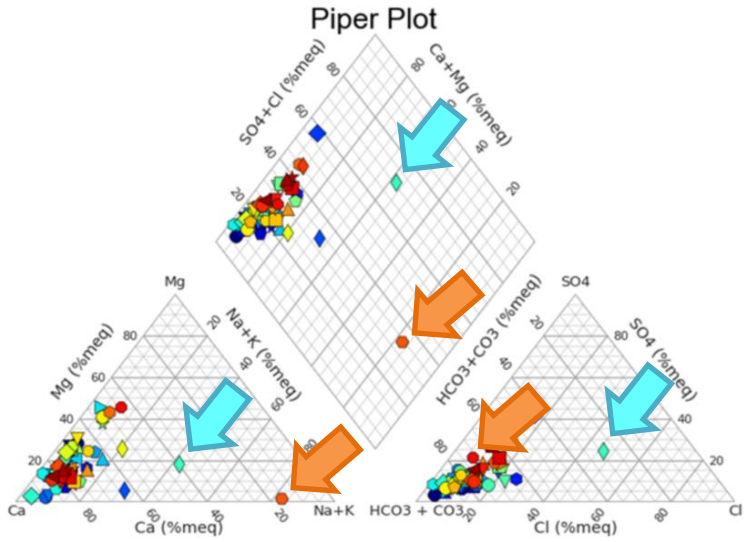

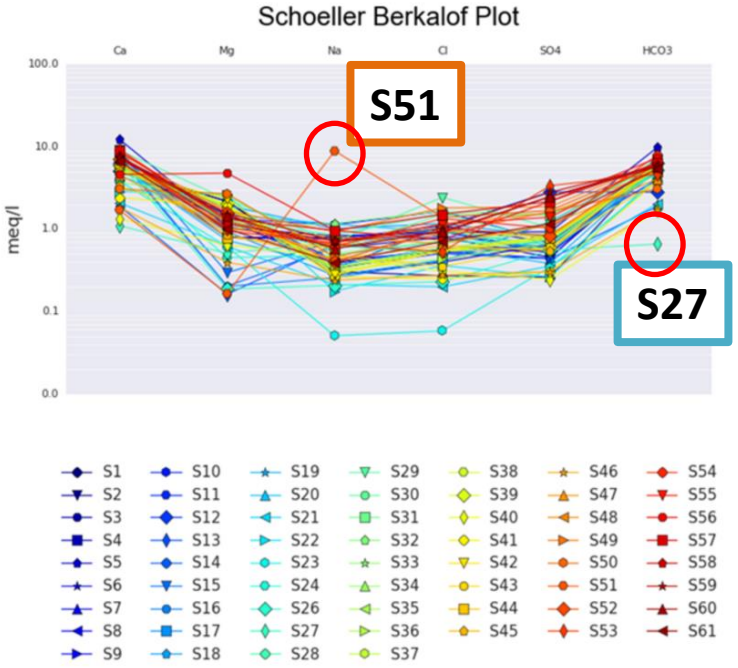

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