FREEWAT

Free and Open Source Software Tools for Water Resource Management

EU HORIZON 2020 Project

Policy Brief
N. 5/7

Modeling tools for EU water-related Directives

Key Policy Messages

- ✓ ICT tools may help simplifying the application of EU water-related Directives
- ✓ The FREEWAT platform was applied to case studies for dealing with several groundwater issues
- ✓ The FREEWAT platform allowed to evaluate water management scenarios

WHAT H2020 FREEWAT is

FREEWAT is an HORIZON 2020 project financed by the EU Commission, aiming at promoting water resource management through innovative ICT tools and participatory approach.

Main result of the project is the free and open-source FREEWAT software: a QGIS integrated environment, where several simulation codes, based on the hydrological cycle, hydrochemical or economic-social processes, are integrated in a unique GIS project for conjunctive use of surface- & ground-water.

This Policy Brief is part of series of seven whose goal is to illustrate the FREEWAT approach and achievements.

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ICT tools for simplifying the application of EU water-related Directives

Preserving water availability and quality in compliance with the requirements of National and EU legislation (e.g., the Water Framework Directive – WFD; EU, 2000) consists in a complex sphere of activities According to the WFD, Member States shall protect, enhance, and restore groundwater bodies, through ensuring a balance between abstraction and recharge components, with the aim of achieving good qualitative and quantitative groundwater status.

One of the main objectives of the WFD and other water-related EU Directives is to increase the capacity of water management authorities to ensure sustainable water management in the context of climate change and human pressure. This is made by National competent water authorities, by including in River Basin Management Plans (RBMPs) measures aimed at guaranteeing water resource protection along with the assurance of water supply in the long term. Achieving the good chemical status of groundwater bodies is the aim of the Groundwater Directive (EU, 2006).

Integration of qualitative and quantitative aspects of ground- and surface-water is faced, among the others, in the Habitats Directive, where the primary scope is preventing deterioration of water bodies, conserving aquatic ecosystems, habitats and species, by assessing the potential effects of polluting events. Achieving water management goals meets also the objectives posed by the Flood Directive, which aims at mitigating the effects of floods and droughts on water bodies.

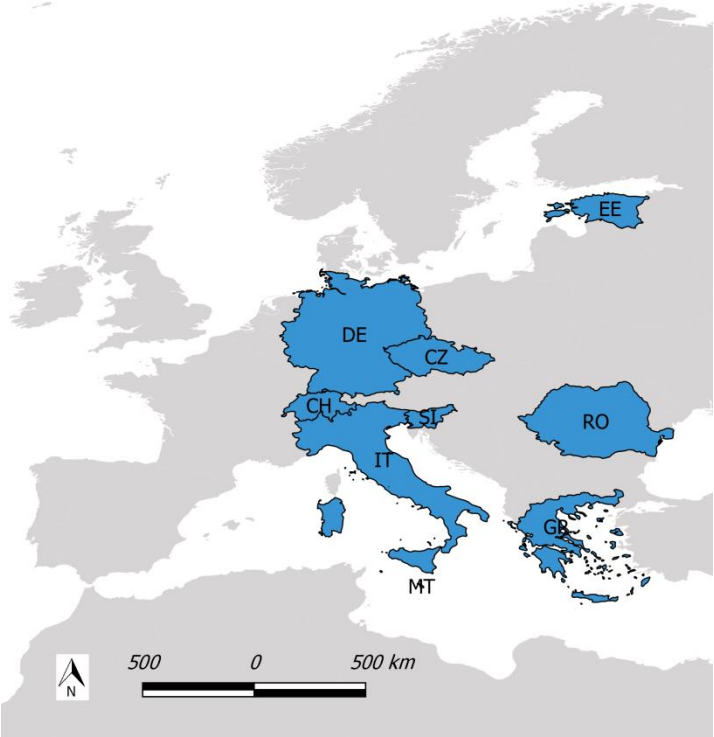
As stated in the EU Water Framework Directive (WFD; EU, 2000), "Member States shall carry out an assessment of the susceptibility of the water status of bodies to the pressures identified" (i.e., anthropogenic and natural pressures) and they

"may utilise modelling techniques to assist in such an assessment".

To this scope, GIS-integrated simulation environments may provide reliable tools to evaluate phenomena in space and time and to address water management issues, specifically referring to water-related directives.

In the framework of adopting innovative ICT (Innovation and Communication Technology) tools for simplifying the application of water-related Directives, capabilities integrated within the FREEWAT platform have been tested and applied to nine case studies, in EU and non-EU Countries (Romania, Estonia, Greece, Slovenia, Czech Republic, Germany, Italy, Malta and Switzerland).

The case studies are specifically targeting the requirements of the above-mentioned Directives on selected issues. Links to the application of Directives were established by testing the feasibility and effectiveness of measures foreseen within RBMPs for achieving the environmental objectives of the WFD and other water-related Directives.



FREEWAT platform applicability to a wide range of groundwater issues

The FREEWAT platform was applied to a wide range of issues: seawater intrusion, effects of climate change, groundwater pumping zones allocation, transboundary water bodies, groundwater dependant ecosystems.

Groundwater overexploitation for human activities is a matter of concern in most of the case studies, causing depletion of freshwater resources and worsening of groundwater quality. In coastal aquifers this is mostly due to incoming salinization. In ***Lavrion*** (Greece, 50 km south-eat of Athens), overpumping is mostly related to satisfy irrigation needs, which primarily rely on an unconfined alluvial aquifer, potentially threatened also by nitrates contamination. On the other hand, the ***Follonica*** sandy aquifer (southern Tuscany, central Italy) lays in an area deeply exploited for mining and metallurgical activities, where drinking water supply is also a relevant component during the summer touristic season. The mean sea level aquifer undelying the ***Gozo island*** of the Maltese archipelago represents a particular case of coastal aquifer, where groundwater floats upon seawater in the shape of a freshwater lens, deeply exploited for municipal and agriculture supply.

Groundwater salinization is also a matter of concern for groundwater resources in ***Bremerhaven*** (northern Germany), nearby the North Sea, where the sandy aquifer is connected to the Weser estuary and it is heavily affected by tidal influence causing saltwater intrusion along the coastline.

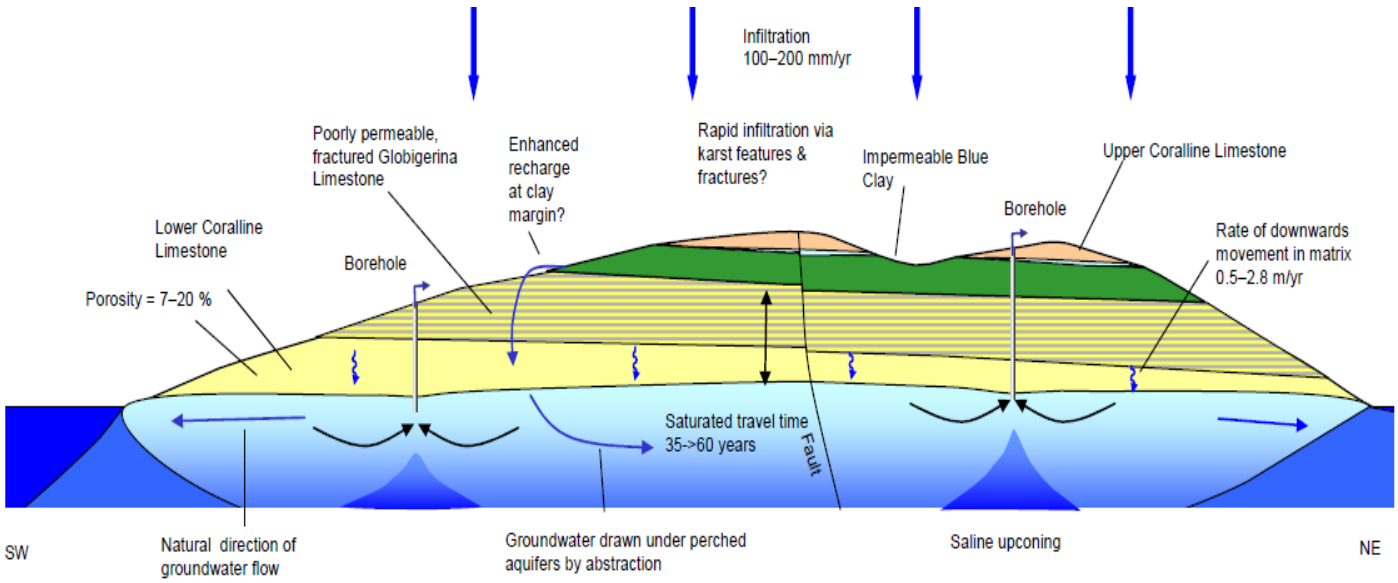
Pressures due to climate change are fundamental also for ground- and surface- water resources in the ***Banat plain*** (western Romania), where the shallow, phreatic aquifer, which lies in a good quantitative status, has been evaluated as an alternative source of freshwater for public supply.

Ground- and surface-water interaction is a key aspect also in the ***Vrbanski plato*** (north-western Slovenia), where an induced riverbank filtration Managed Aquifer Recharge (MAR) scheme was set in place for exploiting an aquifer hydraulically connected to the Drava river.

Relationships with surface water bodies have been investigated also at the ***Lugano lake*** watershed, a transboundary aquifer located at the border between Italy and Switzerland. Here, the scope is to assess the trophic status of the lake, and to quantify the amount of phosphorous reaching it through groundwater.

Regarding groundwater dependant ecosystems, the ***Selisoo*** bog (north-eastern Estonia) is modeled to assess the impact of underground mining activities on the groundwater regime and on the wetland water balance.

Another case study falling within this thematic area is the pilot site of ***Velké Žernoseky*** (north of Lovosice, Czech Republic), which embeds an open pit connected with the Elbe river and endangered by floods.



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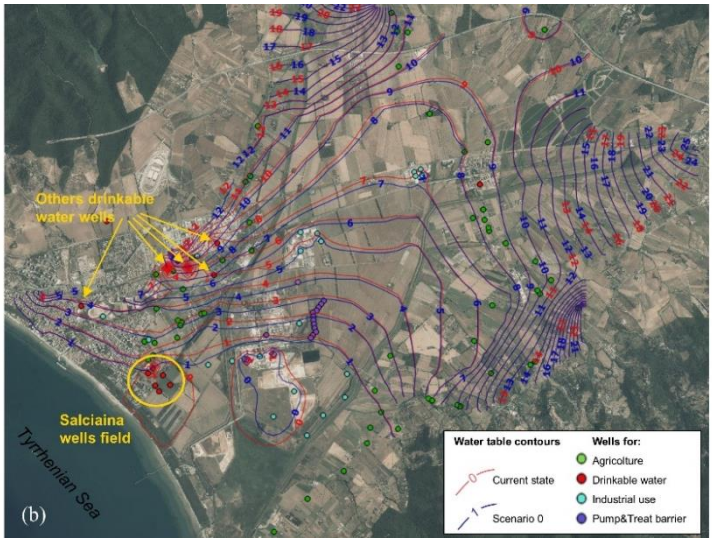
Advances in groundwater resource management

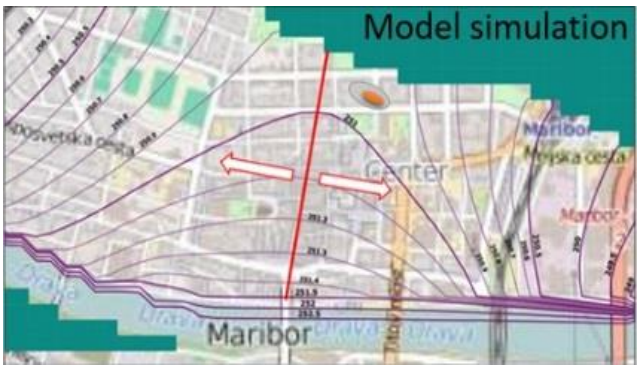
In the FREEWAT project water management scenarios were analysed to understand hydrosystems' response to different climate change and exploitation conditions, while focusing on WFD issues. Results of three of the above-mentioned case studies are presented.

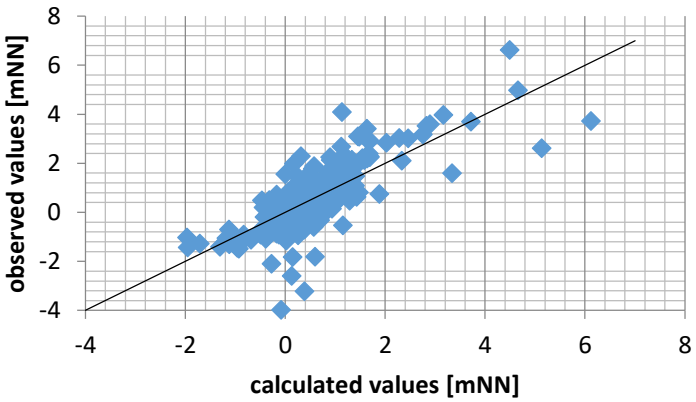


FREEWAT application to the ***Follonica aquifer*** (Italy) aimed at assessing the effects of alternative water management strategies on the quantitative status of the groundwater body. A groundwater model was developed to simulate management scenarios, for evaluating the effectiveness of measures foreseen in the RBMP. Alternative sources of water supply were simulated in lieu of pumping wells. Rise of the water table and reduction of local cones of depression were evaluated as result of setting in place a desalination plant for drinking water supply or reusing mine drainage water for industrial purposes. Such results were then discussed in term of cost feasibility versus effectiveness.

Different scenarios of recharge and pumping rates were simulated at ***Vrbanski plato*** (Slovenia) in order to analyse potential shifts of a groundwater divide close to the Maribor city. Two pumping wells for remediation purposes, after a large spill of heating oil from the Maribor city, were simulated. The direction of the oil spillage was foreseen at each scenario. Results demonstrated that a shift of the divide westwards would occur, consequently redirecting the oil spillage towards the pumping station where, the contaminant would be contained within a local cone of depression.

Preventing saltwater intrusion is one of the main targets of the strategy for climate adaption in ***Bremerhaven***. Scenarios predicting changes in groundwater recharge and seawater level until 2100 have been addressed with FREEWAT. Model outcomes demonstrate that the groundwater budget is mainly affected by groundwater recharge and the tidal effects, each of them accounting for about one half of the total inflows to the system. Some groundwater management measures, such as rainwater harvesting in extreme rainfall events and moving abstraction wells inland far from the coastline, were also tested to prevent lowering of the groundwater table and the occurrence of saltwater intrusion.





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More info at: www.freewat.eu