WATER PLANNING AND MANAGEMENT IN THE CORNIA RIVER PLAIN BY MEANS OF THE GIS-INTEGRATED FREEWAT PLATFORM

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In several Mediterranean areas, coastal aquifer development is often intensive and subject to salinity problems, as result of overexploitation and seawater intrusion.
In the lower Cornia valley (Tuscany, central Italy), groundwater represents the main source of water (providing also part of the water supply to the Elba Island) and it is hosted in a multi-layered aquifer. The water balance has been characterized for years by quantitative imbalance, caused by an intensive exploitation of groundwater for civil, industrial and agriculture supply. In the area, the Cornia river is recharging the aquifer providing about 1/3 of the whole estimated recharge. Since the 1950, groundwater withdrawals largely impacted the hydrologic system, resulting in consistent head lowering (up to 12 m inland), water balance deficit (about 8 Mm3 from the 70s to 2001), subsidence, reduction of groundwater dependent terrestrial ecosystems, and salinization of the coastal side of the aquifer.
Rebalancing the water budget of the hydrologic system of the lower Cornia valley is one of the main aim of the LIFE REWAT project (sustainable WATer management in the lower Cornia valley through demand REduction, aquifer REcharge and river REstoration). Within this project, five demonstration measures are foreseen. They consist in: (1) setting up a Managed Aquifer Recharge facility; (2) river restoration of a Cornia river reach; (3) water saving in the civil water supply sector; (4) water saving in agriculture; (5) reuse of treated wastewater for irrigation purposes.
These demonstration interventions are supported by a Geographic Information System and a hydrologic model based on advanced modeling tools integrated in the FREEWAT platform (developed within the H2020 FREEWAT project - FREE and open source software tools for WATer resource management; Rossetto et al., 2015). FREEWAT is a free and open source, GIS-integrated modelling environment which provides spatially distributed and physically based codes (e.g., MODFLOW and related USGS-family codes) for the simulation of the

hydrologic cycle. The model developed allows: (i) simulating groundwater availability over the last decades; (ii) assessing issues related to salinization and water quality, (iii) evaluating water consumption for agriculture purposes, and (iv) managing the demonstration pilot design and operation.
The model is built on a spatial domain 17.0 km x 18.6 km large, using a dynamic process by which, starting from an initial grid based on 200 m x 200 m large cells, the investigated domain is further refined and new elements are added as soon as new data are gathered. Data implemented are related to surface water and groundwater hydraulic head, detailed riverbed bottom profiles, hydrodynamic parameters, depth of aquifer bottom assessed by both existing boreholes and passive seismic measurements, water quality data. By this means, the final model is achieved with cells 20 m x 20 m large and detailed information on surface water bodies/aquifer interactions are input. Analysis of conjunctive use of ground- and surface-water is then accomplished through the Farm Process module embedded in MODFLOW-OWHM (Hanson et al., 2014), and SEAWAT(Langevin et al., 2007) is used to treat density-dependent flow for the simulation of saltwater intrusion.
The model developed also allows designing scenarios to support project activities (i.e., the demonstration pilot design and operation) and analyzing relevant processes impacting the hydrologic cycle. Finally, this allows building a reliable and robust data-based tool for water planning and management of the Cornia plain.

Acknowledgements
This paper is presented within the framework of the projects LIFE REWAT and H2020 FREEWAT.
The REWAT project has received funding from the European Union's Life Programme LIFE 14 ENV/IT/001290.
The FREEWAT project has received funding from the European Union's HORIZON 2020 research and innovation programme under Grant Agreement n. 642224.

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