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Achieving sustainable ground-water management by using GIS-integrated simulation tools: the EU H2020 FREEWAT platform

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In order to achieve sustainable and participated ground-water management, innovative software built on the integration of numerical models within GIS software is a perfect candidate to provide a full characterization of quantitative and qualitative aspects of ground- and surface-water resources maintaining the time and spatial dimension.
The EU H2020 FREEWAT project (FREE and open source software tools for WATer resource management; Rossetto et al., 2015) aims at simplifying the application of EU water-related Directives through an open-source and public-domain, GIS-integrated simulation platform for planning and management of ground- and surface-water resources. The FREEWAT platform allows to simulate the whole hydrological cycle, coupling the power of GIS geo-processing and post-processing tools in spatial data analysis with that of process-based simulation models. This results in a modeling environment where large spatial datasets can be stored, managed and visualized and where several simulation codes (mainly belonging to the USGS MODFLOW family) are integrated to simulate multiple hydrological, hydrochemical or economic processes.
So far, the FREEWAT platform is a large plugin for the QGIS GIS desktop software and it integrates the following capabilities:
• the AkvaGIS module allows to produce plots and statistics for the analysis and interpretation of hydrochemical and hydrogeological data;
• the Observation Analysis Tool, to facilitate the import, analysis and visualization of time-series data and the use of these data to support model construction and calibration;
• groundwater flow simulation in the saturated and unsaturated zones may be simulated using MODFLOW-2005 (Harbaugh, 2005);
• multi-species advective-dispersive transport in the saturated zone can be simulated using MT3DMS (Zheng & Wang, 1999); the possibility to simulate viscosity- and density-dependent flows is further accomplished through SEAWAT (Langevin et al., 2007);
• sustainable management of combined use of ground- and surface-water resources in rural environments is accomplished by the Farm Process module embedded in MODFLOW-OWHM (Hanson et al., 2014), which allows to dynamically integrate crop water demand and supply from ground- and surface-water;
• UCODE_2014 (Poeter et al., 2014) is implemented to perform sensitivity analysis and parameter estimation to improve the model fit through an inverse, regression method based on the evaluation of an objective function.
Through creating a common environment among water research/professionals, policy makers and implementers, FREEWAT aims at enhancing science and participatory approach and evidence-based decision making in water resource management, hence producing relevant outcomes for policy implementation.

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