Architecture of the FREEWAT platform for water resource management

Giovanna De Filippis1, Iacopo Borsi2, Laura Foglia3, Massimiliano Cannata4, Rotman Criollo5, Enric Vasquez-Suñe6, Matteo Ghetta1, Rudy Rossetto1

(1) Institute of Life Sciences, Scuola Superiore Sant’Anna, Pisa (Italy); (2) TEA SISTEMI S.p.A., Pisa (Italy); (3) Institut für Angewandte Geowissenschaften, Technische Universität Darmstadt, Darmstadt (Germany); (4) Institute of Earth Sciences, Scuola Universitaria Professionale della Svizzera Italiana, Canobbio (Switzerland); (5) Instituto de Diagnóstico Ambiental y Estudios del Agua, Consejo Superior de Investigaciones Científicas, Barcelona (Spain)

FREEWAT is a free and open source, GIS-integrated platform for the simulation of the hydrologic cycle. FREEWAT architecture results from an integrated coupling among the following pillars:

✓ the OGIS desktop software;
✓ surface and sub-surface model engines, including simulation models belonging to the USGS family (e.g., MODFLOW and MODFLOW-related programs) as well as codes specifically developed for the FREEWAT;
✓ the SpatiaLite Data Base Management System for managing input and output data.

The way of interconnecting such tools is done via Python programming language, with extensive use of the Python library FloPy.

akvaGIS provides tools for the analysis of hydrochemical and hydrogeological data. The capabilities of akvaGIS span from plots and statistics related to hydrochemical data for water quality assessment to interpretation of hydrogeological data and generation of thematic maps for implementing conceptual models.

UCODE_2014 allows to perform sensitivity analysis and parameter estimation, aiming at reducing the gap between model results and the observed data. Several statistics can be used to evaluate model setup and to select parameters to be estimated by an inverse regression method based on the evaluation of an objective function.

FREEWAT is an open source platform for simulating different processes occurring within and around water resources. The main features are:

Multi-species advective-dispersive transport in the saturated zone can be simulated as well using MT3DMS. FREEWAT integrates also SEAWAT for simulating viscosity- and density-dependent flows.

The possibility to simulate solute transport within the unsaturated zone is accomplished using MT3DMS-USGS and the USB module.

OAT (Observation Analysis Tool) provides the User with enhanced time-series processing capabilities. OAT is designed to facilitate the import, analysis and visualization of time-series data and the use of these data to support model construction and advanced model calibration.

Groundwater flow, including interaction with surface-water and the flow through the unsaturated zone, may be simulated using MODFLOW-2005, a physically-based, spatially distributed code developed by USGS. Several MODFLOW packages have been integrated to represent flow associated with external stresses.

Conjunctive use of surface- and groundwater for water resource management is accomplished by integrating MODFLOW-OWHM. Within it, the Farm Process allows to simulate demand and supply components of water use for basic units of water consumption, in a fully-coupled, integrated hydrologic model.

References
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