

Modellazione idrologica e idrogeologica del bacino del fiume Era

Hydrological and hydrogeological modeling of the Era river basin

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Abstract

In the last years much attention of the regional authorities in Europe was spent on the necessity of develop new scientific methodologies to improve knowledge of river basins behavior. The surface modelisation, through hydrological models, leads to better prevision of short term events, for instance flash floods development, and long term events, for instance alteration of river beds and water availability for withdrawals. On the other hand the knowledge of the underground behavior, through hydrogeological models, complete the water cycle and provides global water balances useful to limit the deep withdrawals and to determine the filtration direction and local seasonary levels of water table. The storage of water in the deep soil is necessary for the aquifers recharge. So a limit for deep withdrawals and their dislocation needs a continuous and well done control and management considering the natural dynamics of aquifers and the global warming.

The present paper was created with the aim of integrating innovative theoretical and informatic tools in the field of hydrological and hydrogeological modeling of a river basin. The ultimate aim is the realization of the water balance of the underground water body present in Val d'Era, in the province of Pisa. The case studied is therefore located in the Arno river basin in Tuscany, but the results suggest the extension of the method to other Italian and global river basins.

Two sections are developed: in the first a definition of the surface water balance with a distributed and continuous model is achieved; in the second a deep aquifer model is realized using results obtained from field surveys, satellite images and results from the first section as boundary conditions and steady state as initial condition. The proposed tool for hydrological modeling is the MOBIDIC software, developed by the Department of Civil, Building and Environmental Engineering of the University of Florence. The acronym stands for Distributed and Continuous Hydrological Balance Model. For the second section the proposed tool is the software MODFLOW of the USGS, used through the QGIS Python Plugin FREEWAT, realized between April 2015 and October 2017 by the Life Sciences Institute of the Scuola Superiore Sant'Anna, as part of the HORIZON 2020 project, funded by the European Commission.

By the integration of the two models a global water balance is shown with some considerations about the surface and deep soil exchanges. The river and rainfall recharges of the aquifer happen in autumn, winter and spring, as we could expect. Otherwise in summer no rates of

recharge are granted to aquifer, so it shows a slow emptying due to negative gradients from neighboring aquifers and to the excessive withdrawals for drinking and agricultural purposes. The thesis proposal is born with another implicit interest: the advanced knowledge of the underground water body behavior of the Era river basin will allow to define a management program to improve the quantitative, chemical and global status of the water resource to reach the "good" status by 2020, according to the provisions of the Water Framework Directive 2000/60/EC.

The thesis is written in Italian language.

The thesis can be consulted upon request.

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