HYDROGEOLOGICAL CONCEPTUAL MODEL OF A HIGHLY IMPACTED WATERSHED: THE CASE STUDY OF OGLIO RIVER (N ITALY)

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Objective of this study, regarding the Oglio River watershed, is the reconstruction of the hydrogeological conceptual model. This is a primary step to reach a suitable construction of a numerical hydrogeological model.
The study area, 92 km long and 58 km large, includes the Oglio River watershed from Lake Iseo to the Mella River inflow. It is located in the northern part of Italy.
The study is part of a research project whose key aspect is to consider and analyze the different water bodies (i.e., Lake Iseo, the Oglio River, the spring belt, the irrigation canal network and groundwater) as a single compartment in order to quantify their mutual relations.
The Oglio River natural regime is strongly modified due to multiple water uses. A lake dam regulation supervises both the Lake Iseo stages and the Oglio River outflow, hydroelectric power plants temporarily subtract and release relevant water volumes, large artificial diversions feed an extensive network of irrigation canals. The agricultural demand determined an increase in the Lake Iseo outflow to the Oglio River in summer season (from July to August) up to 90-150 m3/s against an average of 50 m^3/s all over the year.
In order to implement the conceptual model, the following analysis and elaborations were carried:
a) a reconstruction of distributed values of hydraulic conductivity. More than 4600 stratigraphic logs coded and stored in the well database TANGRAM were analysed and imported into a 3D grid in GOCAD®. Geostatistical technique was used to reconstruct the 3D spatial distribution of hydraulic conductivity;
b) a monitoring of hydrodynamic properties. Four field surveys (between November 2015 and September 2016) were carried out in order to measure groundwater heads (55 well monitored in each survey), river discharges along the Oglio River and its main tributaries (16 station monitored in each survey) and river stages (34 stations monitored in each survey);
c) a reconstruction of potentiometric maps. Four potentiometric maps were elaborated, related to the different seasons, in order to evaluate the variations in groundwater/surface water interrelations.
Results leads to implement the hydrogeological conceptual model that is characterized by:
a) a distribution of the hydraulic conductivity ranging between ~2.3*E-03 m/s in the higher plain and~ 8*E-08 m/s in the deeper part of the lower plain;
b) a main groundwater flow direction oriented from North to South; seasonal groundwater table fluctuations are mainly influenced by irrigation. In the higher plain, the highest groundwater heads are in the autumn at the end of the irrigation period, whereas in the lower plain

groundwater heads oscillation are reduced even if the higher values are in summer season;
c) the presence of significant groundwater/surface water interactions. The Oglio River is losing in its first stretch 20-30 km long, then it becomes gaining for the rest of its course. The groundwater discharge to the river in its gaining stretch reaches 0.3 m^3/s*km in summer season, and around 0.09 m^3/s*km in winter season. The transition point between losing and gaining behaviour moves according to the seasonal oscillation of groundwater table within a length of 5 km.
This work represents the first step for the development of a detailed 3D numerical flow model of the Lake Iseo-Oglio River system.

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