GROUNDWATER FLOW CONTROLLED BY RIVERS AND IMPLICATIONS WITH FUTURE CLIMATE SCENARIOS: A PREDICTIVE MODELLING FOR THE MAGRA VALLEY AQUIFER (SOUTHEAST LIGURIA, ITALY)

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The aquifer of the Lower Magra Valley is the main source of water for drinking, industrial and agriculture purposes in the area of La Spezia (SE Liguria, Italy). It extends in a flat plain, within which two main rivers (Magra and Vara) flow. The aquifer is mostly unconfined and made up by gravels and sands. The hydrologic/hydrogeological conditions are favourable to river infiltration, which represents a significant recharge for the aquifer. In this framework, the groundwater system is exposed to high vulnerability, both in terms of quality and quantity, not only in relation to human activities but also towards the climate conditions. This study was aimed to develop a predictive transport model for evaluating the Magra Valley aquifer behaviour in awaited climate scenarios. Part of these activities was carried out in the framework of the national project "ACQUASENSE". The conceptual model was achieved by elaborating and comparing geology, stratigraphy, hydrogeology, geochemistry and isotopes data (including time series produced by two continuously monitoring stations). Groundwater flow resulted widely controlled by stream water infiltration, which affects water levels and water quality. In particular, the wide variation range of the natural concentration of Cl and SO_4 in stream waters is reflected by the groundwater chemistry over the year. A flow and transport model was developed by using MODFLOW/GMS7.1, and it was calibrated in both steady state and transient conditions, over the period 2004-2011. Data-driven modelling was also performed basing on historical data (rainfall, temperature, water level and species concentration), and a good agreement between modelled and real data (both water level and species concentration) was achieved for the period 2004-2011. Hence, the data-driven model was applied to re-define some boundary conditions (e.g. rivers and constant head or general head boundaries) of the physical model under hypothetic future climate scenarios. This was done by using a fully synthetic dataset as a training set of the data-driven scheme, inspired by selected climate models. The flow-transport model was finally run for 30 years ahead, thus highlighting how the groundwater flow of the studied aquifer is sensitive to climate conditions, as a consequence of its dependence upon rivers regime.