



## **Groundwater volume variations according to piezometric surface evolution.**

T. Bonomi, P. Canepa, F. Del Rosso

Dip. Scienze dell' Ambiente e del Territorio, Università of Milano-Bicocca, Milano, Italy  
(tullia.bonomi @ unimib.it / Fax: +39 2 64482895 )

The integrated and sustainable water resource management, to supply natural and human needs, is crucial for the region administration, mainly in the last years when water crisis has become a current problem. The purpose of research project RICLIC “Regional Impacts of Climatic Changes in Lombardy Water resources: Modelling and applications” (that involves University of Milano-Bicocca, University of Milano, University of Pavia, ARPA Lombardia and Fondazione Lombardia per l' Ambiente) is to develop a scientific methodology, to evaluate climatic impacts on water resources of Lombardia region (in North Italy).

Concerning groundwater, it is important to constantly monitor the piezometric level, because it is the index of the hydrogeological system response; it is also essential to analyze the correlations between input (rainfall and irrigation) and output (pumping) water balance. Thus it is necessary to calculate the annual and perennial water balance to understand quantitative variations in water storage and to identify the main balance factors.

The work presents an interesting study area as the Milano province, which is a very industrialized and water rich district. In Milano in the last 50 years the water table oscillation has been substantial because of demographic increase, public and industrial pumping changes and different recharge, due to higher and less frequent rainfall and irrigation. The decrease of water table denoted the reduce of groundwater storage (from 1950 to 1975) and its increase caused flooding in some no proofed infrastructures (from 1992 to 2000), because they were built in the unsaturated-zone when the

water table was deeper than today.

A measure of the available groundwater volume can be made during different years. It is necessary to connect two different kind of data: historical piezometric surfaces and 3d reconstruction effective porosity in according to subsoil textural characteristics.

The first step shows the piezometric data elaborations coming from historical groundwater monitoring net (from 1975 to 2005, measured by Consorzio Acqua Potabile, CAP, of Milano). Then the work explains how to calculate the saturated subsoil volume, starting from the water table, the DTM and the aquifer bottom of the hydrogeological system.

The second step, the reconstruction of effective porosity, results from more than 3000 stratigraphic data on the province, stored and codified in a water wells database and elaborated by a 3D geostatistical technique.

The available water volume is computed by comparing the saturated subsoil volume and the effective porosity. In this study groundwater volume, calculated from 1975 to 2005 in Milano province, is showed. It changes from 34 to 37 billion mc per year, related in proportion to piezometric surface evolution.

Finally the trend of estimated water volumes is compared with the trend of input (rainfall and irrigation) and output (pumping) of water balance: this analysis underlines the most important balance factors which influence the variation in groundwater available volumes.