



How meteorological and flow timeseries contribute to a modelling exercise: an experience on a carbonate aquifer in Tuscany (Italy)

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The monitoring of a natural resource typically involves the identification of a set of parameters, considered as representative of its underlining mechanisms, in order to extract useful information about the current status and the expected behavior of the natural process. This work is focused on the water resources destined to the drinkable water distribution, by studying possible empirical relationships between meteorological parameters and ground-water quantity indices. This activity is in the wider context of a research for the development of support tools for the management of the resource under specific climate scenarios.

For what regards carbonate aquifers, the impact of climate change can be very significant, given the high sensitivity of these reservoirs caused by their karst features. Data used for this study included flowrate at springs of the karst aquifer system of the Apuan Alps (northwestern Tuscany), and meteorological timeseries (both historical and synthetic scenarios) in the relevant hydrological basin. Flowrate measurements were provided by the Tuscan Water Authority (AIT) and GAIA SpA (Integrated Water Service), while synthetic meteorological scenarios were provided by Consorzio LaMMA.

This work describes the data-driven approach experimented with the collected time series, essentially based on multi-variate analysis techniques and on a simplified machine learning scheme based on neural networks.

In fact, a preliminary test of a data-driven approach based on Multi Layer Perceptron Neural Networks (MLP-NN) is described here. Dedicated techniques for data pre-processing, training and validation have been experimented. In particular, a strong hypothesis of linearity and time-invariance of the system under observation was done, and MLP-NNs were essentially used as non-linear approximators. A further activity regarded the assessment of a performance metric for the evaluation of multiple MLP-NNs with respect to independent test sets, based on either historical or synthetic data.

Results are shown in terms of predicted flowrates in a given time window (up to 90 days in our case study), and are organized according to different scenarios of total rainfall quantity.