RELATION BETWEEN CLIMATIC CONDITION, TEMPERATURE AND MOISTURE IN THE SUBSOIL OF TURIN PLAIN

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The temperature distribution in shallow subsoil (<20 m below ground surface) is influenced by seasonal variations in air temperature and soil thermal conductivity. In addition, the advective heat transport, due to the presence of water flow in an aquifer, and variations of temperature related to rainfall and soil permeability, are expected to play a role. To evaluate the influence of these phenomena, an experimental site in the alluvial plain of Po River, about 10 km from Turin, was realized. Land use is mainly agricultural and density of buildings and paved surfaces do not have any important impact on the local thermal regime. From a hydrogeological point of view, an unconfined aquifer (to at least 10 meters thick) is hosted in the late Pleistocene and Holocene fluvial deposits. Below pre-Pliocene marine units of the Turin Hill constitute an impermeable substrate. The water table depth ranges between 4.5 and 5.5 m below ground surface.

The monitoring considered the following parameters: air, unsaturated zone (UZ) and saturated zone (SZ) temperature, moisture in the UZ, precipitation. Moreover, 3 piezometers (PZ1, PZ2 and PZ3) were installed for the measurement of the piezometric level oscillations and the realization of piezometric maps. All these parameters were correlated, in order to highlight similar trends.

The unconfined aquifer has a fairly constant flow direction at site scale, WSW-ENE directed, confirming the draining role of the Po River.

The results, consisting of two-year monitoring, show that while the air temperature fluctuated between -3° C and +30° C, in the subsoil at -0.60 m the oscillations are reduced to 30%, with respect to air temperature, to 70% at -1.80 m and to 88% at -3.80 m. In the SZ the temperature varies between 13°C and 15° C at 9.5 meters deep, with a damping of temperature fluctuations equal to 94%. Furthermore, a time shift of air peak temperatures in the subsurface was recorded. This result highlights a delay in the response of the soil, that is gradually higher at greater depths. The slowest response is in the aquifer, where the delay is about 3 months.

Soil moisture increases with depth, from about 15% to -0.60 m up to values greater than 35% to -3.80 m (capillary fringe). An increased moisture in response to rainfall was recorded up to -1.50 m; at -3.60 m below ground surface the moisture remains nearly constant throughout the year and is affected only by the oscillation of the water table.

Piezometric level and rainfall do not show a correlation. Furthermore, the analysis of groundwater temperature shows no significant correlation with rainfall. This outcome is conceivably connected to a rapid thermal equilibration of the infiltrating water in the UZ.

In conclusion, the groundwater in the investigated site scarcely records the seasonal temperature fluctuations: these, indeed, are largely dissipated in the above UZ. It can also be excluded that the groundwater temperature is significantly influenced by local rainfall input.