URBAN GROUNDWATER WARMING IN TURIN AREA (NW ITALY)

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The large energy demand for heating and cooling of buildings has motivated a new interest for low enthalpy geothermal systems. For this reason shallow groundwater temperatures are nowadays regarded as highly important in Turin area (NW Italy). The area is located in a favourable geological context for geothermal applications: a thick alluvial body, forming the Po Plain, hosts a productive groundwater system. To assess the thermal features of the shallow, unconfined aquifer, thermal surveys in Turin city and in surrounding rural sectors have been carried out.

Multi-temporal downhole thermal logs have been performed by collecting temperature values along the entire water column (8-50 m depth) in various seasons, by means of an electronic water level meter equipped with thermometer.

Temperature profiles in Turin area highlighted a vertical variability up to 10-20 m below ground level: in spring logs the deep temperatures are higher than the shallow ones, while in autumn shallow temperatures are higher and they decrease with depth. Such depth and time variations are connected to the seasonal heating and cooling cycles of air temperatures. Furthermore, the seasonal temperature oscillations are smaller with greater water table depths, meaning that they are damped in the vadose zone. Underneath the seasonal oscillation zone, groundwater temperatures are spatially constant in most wells and residual small deviations are connected to hydrodynamic processes, such as upward or downward water movements of recharge and discharge areas.

Lateral variations of aquifer temperature have been also detected: there is an increase from high plain sectors close to the Alps towards the Po River, which is consistent with the regional groundwater flow direction. This means that colder temperatures of recharge areas -due to colder air temperatures- warm up during the pathway towards the discharge areas. Warmer temperatures are found below the city is likely linked to the large urbanized area: the urban warming intensity is +1.6°C in spring and +0.6°C in autumn. Sparse warm outliers (>17 °C) are connected to punctual heat sources and site-specific conditions, such as geothermal systems, industrial districts.