Geophysical Research Abstracts
Vol. 21, EGU2019-1812, 2019
EGU General Assembly 2019

Piezometric level variations as response of groundwater to climate change: the case study of Piedmont plain (NW Italy)

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Groundwater constitutes the planet's predominant reserve of fresh water and provide an excellent "buffer" against the effects of climate variability on surface-water supplies, because of the generally large and widely-distributed storage reserves of aquifer systems (IAH 2016).
Globally, a significant increase in water needs has been recorded in the last century, and thus an intensification of water withdrawal for domestic, agricultural and industrial sectors (FAO 2016). Estimates of rates of permanent storage depletion range from 100-145 km3/a during 2000-08 (Doell et al 2012; Wada et al 2016).
Monitoring and analysis of piezometric levels is one of the tools for identifying possible alterations in the quantitative status and highlighting the response of groundwater to climate change.
In Piedmont plain (western Po Plain, NW Italy) about 92% of the drinking water supply is from groundwater. Moreover, groundwater provides support to agricultural and industrial activities, and contribute to the feeding of surface water rivers (rivers and lakes). Thus, an analysis of piezometric time series in this area was conducted.
The Piedmont plain represents the largest and most important groundwater reservoir in the Region. More specifically, the shallow unconfined aquifer is hosted in the Quaternary alluvial deposits complex, consisting of coarse gravel and sand, with subordinate silty-clayey intercalations.
Daily piezometric series recorded in 2002-2017 were collected and analyzed. These data are referred to piezometers of the automatic monitoring network of shallow aquifer, homogeneously distributed in Piedmont plain. Daily pluviometric series were also studied, covering the same time period. Monthly aggregated data were then elaborated.
The aim of the study was to analyse the interannual variability of piezometric levels and precipitation, using the Mann-Kendall trend test to evaluate increasing or decresing trend, and the Pettitt break detection test to identify the change points. Moreover, the analysis of anomaly was used to highlight critical situations of groundwater depletion.
The analyses showed that, over the 2002–2017 period, most of piezometers show a main change point in 2008 and subordinately in 2004-2005 and 2015. Generally, a decreasing trend in piezometric levels was detected between 2004-2008, while an increasing trend in the period 2008-2015. At last, a declining groundwater trend was observed in 2016-2017.
Pluviometric series showed a good correlation with piezometric levels. However, the groundwater level responds to rainfall with a delay, ranging between 1 to 6 months. This response is highly dependent on the local aquifer's physical characteristics, which could explain the spatial heterogeneity of the groundwater response.
This study represents a first step to identify the resilience of groundwater to climate change that is essential to act in time with corrective measures.

References
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