Spatial and temporal patterns in the hydrogeochemistry of coastal aquifers in Campania Region (southern Italy)

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International regulations, such as those implemented by the European Union (i.e., Groundwater Directive 2006/118/EC), require the determination of groundwater quality status as well as its evolution. Groundwater quality in areas characterised by different geological formations (i.e., the presence of volcanic areas, carbonate rocks, alluvial-pyroclastic deposits), diversified ecosystems (i.e., wetlands), and located along the coastline may result in heterogeneous hydrochemical facies distribution and variable (e.g., non-linear) temporal evolution. Human activities (i.e., agricultural, industrial, residential and touristic activities) and rapid land use change can modify the amount and distribution of point and non-point sources of contamination affecting groundwater quality, while climate change may significantly impact water availability and quality (IPCC, 2012).

The area of interest is located in the northern part of Campania Region (Southern Italy) and it includes three Groundwater Bodies (DAM, 2021): the Volturno Plain, a coastal plain constituted of fluvial, pyroclastic and marine sediments, the Plain of Naples, an innermost plain of fluvial and pyroclastic sediments, and the Phlegrean Fields, an active volcanic area with a series of monogenic volcanic edifices. Hydrochemical data collected biannually by the Regional Environmental Agency at about 35 wells from 2002 to 2020 were considered for evaluating the spatial distribution and temporal variation (Mann-Kendall trend test) of the main physico-chemical parameters.

Groundwater chemistry reflects the geological characteristics of the study area, being influenced by volcanic edifices and related pyroclastic products and the closeness to carbonate rock formations. Calcium-bicarbonate facies is prevalent, with a gradual transition to alkaline type from the mountains towards the coast. In addition, ions concentration distributions highlighted the occurrence of seawater intrusion (Na^+, Cl^-) and anthropogenic contamination (K^+, NO_3^-, SO_4^{2-}) negatively affecting groundwater quality. Long-term trends show significant increases in ion concentrations in the innermost part of the plain and decreases in the coastal areas for most of the ions (exceptions are Na^+, NO_3^- and SO_4^{2-}). The integration of land-use/land-cover information over the 2002-2020 period, together with the information regarding the decadal and seasonal variation of the population and the characteristics of the sewage systems and agricultural practices (i.e., water demand) allows detecting the singular and combined causes of the evolution of groundwater quality in the study area.

European Community (2006) - Directive 2006/118/EC on the protection of groundwater against pollution and deterioration, (Groundwater Directive). OJ L 372, 27 December 2006, 19-31

IPCC (2012) - Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.

DAM (2021) - Autorità di Bacino Distrettuale dell'Appennino Meridionale. Piano di gestione delle acque ciclo 2021-2027. https://www.distrettoappenninomeridionale.it/index.php/piano-iii-fase-2021-2027-menu/piano-di-gestione-acque-iii-ciclo-2021-2027-menu?layout=edit&id=711.