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Chemical variations in time in a context of climate variability: examples in different hydrogeological settings

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Increased variability in precipitation and more extreme weather events caused by climate change can lead to more extended periods of droughts and floods, which directly affects the availability of groundwater. The consequent fluctuation of the water table can also affect groundwater quality. Particularly, a higher recharge, and the resultant increase of the piezometric level, can have, as a positive result, the dilution of the contaminants in aquifers and a decrease of the concentrations. On the other side, water that infiltrates can leach pollutants that are present in the unsaturated zone, with an increase of groundwater pollution. Even, the rise of the piezometric level can have negative consequences on groundwater quality, also due to groundwater that leach the capillary fringe and the previously unsaturated zone; if a contaminant is present in these sectors, it can lead to an increase of the aquifer pollution.

The increase or decrease in contaminants levels depend on a complex balance between all the described phenomena, and contaminant behaviour. This study wants to analyse the hydrogeochemical variations in time due to climate variability to define the role of different processes.

Two different hydrogeological environments were chosen as test fields: an alluvial aquifer in the Piedmont Po Plain (NW Italy) and an alluvial-pyroclastic aquifer in the Campanian plain (S Italy).

Piedmont Po plain shows a diffuse nitrate contamination, due to intensive agricultural and livestock activities. A nickel contamination is locally present, due to natural causes, namely the presence of basic and ultrabasic rocks debris in the supply basins, containing high amount of nickel-bearing femic minerals. Consequently, nitrate and nickel fluctuation were analysed and compared with precipitation and piezometric levels.

The hydrogeochemistry of the Campanian plain is influenced by the closeness of volcanic active areas (Phlegrean Fields and Vesuvius), bringing high As and F values, and by the presence of reducing conditions, bringing high Fe and Mn values. Moreover, there is a widespread nitrate contamination, prevalently due to intensive agricultural and livestock activities. The fluctuations of these 5 ions (As, F, Fe, Mn and NO_3) have been observed during almost twenty years and compared with the differences in recharge, sometimes significant due to the climate change.

The monitoring and analyses of the chemical concentrations of ions of anthropogenic and natural origin in a context of climate variability represent a key element to offer a new and different research perspective in the field of groundwater chemistry.