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Freshening of a coastal karstic spring revealed by temporal changes in solute concentrations

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Water samples have been collected 17 times over two and a half years at evenly spaced dates (between 2 and 6 weeks the second year), at a karstic spring located about 3 km from the shoreline and feeding the La Palme coastal lagoon. The La Palme watershed is located on the French Mediterranean coast between the Rhône River and the Pyrenees mountains, on the southeast side of the eastern margin of the Nappe des Corbières, a sedimentary limestone formation in the foreland of the Eastern Pyrenees. Temperature, pH, salinity, oxidation-reduction potential (ORP) and the concentration of dissolved oxygen have been measured in situ. The complete composition of the water samples (Na-K-Ca-Mg-Ba-Sr-Si-Cl-SO4-Dissolved Inorganic Carbon) has been determined using ICP-OES, inorganic and organic carbon analysis and ionic chromatography.
The spring water is brackish. Its temperature is quite constant at a value of 18.5° but its salinity has varied between 4 and 9 during the period of observation, with two minima at the end of April 2017 and April 2018. It is modified from modern seawater, as shown by Na-normalized dissolved element concentrations. The calculation of mineral saturation states points to a constant control of Ba and Dissolved Inorganic Carbon by chemical equilibria with aragonite and barite and to an elevated equilibrium CO_2 partial pressure. The salinity minima coincide with extremum values of dissolved element concentrations. The oxygen content of the spring water is maximum when the salinity is at minimum value. This shows that the freshening of the La Palme coastal brackish aquifer is due to the infiltration of oxygenated rain/runoff water into brackish groundwater. This study shows that, when flow rate and precipitation data are not simultaneously available, insight into the hydrological regime of coastal aquifers such as that of the La Palme watershed can be obtained by the simple measurement of salinity and dissolved oxygen concentration of spring waters.