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Multi-tracer assessment of seasonal water source changes of the coastal water systems along the east Ivorian coast (West Africa)

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Hydrologic interactions between freshwater and saltwater determines the chemistry of coastal waters along the east Ivorian coastlines. As the main challenge to coastal water resources is rising sea levels, the predictions of future rise in sea level with consequent socio-economic impacts along the east Ivorian coast, should therefore prioritize the sustainable use and effective management of these coastal zone resources. The objective of this study was to investigate the hydrological interactions of freshwater and seawater in the vicinity of the Ébrié lagoon which is the largest lagoon along the Ivorian coastline. 180 water samples were collected from rain (n= 30), groundwater (wells, 69; boreholes, 12) and surface water (Rivers, 5; Ébrié lagoon, 53; Atlantic Ocean, 11) systems over two seasons: before (dry) and after (wet) the peak annual rainfall event from within 15 km from Atlantic Ocean. Samples were analysed for solutes (Na+, K+, Mg2+, Ca2+, Cl-, SO42-, NO_3-, HCO_3- , SiO44+) and water stable isotopes (δ18O and δ2H). The studied wells were mainly of the Na-Cl facies (87% and 80 % during the dry and wet seasons, respectively) with maximum chloride concentrations of 1,088 mg/L and 785.2 mg/L. Isotopic data showed that more than 80 % of recharge to these coastal shallow aquifer is of meteoric origin. Freshwater contributions to these aquifers more than doubled after peak rainfall events with concomitant four-fold decrease in its sea water component. Sea water intrusion is restricted to the Quaternary wells within the barrier island, while sources of salinization for the Tertiary aquifer in the upland areas is mainly by exchanges with the Ébrié lagoon. The static isotope signals of the deep aquifer (mean δ18O and δ2H of -2.8‰ -10‰ $for the dry season, and -2.7‰ -10‰ for the wet seasons, respectively) suggest stime lag between peak rain event and aquifer recharge. End member mixing ana$ and δ2H of 0.1‰ 4.7‰ was similar to that of the Atlantic Ocean (mean δ18O and δ2H of -0.2‰ 3.2‰ during the dry season, while during the wet season, its isotopic ratio (mean δ18O and δ2H of -1.7‰ -7.9‰ was intermediate between those of discharging rivers (mean δ18O and δ2H of -2.2‰ -7.2‰ and shallow aquifer (mean δ18O and δ2H of -2.7‰ -10.7‰. Freshwater flow to the lagoon increased by three-fold after annual peak rain events. Freshwater flow into the Atlantic coastline was mostly via the lagoon during the wet season. This study clearly shows the influence of seasonal variations in precipitation on hydrological interaction and water quality in these coastal water resources and therefore gives valuable information for their management.

Keywords: coastal aquifers . isotopes . End member mixing analyses . salinization . Cote d'Ivoire