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Temporal and spatial variability of stable isotopes of the water molecule in the Ebro River basin, Spain

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Variations in the stable-isotope O and H composition in a catchment's water balance are mainly caused by natural variations in the isotopic composition of rainfall, through the mixing with pre-existing waters and the influence of evaporation. Stable isotopes of water can be considered as conservative and as not being affected by exchanges with soil or rock. Stable isotopes were analysed in the surface waters along the course of the Ebro River, in main tributaries of the Ebro river, in some groundwater, and over a one year survey at the outlet. The global meteoric-water line is used to represent the meteoric input as well as the local rainwater characteristics measured in five stations, all surrounding the Ebro catchment. Mean weighted rain input showed enriched values for four stations and a depleted one for the latter (large continental circulation of air masses). The δ^{18}O and δ^{2}H relationships for surface- and ground waters collected in the Ebro catchment with other rivers draining the French side of the Pyrenees or along the Mediterranean Sea are compiled. Most of the points clearly plot close to the global and local meteoric-water lines reflecting a meteoric origin and a lack of significant evaporation or oxygen isotopes exchanges between water and the rock matrix.

The tributaries present large variations in their δ^{18}O and δ^{2}H signatures but only the Guadalope river has an evaporated signal.ghe most depleted values are observed for the tributaries draining the Pyrenees agreeing with the Cauterets and Garonne river signatures on the French side. The Aragon, also draining the Pyrenees, has a more enriched signature that agree with the one observed in the Adour river on the French side. However, all tributaries have more depleted values than all mean rain water signal on the Ebro catchment as given by the local rain monitoring stations. If the Burgos station is considered as representative of long range continental transport, the depleted values in the tributaries of the Ebro River originate from depleted rainwater occurring in the Pyrenees. Classical Mediterranean rains yield to enriched values as demonstrated by the likeness between some rain monitoring stations and the Herault River (South France). The Ebro River show gδ^{18}O andδ^{2}H values that fall between that of tributaries and no variation can be related to the location along the course of the river. Such values reflect the depleted rain inputs, the Pyrenees inflows and more enriched Mediterranean rain inputs. The survey at the outlet displays similar range in the δ^{18}O and δ^{2}H, however with some more enriched values. There is no link with the discharge of the river, nor the Cl content. The temporal variations at the outlet of the Ebro River reflect the input of depleted water through Mediterranean rains and enriched ones through Pyrenean waters inflows.

δ^{18}O and δ^{2}H relationships for rainwater (Burgos, Santander, Zaragoza, Tortosa, Gerona and Llobregat), for surface- and ground waters collected in the Ebro catchment and for rivers draining the French side of the Pyrenees or along the Mediterranean Sea in south France.