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Results from stable isotope investigations of river waters in Western Croatia

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During a campaign lasting from 27 October to 21 November 2010, sixty-one water samples were taken from the Kupa River, the catchment of which is about ten thousand square kilometres in size. Due to the fact that the upper tributaries of e.g. the Čabranka-, Dobra-, Korana-, Mrežnica- and Petrinjčica River comprise karstified Mesozoic carbonate formations, the hydrogeologic catchment of Kupa River extends the hydrologic one by far. The upper Kupa River is mainly charged by springs from big karst reservoirs in the Gorski Kotar mountain range, where a mean groundwater residence time of up to one year has to be considered. The rapid increase of discharge of these tributary rivers results from the rapid increase of discharge of karst wells after melting in springtime as well as from storm events. In general, the minimum mean discharge for all hydrographs in July reveals a dry summer season, with the maximum discharge in August/September resulting from an increase in precipitation.
We interpret the d O-18 values of the Čabranka River (of about -8, 07‰ as signals from maritime precipitation in this karstified catchment area. The d O-18 value of upper Kupa River diminishes along its course from -8,09‰ near Osilnica to -9,06‰ west of Karlovac. After the inflow of tributaries south of Karlovac, the oxygen isotope ratio of Kupa River water reveals a significant change because the d O-18 values of the Dobra-, Korana- and Mrežnica River range from -10,45‰ to -9,58‰ . Due to the fact that the catchment of Dobra- and Korana River rises between 400 and 880 metres, we interpret the lower d O-18 values of river waters from recharge areas at those low mean altitudes as not caused by an altitude effect, but instead by precipitation out of more continental air masses.
Our interpretation of stable isotope ratios in river waters is based on the relation between the weighted mean d O-18 and the altitude obtained from stations of the Global Network of Isotopes in Precipitation (GNIP), revealing an approximate vertical d O-18 gradient of -0,30‰ per 100 m, as reported by Vreča et al. (2006). In addition, this stable isotope data for the GNIP station Zavižan predominantly indicates precipitation from the Adriatic coast, in contrary to the GNIP station Zagreb, the precipitation of which is more influenced by continental air masses.
Due to the lack of local precipitation isotope data in the Kupa drainage basin it is not possible to directly analyse the modification of the isotopic signature and its temporal variation in river waters. To sum up, the isotopic composition of river waters in the Kupa Basin is controlled by two factors: the mean altitude of the recharge areas, and differences in the isotope composition of air moisture of more maritime or more continental influence. Along with use for hydrological investigations, the presented isotope data set can serve as a base line of isotope data for assessing future climate impacts within the Kupa Basin, such as temperature changes and change of precipitation distribution.

Vreča, P., Bronić, I. K., Horvatinčić, N., Baresić, J. (2006): Isotopic characteristics of precipitation in Slovenia and Croatia: Comparison of continental and marine stations.- Journal of Hydrology, 330, 457-469.