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Application of stable isotope ratios in drinking water supply system of Ljubljana, Slovenia

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The key to understand the deterioration of the quality of urban water resources is to know the impact of urbanization on the entire waterway, which can change dramatically during the extreme climatic events. Various geochemical parameters, including stable isotope ratios of light elements (H, O, C), represent an important tool to investigate water sources, transport routes, and the mixing of individual components of the water cycle. They are indispensable in urban hydrology, both for characterizing drinking water resources and for evaluating changes within a complex water system.

In Slovenia, the majority of the population is supplied with drinking water from groundwater. In Ljubljana, the capital city of Slovenia, groundwater represents the main drinking water resource. Therefore, the knowledge and understanding of the groundwater vulnerability is important for the protection and management of water resources. In Ljubljana, the water is supplied through the central water system (WSS), more than 1.000 km long, according to the legislation and the latest standards from five different wellfields (Kleče, Hrastje, Brest, Jarški prod and Šentvid). Despite the established water protection areas, the water supply areas are exposed to the pressures of urbanization, industry, transport, agriculture and old environmental burdens, which are often unknown.

In the past, various short-term isotopic studies have been conducted and the Ljubljansko polje and Ljubljansko barje aquifers were characterized. In addition, the sources, paths and interactions of water were determined and the obtained data were used to improve the conceptual model.

However, isotopic studies of water circulation in the drinking water supply system (WSS), which would cover the simultaneous characterization of water sources and changes within the WSS, have not been performed so far. In order to assess the usefulness of isotopes more systematically, we performed the first more detail sampling of water from WSS of Ljubljana in autumn 2018. Sampling was carried out at 103 locations that were selected according to the type of facility in the WSS (i.e. 41 wells, 7 joint exits from water pumping station, 22 water reservoirs, 2 water treatment locations, 13 fountains, and 19 taps) and according to 9 different WSS areas. Additional samples were collected on River Sava, important infiltration source of groundwater, and at outflow from Ljubljana central wastewater treatment plant. This contribution focuses on presentation of changes of different parameters (i.e. temperature, electrical conductivity, pH, total alkalinity, $\delta^{18}O$,

$\delta^{2}H$ and $\delta^{13}C$) in WSS of Ljubljana.