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ISOTOPE COMPOSITION OF PRECIPITATION AT LJUBLJANA AND PORTOROŽ (SLOVENIA) – PERIOD 2011-2015

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The first monitoring of isotope composition of precipitation in Slovenia was performed in the period 1972-1975 in the frame of Ljubljanica River drainage basin investigations while regular and systematic monitoring began in 1981 in Ljubljana. The Slovenian Network of Isotopes in Precipitation (SLONIP) monitoring network has been extended during the last few decades to more than 30 different locations countrywide, mostly in the frame of short-term research projects performed by different institutions and the data were used in many hydrological, hydrogeological, climatological investigations and studies related to food authentication (Vreča and Malenšek, 2016 and references therein). SLONIP is still not a part of a national monitoring program such as that operating in European countries (e.g. Schürch *et al.*, 2003) and a national isotope in precipitation database as well as a dedicated precipitation isoscape based on coherent periods are still not available for a region under the influence of mixing continental, Alpine and sub-Mediterranean climate.

Based on the review of the history of isotope in precipitation investigations performed in Slovenia in the period 1981–2015 we summarized information about sampling, analytical methods used and basic isotope data for a particular sampling location, identified the main gaps in the past research and presented general recommendations for future work in the frame of SLONIP (Vreča and Malenšek, 2016). Next step is to collect and evaluate available data before their compilation into a Slovenian ‘ready-to-use’ precipitation isotope database, which will be further used for geostatistical treatment to evaluate the distribution patterns useful for hydrological, climatological and food authentication applications.

The longest precipitation data sets ($\delta^2\text{H}$, $\delta^{18}\text{O}$, ^3H) exist for Ljubljana and Portorož (Vreča and Malenšek, 2016) and are also part of the Global Network of Isotopes in Precipitation (GNIP). The data were published and evaluated until the end of 2010 (Vreča *et al.*, 2006, 2008, 2011, 2014, 2015). Therefore, the main purpose of this paper is to present results concerning the stable isotope composition of precipitation at Ljubljana and Portorož in relation to basic

meteorological parameters (e.g. air temperature, precipitation amount) for the period 2011–2015 and to compare them with the past records.

Mean annual temperatures (T) and annual amounts of precipitation (P) varied considerably (i.e. 1°C difference in annual T and >700 mm in P) in the period 2011–2015 at both stations. The temperatures were on average higher than in the past, while the precipitation decreased considerably at Portorož but was similar as long-term mean at Ljubljana. The mean values for $\delta^2\text{H}$ and $\delta^{18}\text{O}$, weighted by precipitation amount at Ljubljana (–56.9 ‰ and –8.45 ‰) and Portorož (–41.3 ‰ and –6.45 ‰) are similar to those observed for previous periods but indicate slightly more positive values in recent period. The change is more pronounced in the deuterium excess weighted mean values that amount to 10.7 ‰ and 10.3 ‰ for Ljubljana and Portorož, respectively, being 0.4 and 1.7 ‰ higher than those obtained for the period 2007–2010. The precipitation weighted least square regression local meteoric water lines result in $\delta^2\text{H} = (7.77 \pm 0.13) \times \delta^{18}\text{O} + (9.00 \pm 1.14)$ for Ljubljana and $\delta^2\text{H} = (7.56 \pm 0.18) \times \delta^{18}\text{O} + (7.25 \pm 1.21)$ for Portorož. Both lines indicate changes in slope and intercept that have to be inspected into more detail.

Key words: water stable isotopes, precipitation, hydrology, SLONIP, Slovenia.

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