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Oxygen and Hydrogen Isotope Variations in Precipitation along the Adriatic Coast of Slovenia and Croatia

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Precipitation is of major interest in the hydrologic cycle as it is the ultimate source of water to catchments. The terrestrial portion of the hydrologic cycle begins when the precipitation reaches the ground. Therefore, the understanding of the formation of precipitation, as well as knowledge of temporal and spatial variations in the amount and mode of precipitation, are important for basin-wide balance studies. Understanding how isotopic composition (oxygen-18, deuterium and tritium) is controlled by the formation of precipitation, and knowledge of the temporal and spatial variations in isotopic composition of precipitation are equally important.

Within the Global Network of Isotopes in Precipitation (GNIP) organised by IAEA and WMO worldwide monitoring of isotopes in precipitation is performed. The GNIP database is thus extremely valuable for modelling climate changes as well as in hydrologic and hydrogeologic investigations. Monitoring of isotopes in monthly precipitation within the GNIP has been performed at continental stations Ljubljana (Slovenia) and Zagreb (Croatia) since 1980 and 1976, respectively. In the framework of the IAEA Co-ordinated Research Program “Isotopic Composition of Precipitation in the Mediterranean Basin in Relation to Air Circulation Patterns and Climate” the monitoring program was extended in the period between October 2000 and December 2003 to several sampling stations along the Adriatic coast of Slovenia (Portoroz Airport and Kozina) and Croatia (Malinska – Krk Island, Zadar, Komiza – Vis Island, Dubrovnik and Zavizan – Mt. Velebit). The main purposes of our investigation were (1) to determine the monthly variability of isotopic composition in precipitation along the Adriatic coast, and (2) to correlate these variations with the general meteorological

parameters, such as temperature and precipitation amount.

Isotopic composition of precipitation varies considerably at all sampling stations. The coastal stations show smaller seasonal stable isotope variations than the continental stations due to smaller temperature variations. The highest values were generally observed at the south Adriatic stations and the lowest, due to the continental effect, at Ljubljana and Zagreb, as well as at the high-altitude station Zavizan. Obtained data fit well to the Craig's Global Meteoric Water Line (GMWL). Some deviations were observed in summer months at the maritime stations and are probably a result of partial evaporation of raindrops. Furthermore, most deuterium excess values vary around 10 per mill but much higher values were also observed and can be attributed to precipitation from the Mediterranean Sea. The comparison of obtained stable isotopic data with precipitation amount showed no significant correlation that can be explained by rather uniformly distributed precipitation amount with no seasonal maximum. In contrast, good correlation between stable isotopic data and air temperature was observed at all sampling stations. We found that the temperature gradient decreases with the increasing mean temperature. Differences in station altitudes allowed us to analyse the altitude gradient of stable isotopic composition. Different altitude gradient were found for the continental and the maritime stations. Tritium activity concentrations in monthly precipitation vary seasonally at all stations. At the continental stations the observed variations are typical for the stations of Northern Hemisphere: the lowest values were observed in winter and the highest in early summer. At the maritime stations the summer maxima are lower than at the continental ones, and are decreasing from North to South Adriatic. The mean tritium activity concentrations are therefore also decreasing towards south.