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Contribution of correlation and spectral analyses to the hydrological study of two adjacent karst springs: example of the Jadro and Zrnovnica Springs

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The Jadro and Zrnovnica Springs are situated in the vicinity of the city of Split, Adriatic Sea coast, Croatia. The catchment is located in the bare Dinaric karst mainly formed of carbonate rocks and partly of impermeable flysch. There is no reliable hydrological delineation of the catchment area. Although the tracer tests show that the Jadro and Zrnovnica Springs share partly the same aquifer, these two adjacent springs have different hydrological characteristics. In order to give an additional contribution to the existing knowledge about hydrological functioning of these two springs, correlation and spectral analyses including: autocorrelation, cross-correlation, spectral density, cross-amplitude, phase, coherence and gain functions; were applied to the time series of rainfalls and springs discharges. The used data are daily rainfall rates from the meteorological stations Dugopolje and Muc located inside the catchment area and the daily discharges from the Jadro and Zrnovnica Springs for the period 1995-2005. The main assumption is that the karst aquifer acts as a filter between input signal of rainfall rates and the output signal of spring discharges. The way the karst aquifer modulates the input signal is in strong connection with physical characteristics of the karst aquifer including its degree of karstification, its water storage and its hydrodynamic properties. Different characteristics of the karst aquifer response represented by the discharges from the two springs are examined. The objective of the study is preliminary characterization and understanding of the mechanism of the karst aquifer groundwater recharge and the spring discharge.