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Wavelet analysis applied to karstic hydrodynamic determination in a Mediterranean climate area

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Mediterranean region is characterized by scarce water resources as a consequence of the temperate climate (with dry hot summers and mild winters), in addition to the increase of the population and the water consumption. Water scarcity constrains the economic development of some areas within this region, which have troubles to keep the sustainability, quantity and quality of water resources. Taking into account that climate change is an evidence which points to a general tendency for annual-mean conditions to be warmer and drier, it seems necessary to develop specific water management tools that provide trustful quantification of water availability. Alicante province (southeast Spain) is thoroughly affected by this semi-arid Mediterranean climate with scarce precipitation rates. Water supply in this area is mainly provided by groundwater resources, essentially by karstic aquifers. This fact highlights the importance of being capable of predicting the karstic aquifer behaviour in order to control water available resources. In this line, wavelet analysis assists us to understand the behaviour of karstic systems defining temporal relations between an input hydrogeological factor and its related hydrogeological consequence. In the present study case, Mela aquifer, a surplus, 0.78 km^2 area, non-exploited, karstic aquifer in Alicante province, has been evaluated with wavelet analysis, implementing cross wavelet transform (XWT) and wavelet transform coherence (WTC) between two continuous wavelet transforms (CWTs). Relationships between climatic parameters (evapotranspiration and precipitation) and discharged flow through the unique spring are evaluated. For a studied period of 10 years, averaged total annual values are: 736 mm for registered precipitation, 1075 mm for calculated reference evapotranspiration and 0.26 $hm^3$for calculated discharged flow. From the wavelet analysis through the whole studied period, it is possible to stablish the seasonal behaviour of Mela aquifer as well as its variation in large-term. XWT analysis highlights relations between signals at different scales: daily periodicity in wet periods when Mela spring becomes activated with precipitations occurrence; seasonal behaviour with two annual periods of maximum activity in Mela spring (spring and autumn) and a changing behaviour in larger term as consequence of variation in rainfall distribution over the studied period. Results obtained from wavelet analysis confirm the fast response of Mela aquifer hydrodynamics, an inherent feature of many karstic systems.