Quaternary times. Spatial correlation between geomorphic and structural data proved that calculated geomorphic indices in the northwestern part of Bilogora Mt. correlate well with subsurface fault-related folds of Late Pontian-Quaternary age. These folds are formed in hangingwalls of either normal-inverted or younger reverse faults that cut across the base Pliocene-Quaternary horizon and propagate towards the surface. Vertical offset along these faults is in range between 20-480 m, thus indicating a slip rate of ≤ 0.1mm/year during the Pliocene-Quaternary times. Using the published empirical geometrical fault-scaling relationships, we estimate that at least some of these faults are capable to generate earthquakes with magnitudes up to 6.86 which are significantly greater than historically reported in Croatian Earthquake Catalogue.

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Single event time-series analysis in a karst catchment evaluated using a groundwater model

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The Lurbach-Tanneben karst system (Styria, Austria) is drained by two major springs and replenished by both autogenic recharge from the karst massive itself and a sinking stream that originates in low permeable schists (allogenic recharge). Detailed data from two events recorded during a tracer experiment in 2008 demonstrates that an overflow from one of the sub-catchment to the other is activated if the discharge of the main spring exceeds a certain threshold. This data was used to examine how far the time-series analysis (auto-correlation, cross-correlation) supports the identification of the transient inter-catchment flow observed in this karst system. As inter-catchment flow is found to be intermittent, the analysis was focused on single events. In order to support the interpretation of the results from the time-series analysis a simplified conceptual model of the karst system was implemented in the numerical groundwater flow model MODFLOW. In particular, the overflow inferred from the tracer experiment was represented using the wetting capability package of MODFLOW. Thus, the groundwater model represents a synthetic karst aquifer for which all aquifer properties are known in detail. Different types of recharge events were employed to generate synthetic discharge data, which was then used for the time-series analysis. In addition, the geometric and hydraulic properties of the karst system were varied in several model scenarios to distinguish in the results from the time-series analysis the effects of recharge from those of aquifer properties. Comparing the results from the time-series analysis of the observed data with those of the synthetic data a good general agreement was found. For instance, the cross-correlograms show similar patterns with respect to time lags and maximum cross-correlation coefficients if appropriate hydraulic parameters are assigned to the groundwater model. Thus, the heterogeneity of aquifer parameters appears to be a controlling factor. Moreover, the location of the overflow connecting the sub-catchments of the two springs is found to be of primary importance, regarding the occurrence of inter-catchment flow, and further support our current understanding of an overflow zone located near the sinkhole. Thus, time-series analysis of single events can potentially be used to characterize transient inter-catchment flow behaviour of karst systems.

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