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Research in karst aquifers developed in high-mountain areas combining KARSYS models with springs discharge records. Picos de Europa, Spain

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The study of karst aquifers developed in high-mountain areas is quite complex since the application of many techniques of hydrogeology in these areas is difficult, expensive, and requires many hours of field work. In addition, the access to the study area is usually conditioned by the orography and the meteorological conditions. A pragmatic approach to study these aquifers can be the combination of geometric models of the aquifer with the monitoring of the discharge rate of springs and the meteorological records. KARSYS approach (Jeannin et al. 2013) allows us to elaborate a geometric model of karst aquifers establishing the boundaries of the groundwater bodies, the main drainage axes and providing evidences of the catchment delineation of the springs. The aim of this work is to analyse the functioning of the karst aquifer from the western and central part of the Picos de Europa Mountains (Spain) combining the KARSYS approach, the discharge record from two springs and the meteorological records (rain, snow and temperature). The Picos de Europa (North Spain) is a high-mountains area up to 2.6 km altitude with 2,500 mm/year of precipitations. The highest part of these mountains is covered by snow four to seven months a year. The karst aquifer is developed in Carboniferous limestone which is strongly compartmentalized in, at least, 17 groundwater bodies. The method of work includes: 1) the elaboration of a hydrogeological 3D model of the geometry of the karst aquifers by KARSYS approach, 2) the definition of the springs catchment areas based on the hydrogeological 3D model, 3) the selection of two representative springs emerging from the aquifers to study it, 4) the continuous monitoring of water levels in two karst springs since October 2013, 5) the transformation of the water level values to flow values using height-stream relation curves constructed by measures of the spring discharge, and 5) the comparison of the spring discharge rate records and meteorological measurements with the geometry, extension and elevation of the springs catchment areas. This comparison allows us to characterize the functioning of the karst aquifer, validating the dimensioning of the catchment, identify other overflow springs, etc. Pressure sensors have been placed into caves of springs with the purpose of establishing quantitative relations between hydraulic heads and discharge rates in these aquifers.
Jeannin et al. 2013. Environmental Earth Sciences, 69, 999-1013.