

## ORAL presentation

### The characterization of karst hydrological functioning based on spring responses analysis

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The presentation overviews the results of different methods used on the study of karst hydrodynamic functioning based on spring responses analysis. These methods were developed and applied separately in order to better understand a complex karst system functioning. From a global to a detailed perspective, we applied three different methods, widely used in karst hydrology: (i) study of recession curve; (ii) study of the relationship between rainfall and spring response using time series analysis (correlation and spectral analysis) and the interpretation of water temperature and electrical conductivity variations at spring outflow. The time series considered in the analysis are daily and hourly data of rainfall (recharge area), flow, temperature and electrical conductivity of the main spring collected every twenty minutes during four hydrological years (since 2009-2010 to 2012-2013).

This analytical perspective provides valuable results because spring response reflects a composite of everything that happens upstream. As a result, water discharging from a karst spring carries an imprint of the global functioning of the aquifer. Due to the complexity of karst aquifers and of the processes involved, the hydrodynamic behaviour of the karst aquifer is studied here from an input-output systems analysis viewpoint, establishing the relationship between hydrological inputs and the spring discharge as outputs. Thus, karst aquifer is considered as a black-box system, i.e. a filter that transforms, retains, or eliminates the input signal in the creation of an output signal.

The study system is a non-well-known karst aquifer that covers an area around 120 Km<sup>2</sup> in middle Jurassic rocks (Bajocian and Bathonian limestone) at the central-western part of Portugal. This rock massif is highly karstified and extremely faulted at western and south shore. The recharge area locates about 300 to 350 meters a.s.l. and is quite flat but heterogeneous in terms of soil/epikarst thickness spatial distribution and karst surface forms as well. The discharge points are intermittent and perennial springs at 40-70 meters a.s.l. along western boundary of the aquifer. The main outlet of the system is Olhos d'Água do Anços spring, where the data are collected. Daily discharge rates present a significant annual variation: from 0.2 m<sup>3</sup>/s (low waters period) to 5.5 m<sup>3</sup>/s (winter period).

The main results reflected simultaneously high and low transformation of the input signal, which provided valuable information on the nature of global flow dynamics in the karst aquifer. Furthermore, these results revealed some general characteristics of the structure of the karst aquifer, mainly in terms of functionality of network drainage system, storage capacity and internal degree of karstification.

The improvements on the knowledge of the hydrodynamics of the studied karst aquifer prove that the compilation of several methods and techniques is an excellent methodology to karst hydrological functioning study.