
H32A-05: How to Interpret the Responses of a Karstic Field to a Harmonic Pumping

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In a karstic field, the flow paths are very complex as they globally follow the conduit network. The drawdown responses to a pumping test at constant rate in this type of aquifer are highly variable spatially and difficult to interpret. Furthermore, a constant-rate pumping tends to mobilize matrix diffusive flows and, thus, the conduit flows become 'blurred'.

Harmonic pumping tests represent a new investigation method for characterizing the subsurface groundwater flows. They have several advantages compared to a constant-rate pumping (i.e. more signal possibilities, extracting the signal in the responses, possibility of closed loop investigation). In the case of a karstic field investigation, several works have shown that a harmonic pumping test allows a better characterization of the local field hydraulic properties.

We show in our recent works that interpreting the responses from a harmonic pumping test permit to go further in the conduit network characterization by delineating a connectivity degree between measurement points. We have studied the amplitude and phase offset values in the responses to a harmonic pumping test in a theoretical synthetic modeling case in order to define an interpretation method for the responses. According to the amplitude and phase offset values in a response, relative to the pumping signal, we have distinguished three different type of responses to be interpreted: a direct connectivity response (conduit flow), an indirect connectivity (conduit and short matrix flows), and an absence of connectivity.

We have applied this interpretation method on a true field responses (from a karstic field in Southern France). Firstly we have stated that the whole set of field responses appears to be coherent toward the observation that have been made in the theoretical case. Then, by comparing the periodic responses between them and with the pumping signal, we could interpret and delineate easily and quickly the main flow paths, through the degree of connectivity between each measurement point. We believe that harmonic pumping investigation will soon become of first interest for subsurface flows characterization. The responses interpretation method we propose allows a simple and quick comprehension of principal flow paths, without necessary a need of calculation or modeling.

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