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# Characterization of groundwater dynamics in an heterogeneous karstic aquifer through active and passive Fiber Optic DTS methods

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Temperature has been proposed as an excellent tracer for monitoring groundwater flows, especially in karstic aquifers which are characterized by rapid and localized flows. Here, we present some experiments that demonstrate the interest of passive and active Fiber-Optic Distributed Temperature Sensing (FO-DTS) for characterizing heterogeneities and groundwater dynamics in a karstic aquifer. The experimental tests were achieved at the Poitiers Experimental Hydrogeological Site (SEH) where groundwater flows are mainly associated with sub-horizontal karstic structures and sub-vertical fractures. The site consists in 35 boreholes drilled within a regular 210 x 210 m grid, and having an average depth of about 125 meters (http://hplus.ore.fr).
The simplest experiments consist in monitoring temperature changes simultaneously in 3 to 4 boreholes during a pumping test. The duration of each pumping test was about 3 to 4 h, a duration that allowed obtaining a clear hydraulic response on most boreholes. Temperature was monitored every 30 seconds with a temperature resolution varying between 0.02°C to 0.05°C for a spatial resolution equal either to 29 cm or 50 centimeters depending on the DTS unit. As expected, the changes in temperature are highly variable from well to well. In most boreholes, one clearly observes some changes of borehole temperature that may be used to locate precisely the main permeable levels and to estimate borehole flow rates through the borehole temperature evolution. When no temperature changes are observed, active DTS methods may still allow monitoring of groundwater flows. Active-DTS methods are considered when the cable or borehole fluid is heated. For instance, it is possible to use a thermal resistance within a borehole and monitor fluid movement through temperature evolution with time. Thus, passive and active DTS methods are found very complementary for providing spatial and temporal monitoring of groundwater dynamics in heterogeneous aquifers.