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Time-lapse ERT and DTS for seasonal and short-term monitoring of an alpine river hyporheic zone

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The hyporheic zone (HZ) is the area located beneath and adjacent to rivers and streams, where the interactions between surface water and groundwater take place. This complex physical domain allows the transport of several substances from a stream to the unconfined aquifer below, and vice versa, thus playing a fundamental role in the river ecosystem.
The importance of the hyporheic zone makes its characterization a goal shared by several disciplines, which range from applied geophysics to biogeochemistry, from hydraulics to ecology. The frontier field of HZ characterization stays in applied non-invasive methodologies as Electrical Resistivity Tomography – ERT – and Distributed Temperature Sensing – DTS. ERT is commonly applied in cross-well configuration or with a superficial electrodes deployment while DTS is used in hydro-geophysics in the last decade, revealing a wide applicability to the typical issues of this field of study. DTS for hydro-geophysics studies is based on Raman scattering and employs heat as tracer and uses a fiber-optic cable to acquire temperature values. We applied both techniques for an alpine river case studies located in Val di Sole, TN, Italy. The collected measurements allow high-resolution characterization of the hyporheic zone, overcoming the critical problem of invasive measurements under riverbeds. In this work, we present the preliminary results regarding the characterization of the hyporheic zone of the alpine river obtained combining ERT and DTS time-lapse measurements. The data collection benefits from an innovative instrumentation deployment, which consists of both an ERT multicore cable and a DTS fiber-optic located in two separated boreholes drilled 5m under the watercourse and perpendicular to it. In particular we present the first year monitoring results and a short time-lapse monitoring experiment conducted during summer 2015. The site and the results here described are part of the EU FP7 CLIMB (Climate Induced Changes on the Hydrology of Mediterranean Basins) project.