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Time Lapse Electrical Resistivity Tomography and Distributed Temperature Measurements in the Hyporheic Zone of an Alpine River.

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The hyporheic zone is a very complex transition zone, where interrelated hydrological and biogeochemical processes take place, mainly controlled by the exchanges of water between the stream and the surrounding riparian zone and underlying aquifer. Monitoring of the hyporheic zone faces similar problems of groundwater monitoring, often exacerbated by the strong physical and biogeochemical gradients that characterize this transition area. Geophysical time-lapse techniques can provide a dynamic monitoring of the hyporheic and riparian zones. We installed in the hyporheic zone of the Vermigliana creek, Trentino, Italy, a monitoring system composed of (a) an Electrical Resistivity Tomography (ERT) apparatus for time-lapse monitoring of electrical resistivity changes, (b) an optical fiber for DTS monitoring of temperature. The installation below the river bed was done thanks to the recent horizontal directional drilling technology capable to be remote-guided during perforation. We installed 48 electrodes below the stream, plus 24 electrodes on the top of the riparian zone, thus closing nearly entirely the region to be monitored. Parallel to the ERT cable we also installed Raman technology fiber optic cable for the distributed monitoring of the subsoil temperature. We present here the results of the time-lapse measurement surveys of the first year, together with the flow/transport modeling conducted to link quantitatively the data collected to the hydraulic parameters of the system. The hyporheic zone evidences an active underflow dynamics that, to be correctly described, needs accurate distributed variably saturated flow and transport modeling.