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Geophysical characterization of Hydrogeological processes at the catchment scale

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The characterization of hydrogeological properties in the subsurface with high resolution across space and time scales is critical to improve our understanding of water flow and transport processes. However, to date, hydrogeological investigations are mainly performed through well-tests or the analysis of samples, thus, limiting the spatial resolution of the investigation. To properly capture heterogeneities in the subsurface controlling surface-groundwater interactions, modern hydrogeological studies require the development of innovative investigation techniques that permit to gain continuous information about subsurface state with high spatial and temporal resolution at different scales: from the pore-space all the way to the catchment. To achieve this, we propose the conduction of geophysical surveys, in particular field-scale Spectral Induced Polarization (SIP) imaging measurements. SIP images provide information about the complex electrical conductivity (CEC), which is controlled by important hydrogeological parameters, such as porosity, water content and the chemical properties of the pore-water. Here, we present imaging results collected at the catchment scale (approximately 66 ha), which permitted to gain detailed information about the spatial variability of hydrogeological parameters at different scales. The heterogeneities observed in the geophysical images revealed consistency with independent information collected at the study area. In addition to this, and taking into account that different geophysical methods yield information about different properties and at diverse scales, interpretation of the SIP images was improved by incorporation of complementary measurements, such as: ElectroMagnetic Induction (EMI), Ground Penetrating Radar (GPR), Multichannel Analysis of Surface-Waves (MASW) and Seismic Refraction-Reflection (SRR).