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Dynamic river-wetland interactions revealed by time-lapse electrical resistivity tomography

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Wetlands provide a number of important ecological, hydrological and biogeochemical functions with implications for the entire catchment. Wetland processes are typically dictated by subsurface geology and interactions between the wetland, river, and groundwater. Our study site, the Boxford Wetland, UK, is a riparian wetland comprising peat and gravel deposits overlying chalk bedrock. The wetland has been considered groundwater-dependent, but the influence of the adjacent River Lambourn is unclear.

Electrical resistivity methods are sensitive to geological properties, pore water electrical conductivity and temperature, and can provide high spatial and temporal resolution of processes in the subsurface. To assess the influence of the river on the wetland, we installed an electrical resistivity tomography (ERT) array and a series of point sensors to monitor river stage, river electrical conductivity and subsurface temperature. The array was installed laterally across the river at a site of known groundwater connectivity, and extended into the wetland. ERT measurements were recorded diurnally from November 2018 to November 2019 using the PRIME system (British Geological Survey).

ERT data quality was good, with low reciprocal errors, and near full coverage of the year. Initial interpretation shows that the riverbank comprises three hydrologically distinct layers: an upper and lower peat layer and an underlying gravel layer, which show different seasonal resistivity patterns arising from changes in saturation and pore water electrical conductivity. Our results demonstrate that geophysical techniques can image river-riparian zone interactions at high temporal and spatial resolution, and are relevant in improving our understanding of complex groundwater-surface water interactions.