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Method refinement for the measurement of electrochemical properties of floodplain soils

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Floodplains with alternating water saturation and, thus, dynamic redox conditions in their soils play a crucial role when it comes to understand environmental cycling of nutrients and anthropogenic substances such as herbicides. The reduction or oxidation of these compounds not only depends on the actual redox conditions but also on the availability of electron donors or acceptors either in dissolved or solid state.
In our study we investigate an intensively managed floodplain in the Ammer valley near Tübingen, Germany. We want to characterize and quantify the capacity of reversible redox buffering within these soils during alternating redox conditions throughout the year.

The electron accepting and donating capacities (EAC; EDC) of the soils from the Ammer valley are quantified by using the recently developed method of mediated electrochemical reduction and oxidation: a certain potential is applied and a mediator substance is used as electron shuttle to allow a reduction/oxidation as complete as possible.
So far, the method has been used for the electrochemical characterization of model compounds, e.g. standard humic substances, well-defined iron-containing clay minerals or iron oxides and hydroxides, and also natural samples, e.g. particulate organic matter in sediments or clay-rich sediments.

Now, we want to go further and adapt the method to measure EAC and EDC of bulk soil samples. Therefore, we studied samples with increased complexity, i.e. reduced and oxidized claystone samples and soil samples from the study site, and tested the effects of different grain size fractions and the type of electrochemical mediator substance.
Our results showed that complex sample matrices require optimization of the electrochemical setup in order to generate reproducible and reliable EAC and EDC data.

Profound understanding of the electrochemical behavior of the soils shall later be linked to a variety of biogeochemical processes including transport, sorption and degradation of glyphosate in soils.