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Mapping patterns of soil properties and soil moisture using electromagnetic induction to investigate the impact of land use changes on soil processes

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As highlighted by many authors, classical or geophysical techniques for measuring soil moisture such as destructive soil sampling, neutron probes or Time Domain Reflectometry (TDR) have some major drawbacks. Among other things, they provide point scale information, are often intrusive and time-consuming. ElectroMagnetic Induction (EMI) instruments are often cited as a promising alternative hydrogeophysical methods providing more efficiently soil moisture measurements ranging from hillslope to catchment scale.

The overall objective of our research project is to investigate whether a combination of geophysical techniques at various scales can be used to study the impact of land use change on temporal and spatial variations of soil moisture and soil properties.

In our work, apparent electrical conductivity (ECa) patterns are obtained with an EM multiconfiguration system. Depth profiles of ECa were subsequently inferred through a calibration-inversion procedure based on TDR data. The obtained spatial patterns of these profiles were linked to soil profile and soil water content distributions.

Two catchments with contrasting land use (agriculture vs. natural forest) were selected in a subtropical region in the south of Brazil. On selected slopes within the catchments, combined EMI and TDR measurements were carried out simultaneously, under different atmospheric and soil moisture conditions. Ground-truth data for soil properties were obtained through soil sampling and auger profiles. The comparison of these data provided information about the potential of the EMI technique to deliver qualitative and quantitative information about the variability of soil moisture and soil properties.