Geoelectrical monitoring for detecting soil moisture changes in the main rooting zone of forest sites with different lithology in Lower Franconia, Germany

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For assessing the water supply of forest stands, knowledge about the small-scale distribution of the soil moisture as well as its temporal changes is a key issue especially in an era of climate change. Traditional methods, like taking soil samples or installing data loggers, solely collect parameters of a single point or of a small volume in the soil, respectively. Since time-lapse electrical resistivity monitoring is a suitable method to qualitatively monitor the soil moisture variability, we used this approach for a forest site to obtain high-resolution data of soil moisture variation, although, electrical resistivity is influenced by further parameters such as soil texture, organic content and salinity.

As a pre-study, a 2D geoelectrical monitoring was installed in a forest monitoring plot of the Bavarian Institute of Forestry (LWF) nearby Würzburg which represents one of the driest forest sites in Bavaria. For five years, geoelectrical measurements have been performed and are compared with monitoring data (measured by the LWF) such as e.g., throughfall, bulk precipitation, air temperature and point measurements of soil moisture content.

The weekly changing resistivity values are highly correlated with the variation of the soil moisture to a depth down to 1m representing the main rooting zone. We also address further relations between electrical resistivity and air temperature or precipitation events. Our results show that time-lapse electrical resistivity imaging is a suitable method for monitoring relative changes in soil moisture content also at forest sites, even if soil temperature and salinity variations cannot be considered in electrical conductivity measurements to isolate additional effects like changing salt distributions as in our case. Since we are currently instrumenting additional monitoring plots in Lower Franconia we will also present first new data for sites with different soil types.