Contribution ID: **16** Type: **Vortrag in der SEI-Tagung - nicht workshop**

MODEL-BASED CORRECTION METHOD FOR TEMPERATURE-DEPENDENT MEASUREMENT ERRORS IN EMI SYSTEMS

Wednesday 23 March 2022 08:30 (20 minutes)

Electromagnetic induction (EMI) is a non-invasive and fast geophysical measurement technique that provides information about the uppermost meters of the subsurface with a spatial resolution in the sub-meter range. Frequency domain EMI systems measure the apparent electrical conductivity (ECa) of the soil by inducing a time-varying primary electromagnetic field into the ground using a sender. Since the subsurface is electrically conductive, the primary field produces eddy currents that lead to the generation of secondary electromagnetic fields. The superposition of the secondary and the primary electromagnetic field is measured at a receiver, and the imaginary part of this superposed magnetic field is related to the ECa of the subsurface.
Data measured using EMI systems are known to be susceptible to measurement influences associated with time-varying external ambient factors. Temperature variation is one of the most prominent factors causing drift in EMI data, leading to poor predictive performance and non-reproducibility of results. Typical approaches to mitigate drift effects in EMI instruments are performing a temperature drift calibration where the instrument is heated up to specific temperatures in a controlled environment and the observed drifts are collected in a lookup table for a static ECa correction.
An enhanced correction method is presented that models the dynamic characteristics of drift and later uses it for correction. The model is tested with a custom-made EMI device equipped with ten temperature sensors that simultaneously measure the internal ambient temperature across the device. The device was used to perform outdoor calibration measurements over a period of 16 days within a wide range of temperatures. In order to reduce the influences of soil variation over time, the instrument measured ECa at a height of 0.7 m with an intercoil spacing of 1.2 m. In contrast to typical approaches involving static thermal ECa error correction based on a look-up table, this new approach models the dynamic thermal characteristics of the drift and actively uses it for correction.
The results are showing that modelling the dynamic thermal characteristics of the drift helps to improve accuracy by a factor of five compared to purely static characterization with a look-up table. In addition, the modelling parameters used for drift correction are very stable for all sixteen datasets. For instance, the average temperature-dependent ECa drift of about 2.45 mSm-1K-1 fluctuates only by 0.04 mSm-1K-1 between measurements for a temperature variation of about 30 °C. These results suggested that our enhanced correction method using the modelling of dynamic thermal characteristics of EMI systems is a relevant method and beneficial for usage to improve drift correction.

Summary

Proceedings

Es soll nicht veröffentlich werden

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Session Classification: Detektoren und Systeme