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Towards quantitative usage of EMI-data for Digital Soil Mapping

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As formulated in the Thematic Strategy for Soil Protection prepared by the European Commission soil degradation is a serious problem in Europe. The degradation is driven or exacerbated by human activity and has a direct impact on water and air quality, biodiversity, climate and human life-quality. High-resolution soil property maps are one major prerequisite for the specific protection of soil function and restoration of degraded soils as well as sustainable land use, water and environmental management. However, the currently available techniques for (digital) soil mapping still have deficiencies in terms of reliability and precision, the feasibility of investigation of large areas (e.g. catchments and landscapes) and the assessment of soil degradation threats at this scale. The focus of the iSOIL (Interactions between soil related science – Linking geophysics, soil science and digital soil mapping) project is on improving fast and reliable mapping of soil properties, soil functions and soil degradation threats. This requires the improvement as well as integration of geophysical and spectroscopic measurement techniques in combination with advanced soil sampling approaches, pedometrical and pedophysical approaches.

Many commercially available geophysical sensors and equipment (EMI, DC, gamma-spectroscopy, magnetics) are ready to use for measurements of different parameters. Data collection with individual sensors is well developed and numerously described. However comparability of data of different sensor types as well as reproducibility of data is not self-evident. In particular handling of sensors has to be carried out accurately, e.g. consistent calibration. Soil parameters will be derived from geophysical properties to create comprehensive soil maps. Therefore one prerequisite is the comparison of different geophysical properties not only qualitative but also quantitative. At least reproducibility is one of the most important conditions for monitoring tasks.

The first parameter we focussed on is apparent electrical conductivity (ECa). It is an important geophysical properity in soil science since soil parameters (water content, etc.) can be deduced. Nowadays mobile geophysical platforms allow to survey large areas comprehensively in a short time period. These platforms have been equipped with EM38DD (Geonics) and Profiler EMP-400 (GSSI) - two different types of electromagnetic induction (EMI) instruments - within first iSOIL field campaign. While EM38DD measures in horizontal and vertical mode at the same time, Profiler measures three frequencies simultaneously and magnetic susceptibility additionally. Coil separation of the instruments is nearly the same, so penetration depth is similar. On the other hand, frequencies are arbitrary at Profiler but fixed at EM38DD. These differences in penetration depth have to taken into account.
By our measurement we tested the comparability of the data to show differences between instruments of the same type (EM38DD-EM38DD) using different settings, and different types (EM38DD-Profiler). Moreover both sensors work in continuous as well in discontinuous mode.
The results show that quality of data is comparable, but the quantities are varying. This has to be considered for further interpretations and monitoring. In the next steps we have to determine how to convert relative data into absolute data since ECa data from different locations are not comparable to each other in a quantitative way. In the talk we will give an introduction in the application of EMI for soil monitoring, followed by an overview about comparability and reproducibility of data.