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imVisIR – a new tool for high resolution soil characterisation

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The physical and chemical heterogeneities of soils are the source of a vast functional diversity of soil properties in a multitude of spatial domains. But many studies do not consider the spatial variability of soil types, diagnostic horizons and properties. These lateral and vertical heterogeneities of soils or soil horizons are mostly neglected due to the limitations in the available soil data and missing techniques to gather the information. We present an imaging technique that enables the spatially accurate, high resolution assessment (63×63 μm2 per pixel) of complete soil profiles consisting of mineral and organic horizons. We used a stainless steel box (100×100×300 mm3) to sample various soil types and a hyperspectral camera to record the bidirectional reflectance of the large undisturbed soil samples in the visible and near infrared (Vis-NIR) part of the electromagnetic spectrum (400-1000 nm in 160 spectral bands). Various statistical, geostatistical and image processing tools were used to 1) assess the spatial variability of the soil profile as a whole; 2) classify diagnostic horizons; 3) extrapolate elemental concentrations of small sampling areas to the complete image and calculate high resolution chemometric maps of up to five elements (C, N, Al, Fe, Mn); and 4) derive maps of the chemical composition of soil organic matter.
Imaging Vis-NIR (imVisIR) has the potential to significantly improve soil classification, assessment of elemental budgets and balances and the understanding of soil forming processes and mechanisms. It will help to identify areas of interest for techniques working on smaller scales and enable the upscaling and referencing of this information to the complete pedon.