Use of VNIR-SWIR and TIR diffuse reflectance spectroscopy for the quantitative prediction of common soil properties

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With the focus on new available hyperspectral remote sensing sensors with high spectral resolution and high signal-to-noise ratio that could deliver at the remote sensing scale reflectance spectroscopy laboratory signatures, we are testing in this paper the use of different spectral regions for the prediction of common soil properties such as organic carbon content, clay content, sand content. For this, soil surface samples from the Australian wheat-belt region were analysed bio-chemo-physically and spectroscopically in the laboratory for their properties in the optical region until the short-wave infrared (400-2500 nm) and for the thermal remote sensing window (8-12 µm).
Soil diffuse reflectance spectroscopic measurements were acquired in the VNIR-SWIR spectral region in the laboratory on the homogenised samples using an ASD FieldSpec-Pro spectrometer with a contact probe (scale of observation~10mm). Soil radiance spectra in the TIR region were recorded indoors using a micro Fourier Transform Interferometer (µFTIR) (model 102, D&P instruments) covering the spectral range from 7 to 14 µm with a resolution of 6 cm^{-1} on a 4.5° (scale of observation~20mm) field of view on identical samples as for the optical measurements. The samples were analysed based on XRD and standard analytical methods for soil texture (clay, silt, fine and coarse sand fractions) and soil organic matter content. Multivariate regression models were built to quantify the soil parameters from the spectral signatures.
This work has shown that the prediction of the selected soil parameters benefits very much from using 32 spectral channels from the thermal infrared emissivity spectra. These bands correspond to spectral specifications of a hyperspectral imaging sensor, the TASI-600. All of the selected soil parameters show good correlations with the spectral signatures. Due to its direct opto-physical relationships, the models for the TIR region performed best for the sand fraction with its high quartz content. Accordingly all of the spectral regions show their potential for a sufficient prediction for each of the soil parameter from the resampled laboratory spectral data. Nevertheless, with the focus on applying the prediction models to imaging spectroscopic data, we expect a surplus from the additional TIR bands.