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Soil spectra properties modelling to analyze influence of water content

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This study presents results of soil spectra properties modelling under variable soil-water content conditions. In general, soil water has negative influence on calibration and prediction of soil properties in diffuse reflectance soil spectroscopy, as well as in remote sensing. The effects are typically described as increased heterogeneity in spectra signatures that propagate through predictive models. Quantitative application of soil spectroscopy in laboratory assumes spectra collection from dry samples, while field conditions provide soil in variable soil moisture levels.
In this study, laboratory soil spectra in range of 350 to 2500 nanometres were collected for soil samples with sequentially increasing soil-water contents. Water content ranged from 0 (air dried sample) to saturation in about 15 water content steps. Set of 13 reference soil samples from various climatic conditions and parent materials (marlite, loess, gravely sand, orthogenesis, syenite, quartzite, paragneiss and sand) were used in the analysis. Soil properties like organic matter content ranged from 0.04 to 5.03 %, clay content from 3.3 to 24.5, while sand varied from 9.5 to 93.7 % in the samples. The soil spectra were modelled on relationship between lambda integral (area under curve), continuum function, water absorption band properties (e.g. depths and width) and water content. The results confirm expected trends. Area under the spectra curve changes nearly linearly between 5 and 15 % soil moisture, while outside this limit the values of area changes are nearly neglectable. The soil spectra continuum function shows the same trends without significant features changes. The most prominent changes detected are in the water absorption bands. Water absorption features are studied on normalized, continuum removed spectra, where effect of increasing moisture is not eliminated. Moisture wavebands assigned to vibrations in water and hydroxide bonds stretching and bonding are studied separately according to their comparative energy absorption strengths. First of all very strong bands at 1400 and 1990 nanometres are analysed, then weaker bands at e.g. 1200 and 2400 nanometres are analyzed on absorption depth and width. Regression models with water content gives good correlation results for absorption depths feature at the main strong water bands.

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