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Estimation of Soil Organic Carbon using Colour Features Derived from Digital Camera

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Soil organic carbon (SOC) management is urgently required to satisfy the demand for precision agriculture, soil carbon monitoring and soil quality preserving since SOC has important influence on soil parameters, crop productions and wide range of ecosystem functions. Conventional SOC analysis is expensive, time-consuming and laborious. The development of spectral imaging sensors by enlarging the cover of point spectrometry into a spatial domain, allows for the acquiring of larger amount of data using cheaper and faster methods. This research aims to measure SOC content using soil colour as an indirect proxy. Measurements of soil colour were made using the images from a low-cost digital RGB camera at an agricultural site of the Czech Republic. Various soil colour spaces and colour indices derived from the digital camera were used as independent variables to train prediction models and produce spatial distribution maps of SOC. Predictions using digital camera were compared to predictions using reflectance spectroscopy in the VIS range (400-700 nm), as an agreed-upon technique for SOC measurement, with random forest (RF) algorithm. The results showed that most applied colour features, especially colour indices were correlated to SOC. For prediction of SOC, the digital camera produced R2 = 0.85 and RMSEp = 0.11, which were almost similar with those obtained from the spectroscopy technique (R2 = 0.84 and RMSEp = 0.10). The SOC maps created using the spectra and camera data showed very similar pattern with accurate performance. In this study, colour features extracted from digital camera images enabled reliable and powerful prediction of SOC, overcoming limitations of traditional and non-imaging SOC analysis methods.