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Evaluating imaging spectroscopy for mapping soil organic carbon content and quantifying SOC stocks in the plough layer of an arable field

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The soil contains one of the largest pools of the global carbon cycle and soil organic carbon (SOC) is an important factor in soil quality. It has been shown that SOC in the topsoil of croplands changes within decades as a result of changes in crop rotation, residue input or management practices. Still the dynamics of the soil organic carbon (SOC) cannot be verified or monitored as its large spatial variation requires prohibitive sample and analysis densities. The objective of this paper is evaluating the potential of airborne imaging spectroscopy as a cost-efficient technique to collect detailed SOC data at the field scale in order to map the SOC content and quantify the SOC stock. A hyperspectral image was acquired using the airborne AHS 160 sensor, and the SOC content, bulk density, stone content and texture were analysed for 30 soil cores at 10 cm depth increments. Multivariate calibration models such as Penalized-spline signal regression produced accurate models for mapping the SOC content in the 0-20 cm plough layer with an RMSE of 2.4 g C kg-1 and a ratio of performance to deviation of 1.4. The accuracy of SOC stocks in the plough layer is mainly determined by the variability in SOC content with a negligible influence of the bulk density and stone content variability. Given the spatial auto correlation in SOC content, the imaging spectroscopy technique enables the extraction of 179 independent samples from the image. This technique allows to determine a SOC stock of 36.6 $\pm$ 0.73 Mg C ha-1 with a low confidence limit that would have otherwise required a prohibitive number of samples for a 5 ha field.