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Hyperspectral imaging for high-resolution mapping of soil profile organic carbon distribution in an Austrian Alpine landscape

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Studies on soil organic carbon (SOC) stocks mostly focus on topsoils (< 30 cm). However, 30 to 63% of the SOC are stored in the subsoils (30 to 100 cm), and the factors controlling SOC storage in subsoils may be substantially different than in topsoils. The low mean SOC content in subsoils makes its quantification and characterization challenging. Thus, new approaches are required to depict the SOC stocks distribution in full soil profile. Hyperspectral imaging of soil core samples can provide high spatial resolution of the vertical distribution of SOC in a soil profile. The main objective of the ongoing study, within the Horizon 2020 European Project Circular Agronomics, is to apply laboratory hyperspectral imaging with a variety of machine learning approaches for the mapping of OC distribution in undisturbed soil cores. Soil cores were collected down to a depth of one meter in grasslands of 15 organic farms located in the Lungau Valley, in Austria. Some samples were divided into five depths in the field for classical bulk soil measurements (total carbon and nitrogen, texture, pH, EC and bulk density) on disturbed samples. Undisturbed soil cores were sliced vertically for laboratory hyperspectral imaging in the range of Vis-NIR (400-1000 nm). We were able to reveal the hotspots of OC and map the OC distribution in soil profile by applying a variety of machine learning approaches (i.e. partial least square and random forest regression) as a function of spectral responses. A digital elevation model was further exploited to investigate the effects of topographical factors such as elevation, aspect and slope on SOC profile distribution. Landsat 8 data were also used to depict the spatial variability of land insensitive cover/vegetation in study area.