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The influence of surface reflectance anisotropy on estimation of soil properties

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The spatial variation in soil properties is an important factor for agricultural management. Unmanned airborne vehicles (UAV's) equipped with a hyperspectral mapping system may provide these data, but anisotropic reflectance effects may have an influence on the derived soil properties. Besides influencing the reflectance, angular observations may deliver added information about soil properties.

We investigated the anisotropic behavior of 59 soil samples with a large variation in soil composition, by measuring their reflectance (350-2500 nm) over 92 different angles using a robot-based laboratory goniometer system. The results show that the anisotropic behavior of the soils influences the measured reflectance significantly, which limits the accurate prediction of soil properties (OM and clay especially). However, prediction accuracies of OM increase when spectra are measured under specific angles. Prediction accuracies further increase when a combination of observation angles is being used. Apart from that, using UAV's the wavelength range is limited to about 1000 nm. In general, this will decrease the model performance, but our results show that this effect can largely be compensated by combining multiple observation angles.

Altogether, we demonstrate that surface anisotropy influences the prediction of soil properties negatively. This effect can be reduced by combining spectra acquired under different angles. Moreover, predictions can be improved if combinations of different observation angles are used.