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Multisensor on-the-go mapping of readily dispersible clay, particle size and soil organic matter

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Particle size fractions affect strongly the physical and chemical properties of soil. Readily dispersible clay (RDC) is the part of the clay fraction in soils that is easily or potentially dispersible in water when small amounts of mechanical energy are applied to soil. The amount of RDC in the soil is of significant importance for agriculture and environment because clay dispersion is a cause of poor soil stability in water which in turn contributes to soil erodibility, mud flows, and cementation.
To obtain a detailed map of soil texture, many samples are needed. Moreover, RDC determination is time consuming. The use of a mobile visible and near-infrared (VIS-NIR) platform is proposed here to map those soil properties and obtain the first detailed map of RDC at field level. Soil properties prediction was based on calibration model developed with 10 representative samples selected by a fuzzy logic algorithm. Calibration samples were analysed for soil texture (clay, silt and sand), RDC and soil organic carbon (SOC) using conventional wet chemistry analysis. Moreover, the Veris mobile sensor platform is also collecting electrical conductivity (EC) data (deep and shallow), and soil temperature. These auxiliary data were combined with VIS-NIR measurement (data fusion) to improve prediction results. EC maps were also produced to help understanding RDC data. The resulting maps were visually compared with an orthophotography of the field taken at the beginning of the plant growing season. Models were developed with partial least square regression (PLSR) and support vector machine regression (SVMR).
There were no significant differences between calibration using PLSR or SVMR. Nevertheless, the best models were obtained with PLSR and standard normal variate (SNV) pretreatment and the fusion with deep EC data (e.g. for RDC and clay content: RMSECV = 0,35% and R2 = 0,71; RMSECV = 0,32% and R2 = 0,73 respectively). The best models were used to predict soil properties from the field spectra collected with the VIS-NIR platform. Maps of soil properties were generated using natural neighbour (NN) interpolation. Calibration results were satisfactory for all soil properties and allowed for the generation of detailed maps. The spatial variability of RDC was in accordance with the field orthophotography. Areas of high RDC content were corresponding to area of bad plant development.
Soil texture has been correctly predicted by VIS-NIR spectroscopy (laboratory or on-the-go) before. However, readily dispersible clay (an important parameter for soil stability) has never been investigated before. This study introduces the possibility of using VIS-NIR for predicting readily dispersible clay at field level. The results obtained could be used in preventing soil erosion.
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