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Evaluation of methods for surface soil moisture content estimation using Near-infrared Reflectance Sensor

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Surface soil moisture is a significant parameter in environmental systems. A new sensor capable of estimating surface soil moisture from reflectance data is presented, called near-infrared reflectance sensor. Two approaches are used for prediction model development, relative reflectance approach and relative absorption depth approach respectively. The present study investigated the reflectance variations in four soil samples with a wide range of soil properties. The results showed that linear correlations were developed between relative absorption depth and soil moisture for individual soil dataset and all soils combined datasets, with R^2 of 0.69, 0.60, 0.76, 0.86 and 0.63, and parabolic models were also constructed between relative reflectance and soil moisture with$R^2$of 0.90, 0.86, 0.96, 0.95 and 0.88. Compared with individual linear models for each soil sample, parabolic models generated better prediction accuracy with values of root mean square error (2.55%, 2.28%, 4.41% and 3.64%). Soil moisture estimation is largely improved when the linear model are developed individually on each soil type, compared with all soils linear model. Individual parabolic model yielded performances very similar to the all soils parabolic model. Therefore, it is still problematic to construct a single linear model for surface soil moisture estimation due to variable soil properties. At the same time, it is feasible to construct a single parabolic model to minimize that factor effecting on reflectance. The most important meaning of this study is that surface soil moisture can be rapidly and accurately measured by near-infrared reflectance sensor. In the future, the prediction models can therefore provide quick assessment of surface soil moisture directly in the field.