Integration of Quantitative Pedological Data Collected at Multiple Scales

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Digital data sets of the earth's surface spectral properties are routinely collected from various sensors mounted on satellite and airborne platforms. The temporal and spectral properties of any one pedon in an agricultural field will soon be available from high-resolution satellites. Soil samples for digital data sets of representative micro-pedofeatures must be carefully chosen to represent their distribution on landscapes. There is a lack of studies linking quantitative data between varying scales of measurement.

We report on the development of a system for the study of soil landscapes at multiple scales by combining remotely sensed data with image analysis techniques, global positioning systems, and soil micromorphology techniques. At a regional scale, the agricultural landscape can be monitored using the 25m Landsat TM satellite data. At the field scale, data from a Compact Airborne Spectrographic Imager (CASI) with a 1m pixel resolution, combined with global positioning systems allows for the spectral characterization and monitoring of agricultural soils for soil organic matter and soil erosion (using ^{137}Cs) related to topography. At the pedon scale, impregnated soil blocks and thin sections can be produced for spectral imaging with a 12 micrometers pixel resolution over a 4 X 5cm area. Soil voids (>30 micrometers equivalent diameter) can be differentiated from the solid matrix, and pore size and shapes can be quantified to assess the influence of management practices on soil structure and short-term pedogenesis in agricultural fields. Thin sections are imaged with an Array Technologies scanner in transmitted light, reflected light and circularly-polarized light. The 9 spectral data sets can be simultaneously used in an unsupervised classification, followed by aggregation to differentiate pedofeatures at this scale, utilizing image analysis algorithms within EASI/PACE (PCI Inc.) software.

The linking of processes at multiple scales will be the basis for prediction of changes in soil organic matter, and detailed soil-landscape relationships within agroecosystems. Robust computer hardware, software and sampling designs are key components of this system.