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Integrating proximal soil sensing techniques and terrain indexes to generate 3D maps of soil restrictive layers in the Palouse region, Washington, USA

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In the Palouse region of eastern Washington and northern Idaho (USA), spatially discontinuous restrictive layers impede rooting growth and water infiltration. Consequently, accurate maps showing the depth and spatial extent of these restrictive layers are essential for watershed hydrologic modeling appropriate for precision agriculture. In this presentation, we report on the use of a Visible and Near-Infrared (VisNIR) penetrometer fore optic to construct detailed maps of three wheat fields in the Palouse region. The VisNIR penetrometer was used to deliver in situ soil reflectance to an Analytical Spectral Devices (ASD, Boulder, CO, USA) spectrometer and simultaneously acquire insertion force. With a hydraulic push-type soil coring systems for insertion (e.g. Giddings), we collected soil spectra and insertion force data along 41m x 41m grid points (2 fields) and 50m x 50m grid points (1 field) to ≈80cm depth, in addition to interrogation points at 36 representative instrumented locations per field. At each of the 36 instrumented locations, two soil cores were extracted for laboratory determination of clay content and bulk density.

We developed calibration models of soil clay content and bulk density with spectra and insertion force collected in situ, using partial least squares regression 2 (PLSR2). Applying spline functions, we delineated clay and bulk density profiles at each points (grid and 24 locations). The soil profiles were then used as inputs in a regression-kriging model with terrain indexes and ECa data (derived from an EM38 field survey, Geonics, Mississauga, Ontario, Canada) as covariates to generate 3D soil maps. Preliminary results show that the VisNIR penetrometer can capture the spatial patterns of restrictive layers. Work is ongoing to evaluate the prediction accuracy of penetrometer-derived 3D clay content and restriction layer maps.