VNIR:
Beyond Assessment of Soil Carbon

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Soil and VNIR Spectroscopy

► Origin of spectra is electronic, vibrational, and rotational state transitions of atomic bonds
  ► Si-O; Al-O; C-C; C-H; C-O

► Prediction of a soil properties relies on the relationship between adsorption of radiation and the property
Quantifying Soil Properties from Spectra

• Identify a property of interest, e.g., calcium carbonate equivalent
• Select a large number (>100) of samples that were analyzed by conventional methods
• Develop statistical relationships between spectra and property

CaCO₃ equivalent  2%  3%  17%  9%  32%  62%  15%  24%  1%  14% ...
The same spectrum can be used to predict multiple properties.
Successful Predictions

- Particle size distribution; clay, sand
- Chemical properties; Extractable Cations, CEC, Acidity, Al, selected trace elements
- Physical properties; water content, COLE
- Other; CaCO₃, gypsum, available P
- Challenge is development of appropriate predictive models
  - SSL has large database available
    - Spectra collected for all samples submitted to SSL
    - Sample archive
  - Nationwide or stratified models
  - Geographic stratification?
  - Other properties – stratify by spectral characteristics?
Clay Content

Air-dried ground soil

60 $r^2 = 0.90$

RMSE = 5%

1:1 line
Gypsum

Dried ground soils
TX spectral library

$r^2 = 0.978$
RMSD = 4.3 %
RPD = 5.8

1:1 line

predicted gypsum, %

measured gypsum, %
Coefficient of Linear Extensibility

**VNIR Spectroscopy**
- RMSD = 0.028
- $r^2 = 0.61$
- RPD = 1.6

**Pedotransfer**
- RMSD = 0.029
- $r^2 = 0.57$
- RPD = 1.5

* clay content
Field Data Collection?

- Water is a strong absorber of visible and IR radiation
- Models from literature for air dried homogenized samples
- 2 factors for use of spectra collected in field
  - Moisture
  - Heterogeneous samples
- Initial research to correct moist spectra to air dry basis (U. of Sydney)
  - Homogenized samples
  - Correction based on spectral characteristics
  - Water content not needed for correction
- SSL and MO-5 (NE) cooperating on research to extend initial results
  - SSL spectra on moist heterogeneous, dry heterogeneous, and dry homogenous samples
  - Field spectra
    - Hydraulic probe core
    - Pit face
Summary

- Additional data can be collected from VNIR spectra
- Less precise than standard laboratory methods but has application for soil survey
  - Site pre-screening
  - Large “N”
- Opportunity for close depth interval measurement of properties
- Methods and models will be developed in the future
Questions?

Comments?