Linking Research to Soil Interpretations and MLRA Updates – Focusing on Benchmarks

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Who Am I?

- Arkansas native
- Married (forever); 1 son
- Educated at University of Arkansas and Texas A&M (Pedology)
- Experience
  - Soil Scientist, SCS, Gatesville, TX
  - Soil Scientist, ARS-NSERL, West Lafayette, IN
  - Professor, University of Georgia, Athens, GA

Benchmark Soils

- Large extent
- Key soils (key positions in Soil Taxonomy)
  - Typically do not share same family
- Important soils
  - Specialty crops
  - Engineering purposes
- Existing data

Applicability to Research and Interpretations

- Cannot work with every series recognized
- Benchmark series intended to maximize
  - Extrapolation of data collection and research results
  - Ability to test predictions of properties and test interpretations

How Many Benchmark Series?

- 1403 series
- By MO
  - Mean = 78
  - Range = 15-126
- By State
  - Mean = 29
  - Range = 2-109

Is This Too Many?

- <2% of series
- “Too many” depends on effort required to collect data and complete project
  - Characterization – one pedon
    - Manageable
  - Characterization of multiple pedons
    - More effort – longer term
  - Intensive research projects
    - More effort – longer term

Characterization

- 223 benchmark series with no data
  - Includes data from 11 university labs
- Basic data to begin to understand system
  - Classification
  - Interpretation
  - Basic information for design and interpretation of other studies
- Multiple pedons of same series
  - Property means and variability

MLRA SSO Field Labs

- *Bad data is worse than no data*
- Procedures and equipment to meet SSO needs
  - Classification
  - Interpretation
  - Understanding
  - Research/investigation projects
- NSSL role
  - Protocols and procedures
  - Training
  - Quality control
- Data disposition

MLRA SSO Research Projects

- Local data collection or broader research study?
  - Single SSO
  - Multiple SSO to nationwide
    - Priorities
    - Buy-in
- Large project requirements
  - Common objectives
  - Uniform methods
  - Data management
  - Communication
- Partnerships with cooperators
  - We need all the help we can get

Investigations / NSSL Involvement

- Main role is project support
  - Design
  - Field assistance
  - Laboratory support
  - Training
  - Data analysis
  - Report preparation and review
- Support for cooperators
- Additional liaisons
  - Discipline support

Research on 1403 Benchmark Series?

- Short term
  - Concentrate on a subset of the benchmarks
- Long term
  - Work through the list?
  - Depends on project and benefits

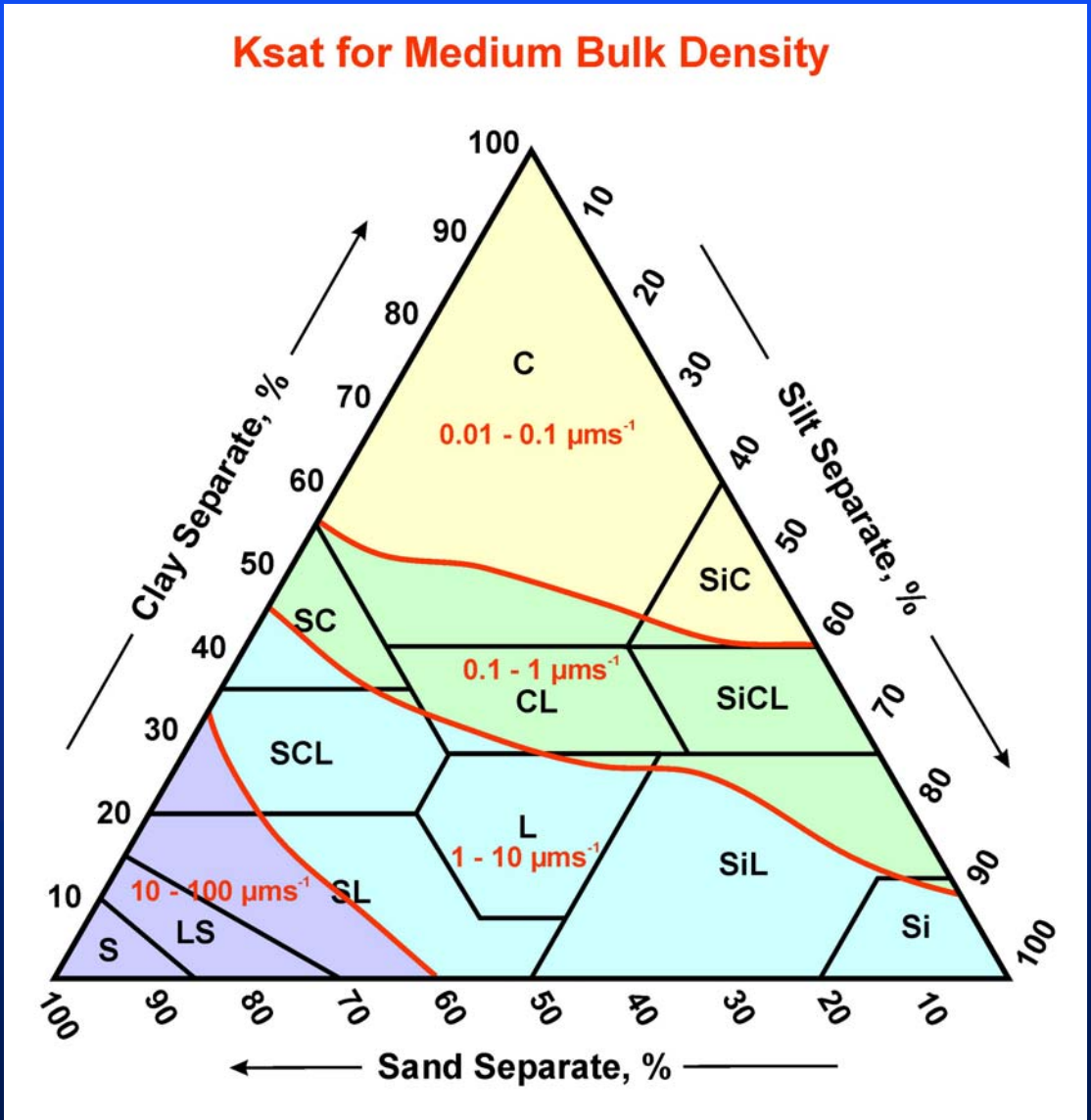
Selecting a Subset

- Criteria will vary with project objectives
- Straw-man criteria
  - Extent
  - Economic importance
  - Ecological importance
  - Unique ecosystems including agroecosystems
  - Unique properties

Pedotransfer Functions

- Prediction of a property from other more easily measured properties
- Long history of use in NCSS

NCSS K_s Pedotransfer Function



Texture overrides are available for mineralogy, consistence, porosity, and cementation

Improved Pedotransfer Functions

- Requires data for development and testing
  - Property measurement
  - Pedon descriptions
  - Characterization
- One pedon per benchmark series?
  - How many replicates?
    - Will depend on soil and landscape

Potential Research/Investigations Projects

- Landscape / Geomorphic relationships
- Hydraulic properties
- Dynamic soil properties
- Geochemistry
- Other

Landscape / Geomorphic Relationships

- Long history for Investigations staff
  - Will remain an emphasis
- Need to better understand soil distribution across the landscape
  - Field work
  - Pedon description, sampling, and analysis
  - Geophysical tools
  - Geospatial analysis
- Benchmark landscapes (catenas)

Beyond Basic Relationships

- Effects of soil, parent material, and landscape on hillslope/watershed hydrology
  - Distribution of water restrictive horizons
- Soils and/or landscape components effect on fate and transport of stuff
  - Surface and subsurface
  - Source or sink

Soil Hydrology (Hydropedology)

- Water ties soils, landscapes, and management together
- Primarily field-based
  - Basic characterization integral component

Seasonal Saturation

- Depth
- Duration
- Epi or endo saturation
- Relation to morphology
  - Saturation without Fe reduction
  - Water restrictive horizons
  - Relict redox features

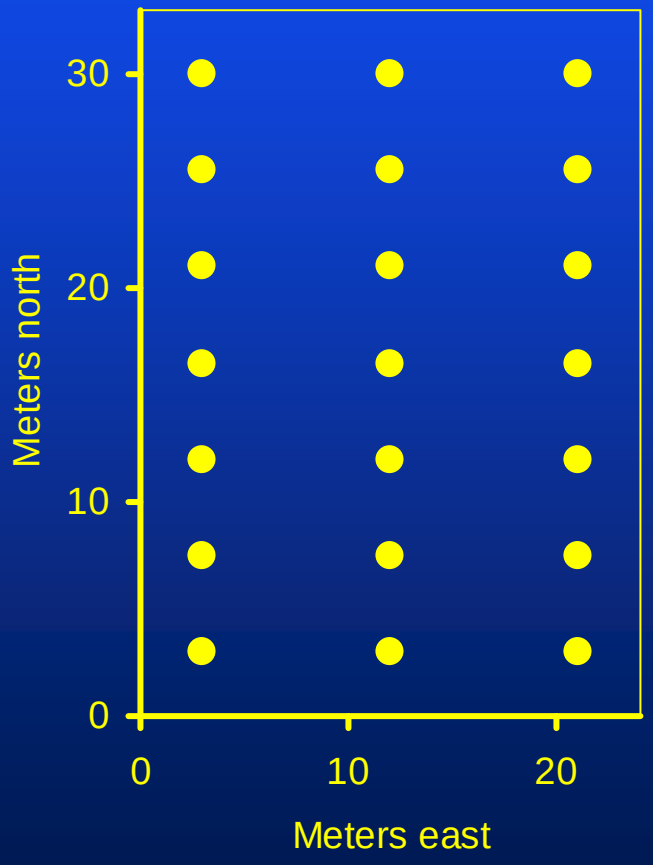
Saturated Hydraulic Conductivity

- Basic property for interpretation of soil behavior
- Input for simulation models
  - Erosion
  - Nutrient dynamics
  - Contaminant fate and transport
- Surface K_s (infiltration rate) varies seasonally and with management
- Relatively simple and reliable field measurement

Variable Property

- Variability is a pain but must be addressed

Cecil Bt K_s – 60 cm depth



	K_s cm/h
Range	0.06 – 5.78
Mean	0.77
Geometric mean	0.35
Standard error	0.27

9 reps needed to estimate mean with 80% confidence

Measured and Predicted Data

fine, kaolinitic, termic Typic/Oxyaquic Kanhapludults/Hapludults

Horizon	---------- K_s ---------- Tabular Data cm/d	Measured* cm/d
Bt1	35-121	7.2
Bt2, Bt3	35-121	1.7
BC	35-121	1.6

* Geometric mean of measurements for 210 pedons on 10 hillslopes

Extrapolate Hydraulic Properties to the Landscape

- Benchmark landscapes and/or watersheds
- Geomorphic analysis
- Geophysical tools
- Geospatial analysis

Dynamic Soil Properties

- Properties that vary with system / state and season
  - Organic C and N
  - Aggregate stability
  - Hydraulic properties
  - Other
- What is the best the soil can be?
  - Management to achieve optimum

Combination of Field and Laboratory

- Variable properties that change over time
- Many must be measured on site
  - Property may change with sample shipment
  - Measurement in field or SSO labs with NSSL support

MLRA SSO Role

- *Cooperator communication*
- Landuse/management definition
- Soil/site selection
- Field measurements
- Lab measurements
- Data compilation and analysis
- Interpretation development / refinement

NSSC and NSSL

- Development of field measurement methods
  - Data quality assurance
- “Static” data and measurement of selected dynamic properties
- Training
- Pedotransfer function development and testing
- Interpretation development / refinement

Geochemistry and Biogeochemistry

- Nutrients (N and P)
  - Fate
  - Distribution
  - Soil affects
- Trace elements (metals)
  - Baseline concentrations
  - Variation with soil and landscape
  - Measure on benchmarks and other selected pedons

The Bottom Line

- Complexity of current and emerging questions requires multi-faceted approach and involvement
  - Research projects must meet local needs
  - Investigations staff and NSSL support
- Multiple evaluations / experiments on one site
  - Can we multitask?
- Benchmark soils will maximize our ability to extrapolate data and develop predictive functions

Questions and Comments