Rapid Soil Carbon Assessment of the U.S. for Conservation Planning and Model Validation

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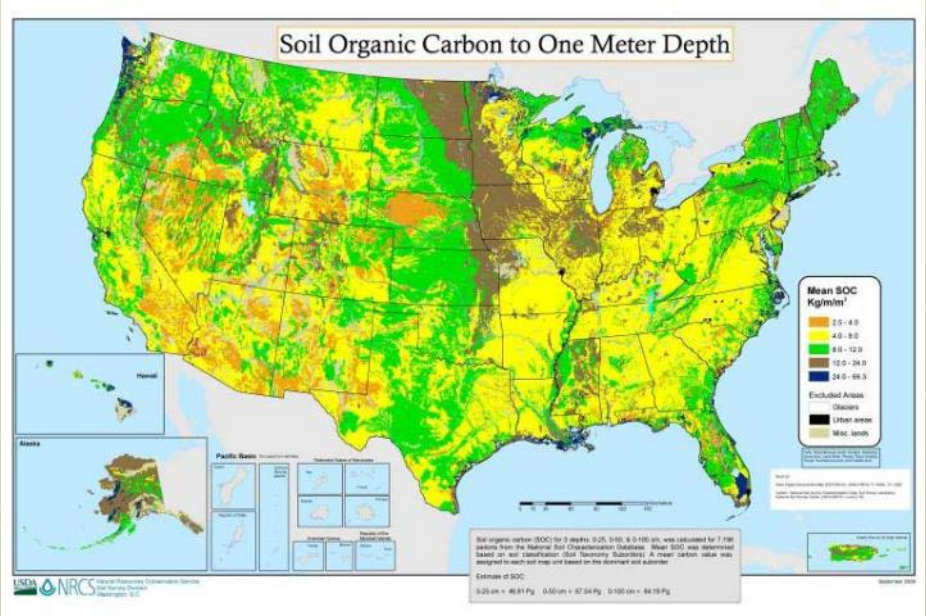
Why Carbon Data?

- Reliable estimates of the amount of carbon that can be practically stored in soil as affected by:
  - Soil properties
  - Land use/land cover (LULC), ag management systems, ecological site and state
- Need quantitative data
  - Decision support tools such as COMET-VR
  - Carbon cap and trade programs
  - Global carbon accounting
  - Model calibration

Objectives

- Evaluate US soil carbon stocks as effected by
  - Soil
  - Land cover
  - Agricultural management
  - Ecosystem state

- Inventory soil carbon stocks for U.S.



2 Phase Program

1. National soil carbon inventory developed from SSURGO
2. Collection of soil carbon and other data for evaluation of carbon stocks for Benchmark and other important soils

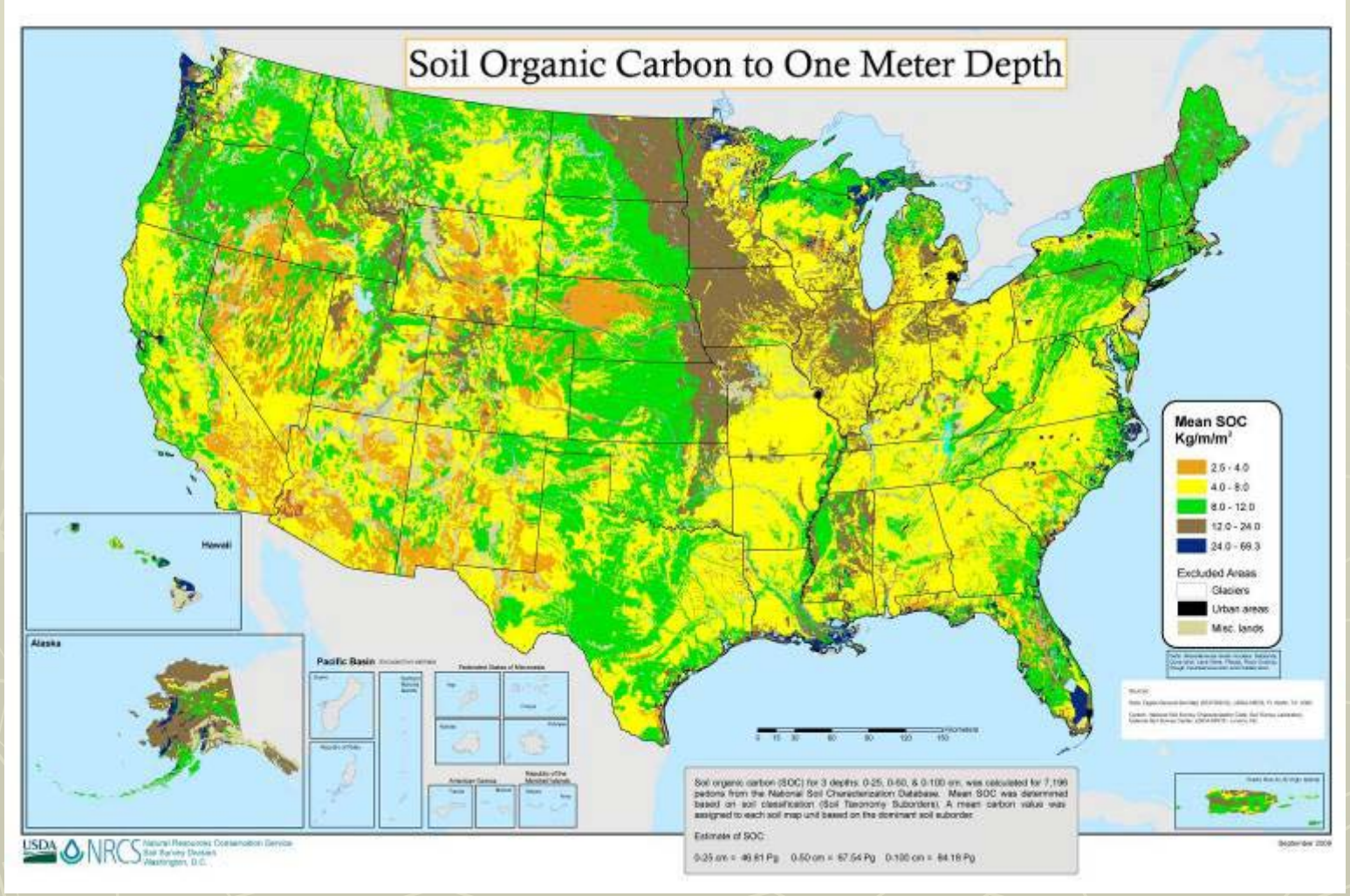
Phase 1

National Soil Carbon Inventory Developed from SSURGO

Short-term Product

STATSGO SOC Estimates

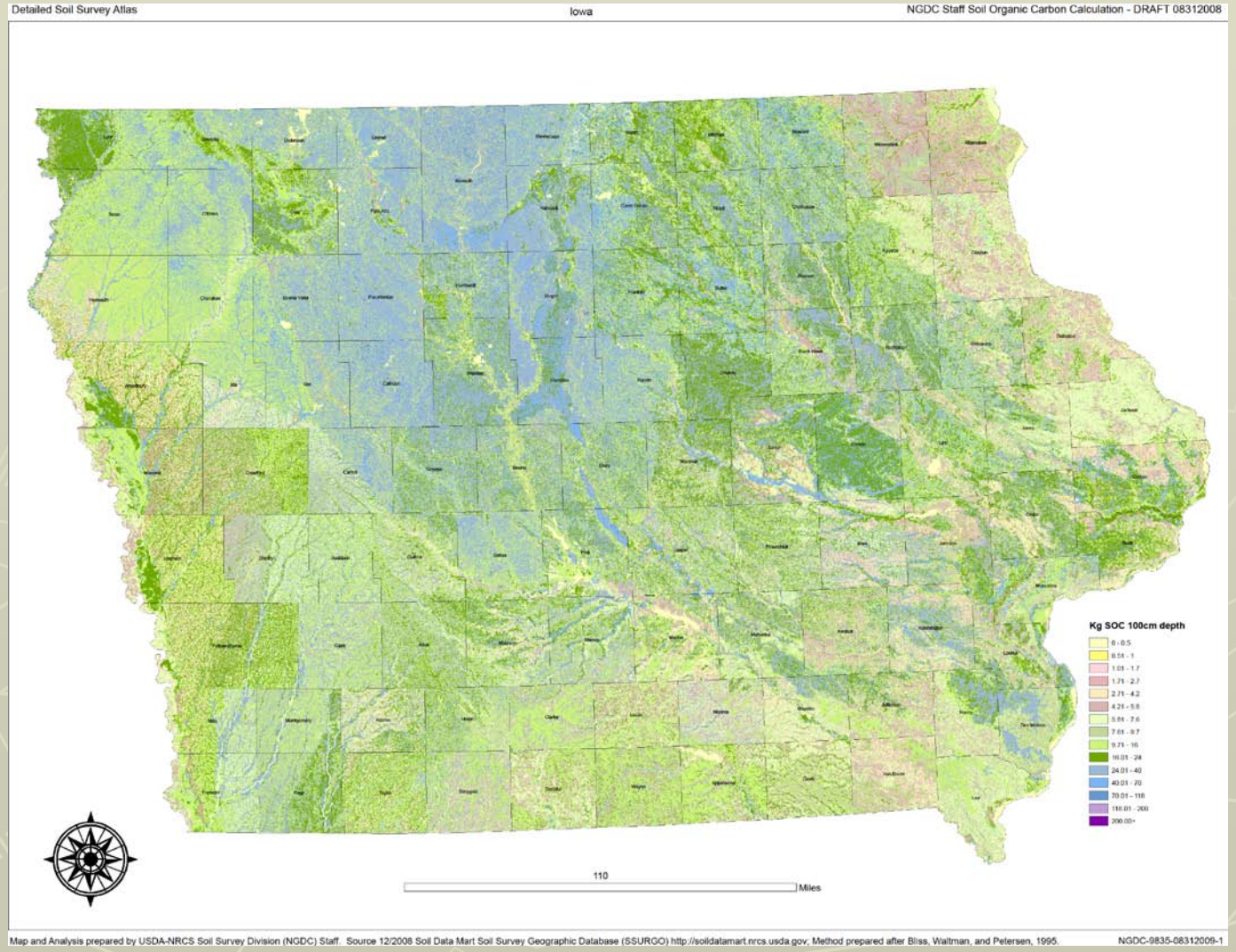
1:250,000 scale; published in 2001



SSURGO Estimates

- Gridded SSURGO
- Soil C to 1 m (various depths?)
  - Organic
  - Inorganic ($CaCO_3$)
- Adjustment to C concentration and bulk density based on land cover
  - USGS NLCD
  - SSURGO RV for “dominant” land use for map unit
  - Dominant cropland; pasture = high OM
  - Dominant forest; cropland = low OM
- State Soil Scientist and cooperator review

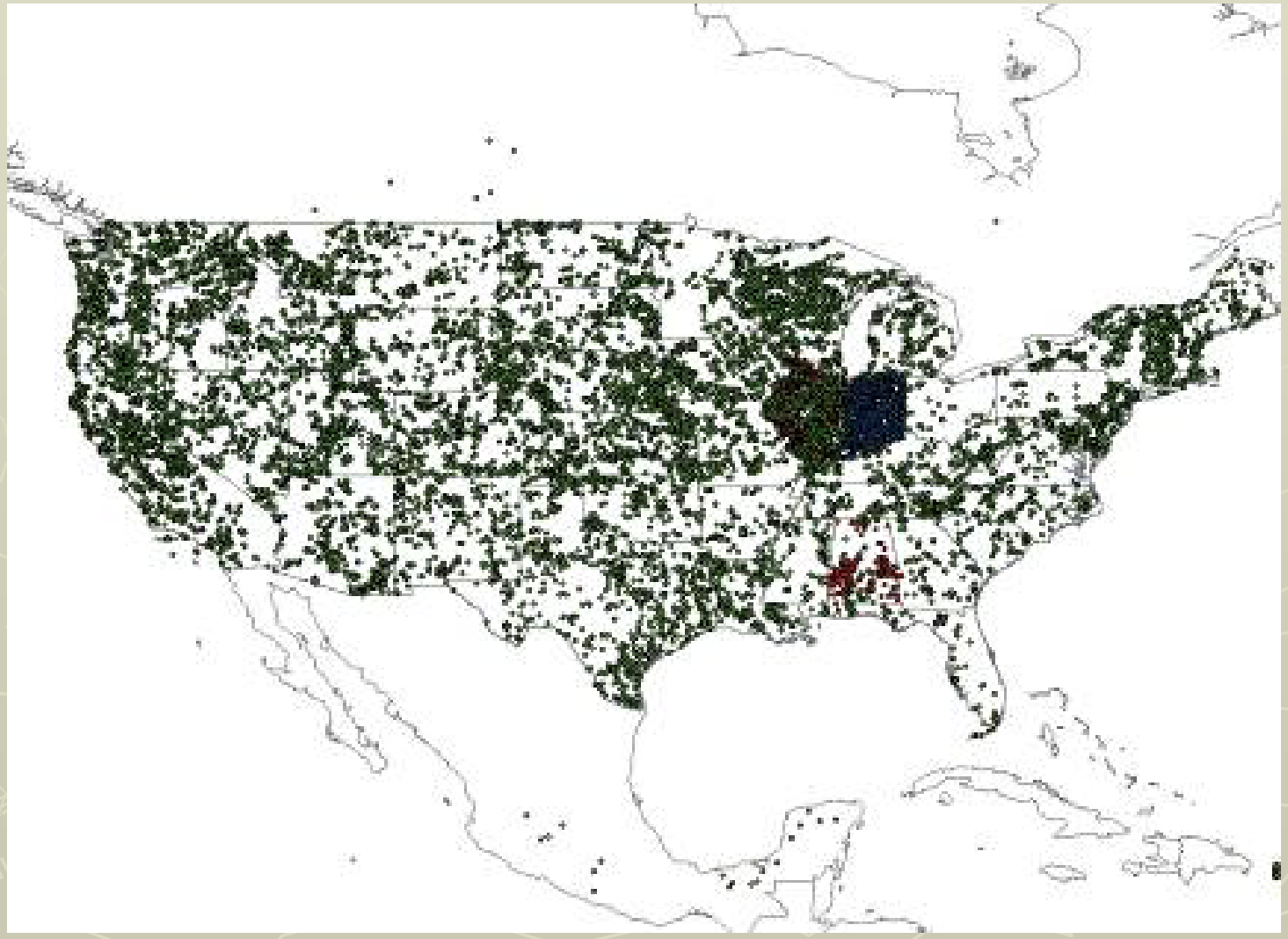
SSURGO SC Estimates to 1 m



Validation

- NCSS pedon data
  - 27,000+ pedons with measured soil carbon and other data for carbon stock calculations
  - Additional data being incorporated from university laboratories
  - Stratified by land cover to enhance accuracy for validation
- Overlay appropriate pedons on SSURGO map units to compare point measurements to aggregated data

NCSS Pedons



Phase 2

Collection of soil carbon and other data for evaluation of carbon stocks

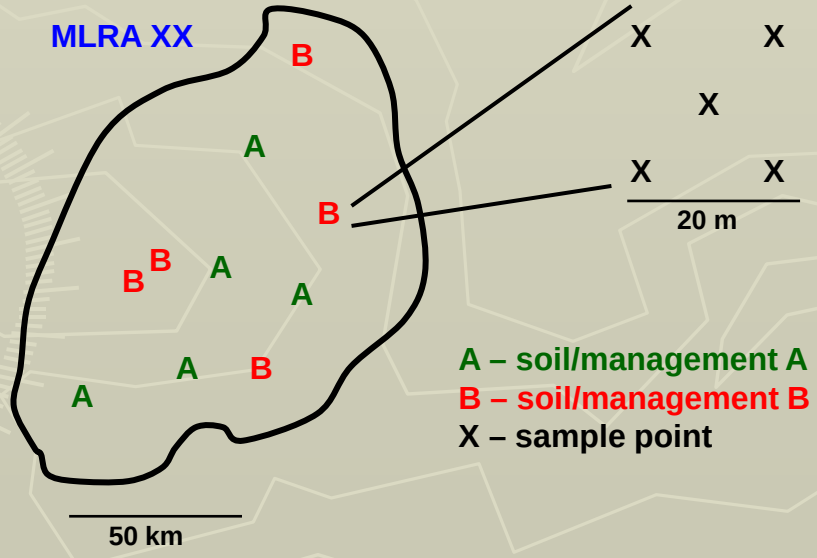
for benchmark and other important soils

Nationwide Effort

- All land uses and ecosystems
  - Cropland
    - Tillage systems
  - Pasture
  - Range
  - Forest
  - Wetlands
  - Floodplains

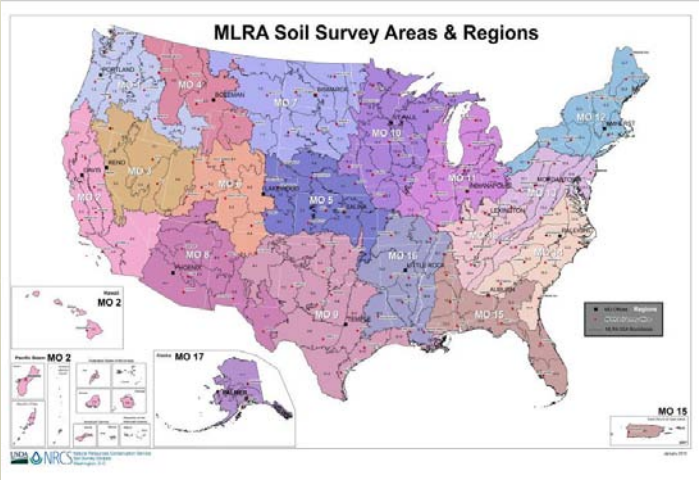
Replication for Statistical Confidence

- NCSS pedon data
  - Suggests 25 replicates (sample points) per soil-LULC combination for 80% confidence in mean
- Clustered sample design
- More replicates for extensive soil groups



How much data can we collect?

- Dispersed sample analysis
  - 18 MO regions
  - 400 sites/MO
  - ~7,000 sites
  - 35,000 sample points
- Cannot evaluate all soil-LULC combinations
- ~1,400 soil-land cover combinations
  - 80 per MO region
  - 5 LULCs
    - Unmanaged forest, pasture, cropland, native grassland, managed forest
  - 16 soils



Sites

- 1st stratification = soil within MLRA region (MO)
- Grouping of similar soils based on properties that influence carbon dynamics
  - Texture, drainage, mineralogy, etc.
- Limited number of groups per MO
  - 13-20
  - Issue for diverse MO regions

Stratification within Soil Groups

- Land use – management – ecosystems expected to have similar influence on carbon dynamics
  - Steady state conditions
    - End result not rate
- Evaluate end member conditions
  - Broad groups
  - “Minor” permutations not addressed

Total Sample Points

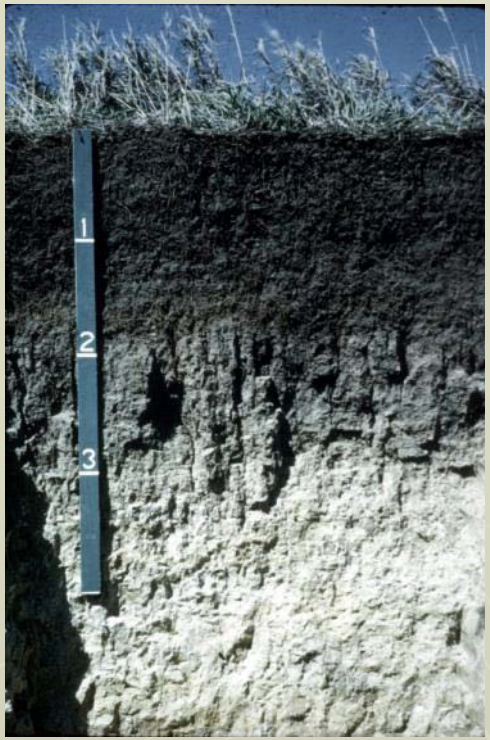
- 7,000 sites across U.S.
- 35,000 sample points
- 1,440 soil-ecosystem combinations
- Goal: Minimal number of soil-ecosystem combinations to represent range of conditions
- 2 year project

Sites

- Randomized NRI points within appropriate map units
  - Land use & management data available
- Site must meet acceptance criteria confirmed on site
  - Soil group confirmed on site
  - Steady-state ecological state/ management system
- Sites may be used in future for ecological site inventories
  - Vegetation
  - Dynamic soil properties

Data Collection

- By horizon to 1 m
  - 0-5 cm depth sampled separately if surface horizon >7 cm
- Landscape properties
- Soil morphology
  - Series identification
- Total and inorganic C
- Bulk density
  - Core, compliant cavity, model
- Dispersed data collection
  - 150,000 horizons
  - VNIR spectroscopy



Who will Do the Work?

- MO rapid carbon leads
  - Field data collection and sampling
  - Sample processing in SSO laboratory
  - Completed 3 day training on sample collection, bulk density measurement, spectrometer operation
  - Additional on site training
- MLRA Soil Survey Offices
  - Field data collection and sampling
  - Other?
- NSSC staff
  - VNIR model development
  - Data storage and analysis
  - Training
  - QA

Use of the Data

- Incorporated into databases, SSURGO & WSS
  - Data accessed depends on land cover/ag management?
  - Group being formed to address issue
- Other impacts
  - Infiltration and runoff
  - K factor?
  - Soil quality assessments

What it is and What it isn't

- Is
  - National one-time inventory of soil C stocks
  - SSURGO data
  - Statistically valid inventory for broad soil and LULC groups
- Isn't
  - Specific for all soil and landscape factors
    - Landform, hillslope position, erosion phases, etc.
  - Specific for all land uses and managements
    - All factors not addressed, i.e. cover crops, tillage type
  - Rate of change inventory
  - 1st point in monitoring program

Additional Data

- Existing pedon data (NCSS database)
- Extension of data
  - ARS research sites
  - University research sites
    - Rates
    - Additional management/ecosystem data
- EPA National Wetland Condition Assessment
  - Hydric soils

The Future?

- Equipment will be available after this project
- Landform effects
- Erosion effects
- Additional data for selected parent materials
- Additional data for specific management systems
- Monitoring studies
- Other soil properties
  - Increase potential for replication

Questions?

Comments?