

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

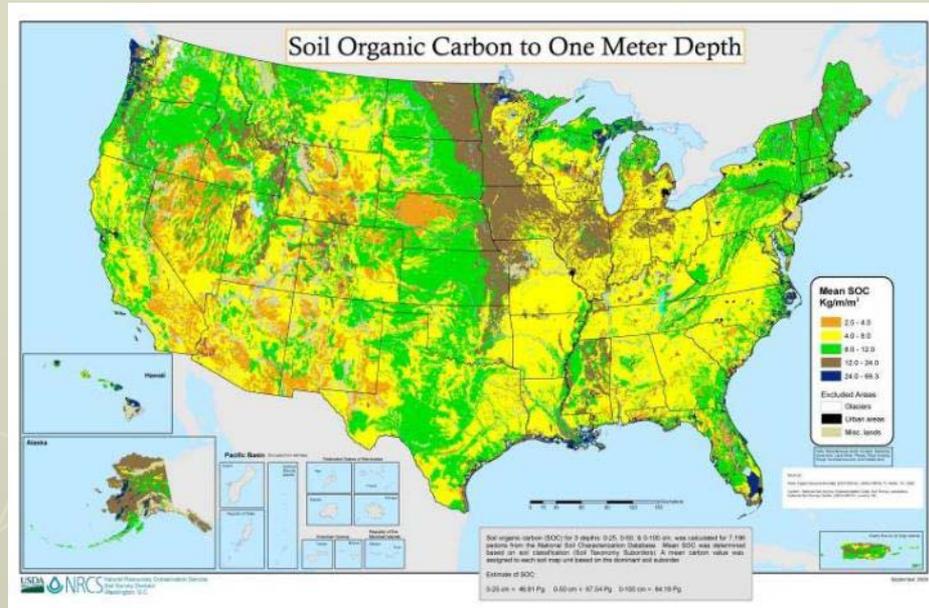
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Why Carbon Data?

- ▶ 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

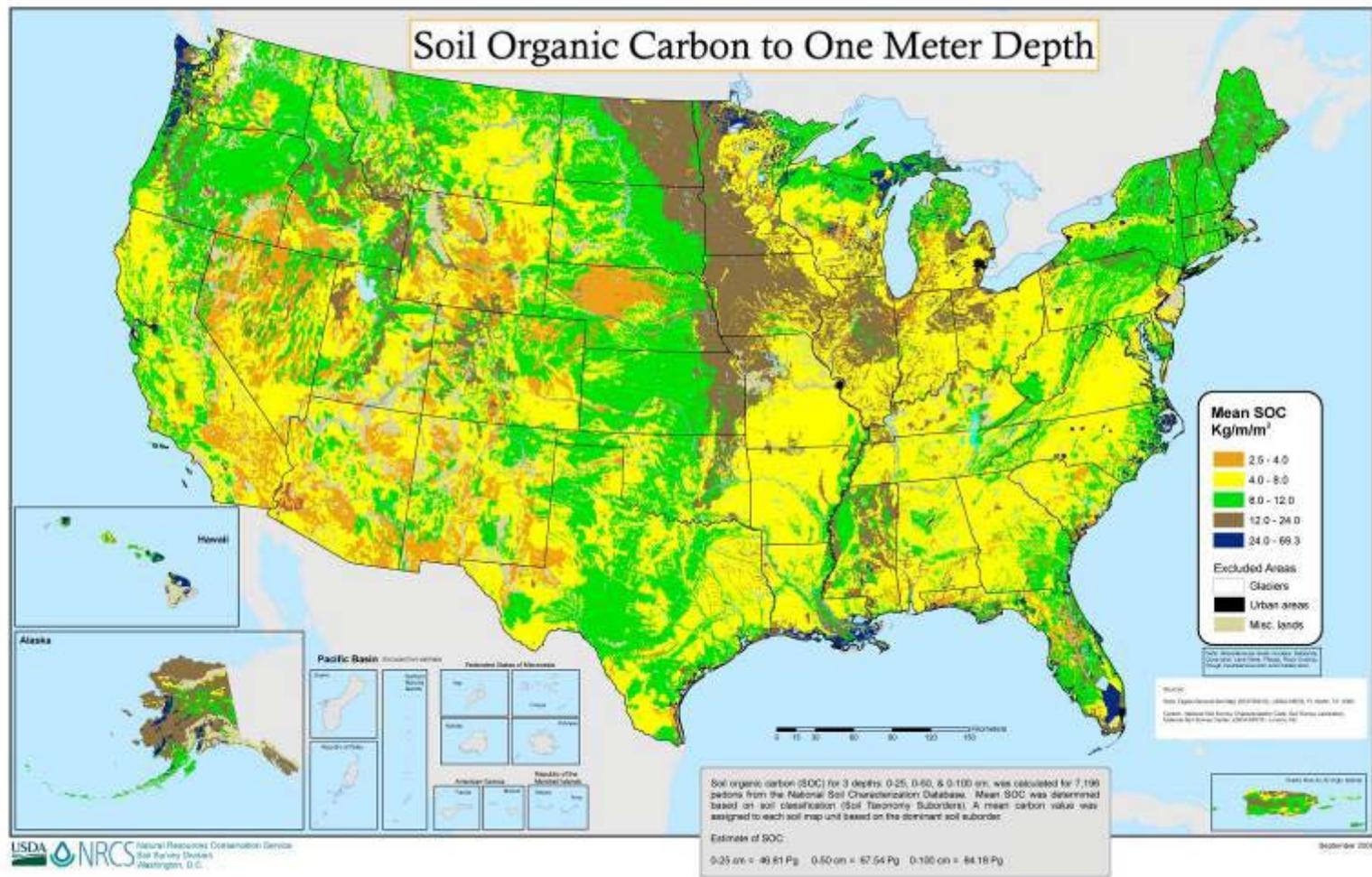
National Soil Carbon Inventory Developed from SSURGO

Short-term Product

The background of the slide features a light-colored, stylized topographic map with contour lines. In the lower-left corner, there is a semi-circular compass rose with a central needle pointing towards the top-left. The compass rose is marked with cardinal and ordinal directions: N (North), NE (Northeast), E (East), SE (Southeast), S (South), SW (Southwest), W (West), and NW (Northwest). The needle is positioned between the N and NE markers.

STATSGO SOC Estimates

1:250,000 scale; published in 2001



SSURGO Estimates

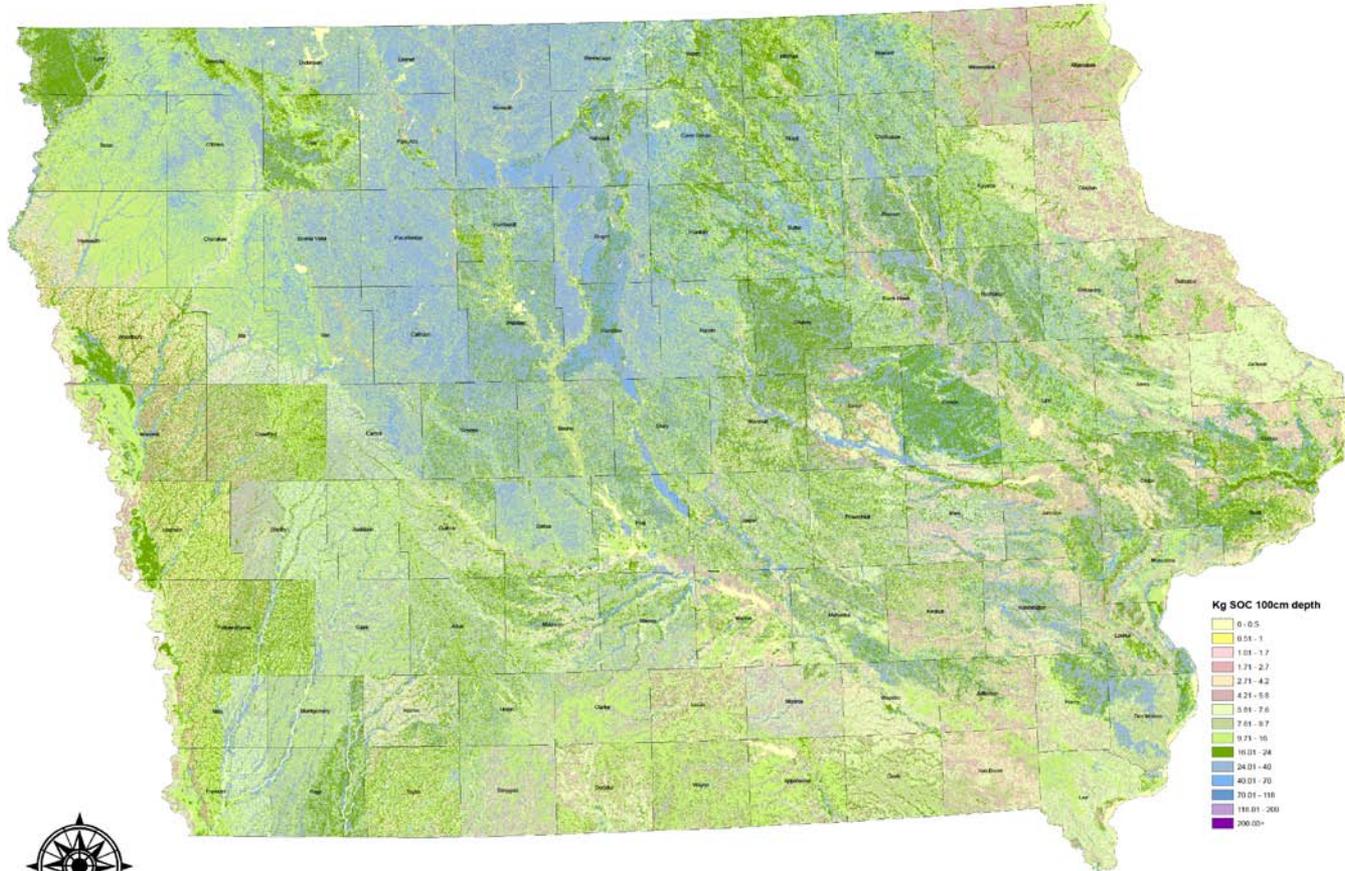
- ▶ Gridded SSURGO
- ▶ Soil C to 1 m (various depths?)
 - ▶ Organic
 - ▶ Inorganic (CaCO₃)
- ▶ Adjustment to C concentration and bulk density based on land cover
 - ▶ USGS NLCD
 - ▶ SSURGO RV for "dominant" land use for map unit
 - ▶ Dominant cropland; pasture = high OM
 - ▶ Dominant forest; cropland = low OM
- ▶ State Soil Scientist and cooperator review

SSURGO SC Estimates to 1 m

Detailed Soil Survey Atlas

Iowa

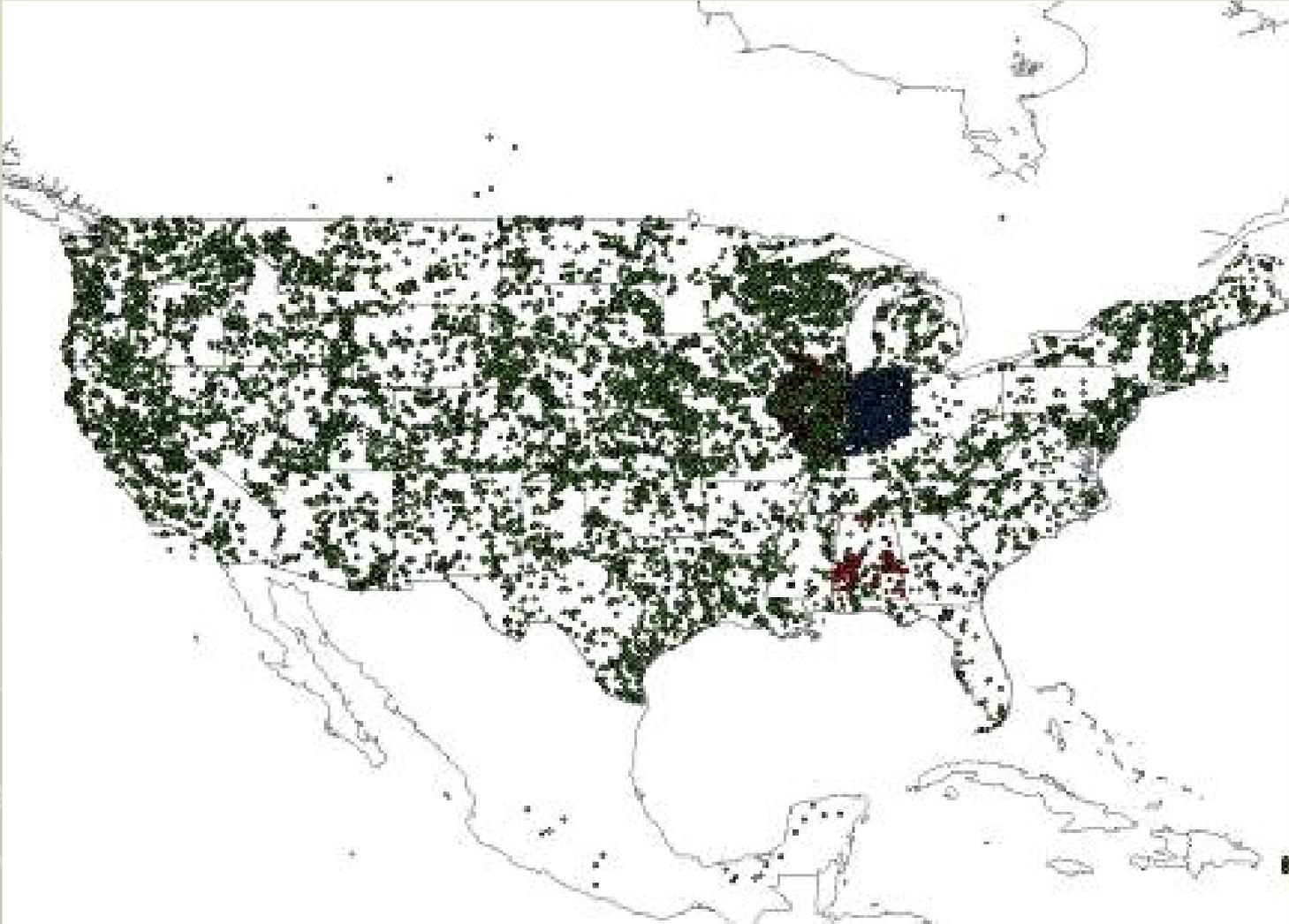
NGDC Staff Soil Organic Carbon Calculation - DRAFT 08312008



Validation

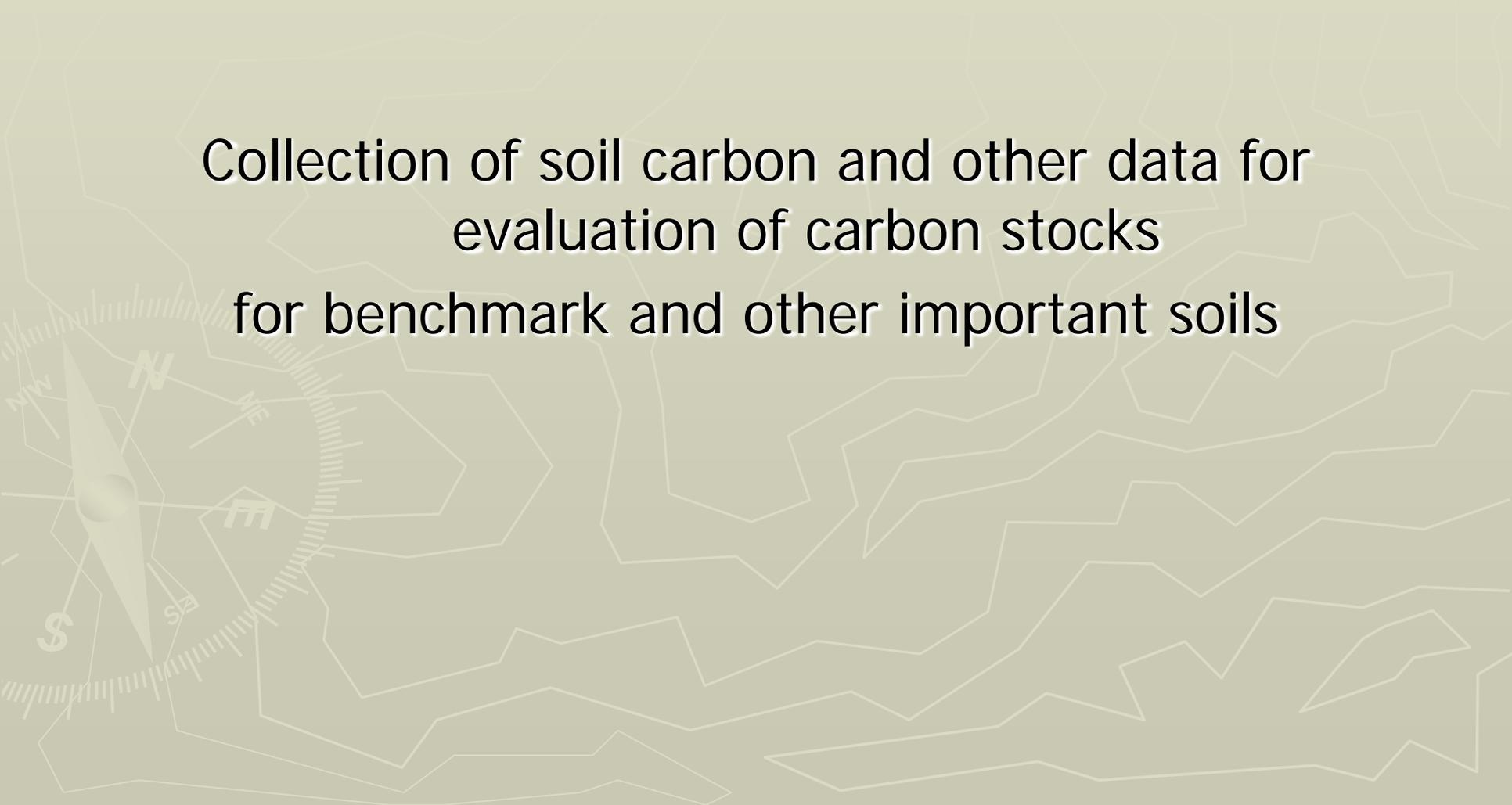
- ▶ NCSS pedon data
 - 27,000+ pedons with measured soil carbon and other data for carbon stock calculations
 - Additional data being incorporated from university laboratories
 - Stratified by land cover to enhance accuracy for validation
- ▶ Overlay appropriate pedons on SSURGO map units to compare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

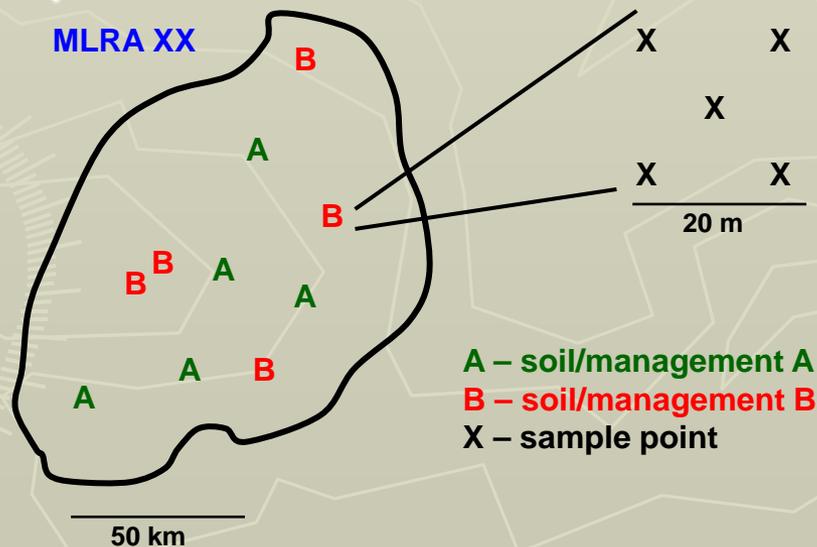


Nationwide Effort

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

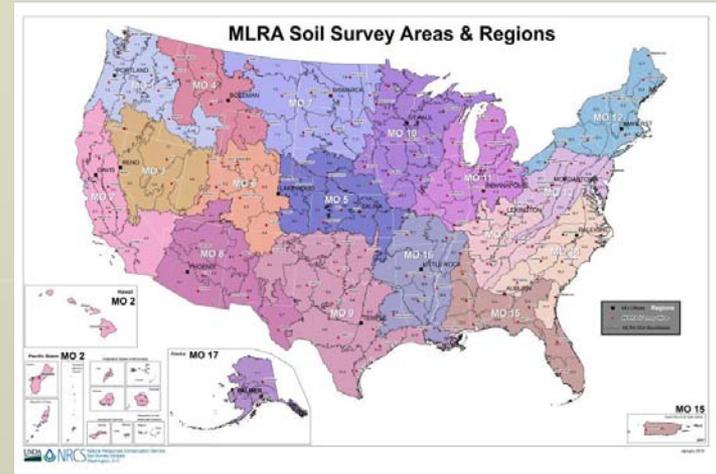
Replication for Statistical Confidence

- ▶ 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

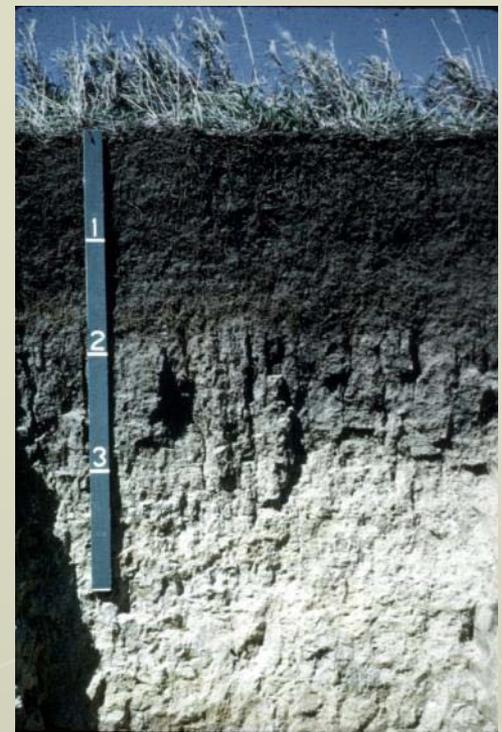
- ▶ 7,000 sites across U.S.
- ▶ 35,000 sample points
- ▶ 1,440 soil-ecosystem combinations
- ▶ **Goal: Minimal number of soil-ecosystem combinations to represent range of conditions**
- ▶ 2 year project

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?

