Rapid Assessment of U.S. Soil Carbon for Climate Change and Conservation Planning

Summary of Protocol

The objectives of this project are (1) to evaluate differences in soil carbon associated with differing soil properties, agricultural management systems, ecosystems, and land uses and apply these differences to improving existing decision support tools, and (2) to develop a scientifically based and statistically valid baseline inventory of soil carbon stocks for the United States.

Products:

1. A preliminary short-term estimate of U.S. carbon stocks based on existing SSURGO data. This estimate will be enhanced and validated by incorporating appropriate land cover data, measured pedon data, and model simulations.
2. An inventory of amounts and distribution of U.S. carbon stocks stratified by soil and state of ecological site, agricultural management system, and land use with known levels of statistical confidence in the data.
3. A publically accessible soil carbon database that can be used for model validation and development.

The project will be accomplished in two phases:

(1) A national soil carbon map will be developed using detailed soil spatial and attribute data (SSURGO) and validation against existing National Cooperative Soil Survey data. This initial step is expected to be complete by June 2010.

An enhancement of the soil carbon map that includes overlay of broad land cover groupings. Soil carbon stocks for map units derived from this map will be compared to results from decision support tools developed from simulation modeling. For map unit-land use combinations with large deviations from modeled results, alternative attribute data will be incorporated in the soil carbon polygon map to better reflect land cover effects on soil carbon. This step is expected to be complete by September 2010.

(2) Soil carbon and related data will be collected for benchmark and other important soils after stratification by steady-State agricultural management, ecological state, and land use conditions. These data can also be used to aid decisions on land use and management by conservation planners, land managers, and policymakers and to compare results from decision support tools developed from simulation modeling efforts.

Step 1 of this phase will focus efforts on measurements of soil carbon stocks (organic and inorganic) for the dominant agricultural management system, ecological state, or land use for all occurring in soil groups with similar properties to benchmark and other important soils. This focus will maximize statistical confidence for the dominant land use. Other ecosystems will also be evaluated but will have fewer replicates and a correspondingly lower confidence. The dominant ecosystem will be emphasized to allow evaluation and modification, as

needed, of representative values in the SSURGO database. Step 1 is expected to be complete by June 2011.

In Step 2, the remaining replicates to achieve the desired level of confidence in the data will be evaluated for all soil-ecosystem combinations. Step 2 and phase 2 are expected to be complete by June 2012.

Phase 1

A national inventory of soil carbon stocks will be developed from SSURGO spatial and attribute data. The basic technique and calculations for this inventory have been developed and applied to small regions. The SSURGO soil carbon data will be validated against soil carbon stocks calculated from point data in the NSSC database with known land use. Incorporation of land cover maps; literature values for land cover effects on soil carbon stocks; model simulations; and low, high, and representative values in the SSURGO database will be used, as appropriate, to refine soil carbon stock estimates based on land cover. The goal is 80 percent confidence in the soil carbon estimates for land resource regions.

Phase 2

The protocol used for field evaluation of soil carbon and related properties is based on the concept of substituting space for time, is intended to encompass all lands in the United States, and will include all ecosystems, including minor ecosystems, such as wetlands and floodplains.

Methods:

The basis for soil evaluations will be the approximately 1,400 benchmark soils. Soils with properties expected to result in similar amounts of soil carbon as benchmark soils will be consolidated into groups within MLRAs. The number of soil groupings per MLRA is expected to vary across the country, but the goal of the grouping is to enhance data collection efficiency by minimizing the number of groups while adequately representing the range of soil conditions expected to influence soil carbon stocks.

Data collection will focus on management systems; land uses; or States of ecological sites that are most common, most degraded, and those considered to be optimal and expected to have the highest soil carbon stocks within the soil grouping. The land uses and agricultural management groups to be evaluated will be based on estimated acreages from NRI points within the soil group. A tool will be developed to objectively evaluate cropland management systems to and consolidate systems into groups with similar effects on soil carbon. This inventory is intended to provide information on the potential impact of management and ecosystem state changes on soil carbon but will provide no indications of the rate of the change.

To the extent possible, NRI points and other sites with reliable documentation of land use and management history such as ARS GraceNet sites and university research plots will be used to provide the management history needed to effectively evaluate management effects on soil carbon. Wetland ecosystems associated with the U.S. EPA National Wetland Condition Assessment will also used for this inventory.

Estimates of variability in soil carbon stocks derived from existing Soil Survey Laboratory (SSL) data suggest that about 36,000 sample points will need to be evaluated nationwide to achieve desired statistical confidence. At each sample point, the soil and landscape characteristics present will be briefly described and soil carbon, bulk density, soil water content, and rock fragment content will be evaluated for each horizon to 1 m in the field or SSO laboratory. Data collected will be stored and analyzed at SSL.

The greatest efficiency for the data collection will be designation of one soil scientist in each MLRA region to have overall responsibility for data collection. In addition, a soil scientist from each MLRA SSO will be needed to assist with data collection for sites within the MLRA SSO area (5-6 weeks for the evaluation). Assistance from field office staff to secure permission to access sites and to help document agricultural management is needed to expedite the program. A rapid assessment project coordinator will be the primary point of contact at the NSSC. Data collection should be completed within 2 years.