NEW TECHNOLOGIES COMMITTEE REPORT

2012 Southern Regional Cooperative
Soil Survey Conference

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- **Digitizing Pens**
  - Current Status
    - The NRCS now has these now
  - Needs
    - Applications and instructions for previously identified uses
      - National standardized forms that will work with these pens
      - Mapping in the field (soil mapping, wetland delineation, etc.).
    - Generate new applications in the office or field
- **Visible NIR**
  - Status
    - portable NIR Units that the NRCS has already invested in
  - Potential
    - Great Potential but needs more research.
    - could be used to predict carbon content and other soil properties
  - Limitations
    - Need to calibrate.
  - Research Needs
    - Work w/ land grants to evaluate these techniques to predict soil properties under varying moisture conditions that are observed in the field.
    - Work is underway at various universities
- **X-ray fluorescence**
  - Description
    - This technology can assess a wide range of elements (e.g., Ca, K, Ph, Fe) fairly accurately but not perfectly. Reliability is directly related to atomic size.
  - Potential Applications
    - Possibly can be used to differentiate between parent materials (as demonstrated during the field trip by David Weindorf)
    - Could be used for urban soil projects that are study trace elements (e.g., lead)
  - Concerns
    - The sampling area is very small and microscopic variability in soil could impact readings (i.e., sample support is very small). This can be offset by multiple measurements
    - Soil moisture, concentration of chlorides, and surface roughness impact fluorescence.
  - Needs
    - Develop NRCS Protocol in laboratory and field
      - number of replicate measures required for a given area of measurement

- length of time required for measurement
- calibration methods
- provide information about accuracy and reliability

Provide example applications (case studies) for soil survey

Document human hazards

- **LiDAR**
  - <u>Need</u>

    Universal agreement that LiDAR is critical.
  - <u>Applications</u>

    Can be used in combination with geostatistical techniques to aid and improve in the delineation of wetland soils (Rex Ellis, see below)

    flooding, engineering, field offices for planning
  - <u>Data Management Issues</u>

    <u>Flexible Product is needed</u>
    - Determine which scales are best for needs of different end users (engineers, soil survey staff, others)
    - Needs to be archived at multiple scales in way that is easy to find access at a national scale in a warehouse.

    <u>Sharing</u>
    - Facilitate sharing between local, state, regional, national private and governmental organizations (e.g., website clearinghouse with data or links to data). NRCS could lead on this nationally. This could pay for itself by reducing replication of effort.
- **Gamma ray measured passively in flight**
  - <u>Potentially Useful</u>

    Potential useful for aiding the mapping of soil texture, depth to carbonates, and parent materials based on reports from Christine Morgan. There has been work on this in Australia where they have used this technology for enhancing their soil survey efforts.
  - <u>Relatively minimal cost</u>

    Can be made while flying LiDAR (It is an additional filter that must be added).
  - <u>Potential Limitations</u>

    Can predict things like total phosphorus and potassium but of greater interest is the fraction of these elements that are plant available.

    Only gives a shallow representation (only 30 cm)
  - <u>Needs</u>

    Work with researchers to
    - evaluate the utility of this technology on US soils.
    - evaluate the use of this technology with suite of sensors (e.g., LiDAR, EMI, resistivity).
- **GPR (Ground Penetrating Radar)**
  - <u>Status</u>

    The NRCS currently owns several systems and has staff with expertise.
  - <u>Potential Utility</u>

Could relate to soil depth, potentially moisture content, horizons, and depth to shallow ground water
Anthropogenic soils and disturbances

- Concerns
  - Greatly impacted by clay content, salinity, iron, and moisture which causes horizontal ringing and attenuation making data difficult to interpret.
  - Expensive post analysis.

- **Mobile Data Devices**
  - Needs
    - Ability for NRCS to add information.
    - Develop cloud based computing solutions
    - Provide pre-processed map analyses (e.g., interpolations)
    - Maps on demand (spatial queries)
    - work on inexpensive mobile devices (iPAD, droids, smart phones)
    - View soils data with other useful information (e.g., LiDAR derived terrain attributes).
    - Ability to rapidly share and interoperability.

- **Modeling Approaches**
  - General Need
    - Indices
      - integrate multiple spatial datasets at different spatial and temporal resolutions (e.g., level 2 soil survey boundaries, soil profile assessments, terrain attributes derived from lidar, national carbon dataset)
      - useful for various interpretations, management, and land use decisions.
      - Potential Tools
        - Multi-colocated factorial cokriging,
        - neural networks,
        - regression tree
    - Accuracy and uncertainty
      - Need to develop approaches to assess soil map accuracy (map error) uncertainty (precision of estimation)
  - Archive knowledge critical for modeling
    - modeling decisions should depend on how the soil surveys were created.
    - there is a limited time window in which we can interview NRCS soil scientists before they retire.
  - Additional sampling based on models of spatial dependence
    - For projects focusing on better defining delineations
      - Locate points where samples should be collected in areas where there is high uncertainty based either on 1) prediction variance maps (e.g., kriging variance), 2) on placing samples in locations where variability of auxiliary data (e.g., soil EC) is large.
    - To better define current delineations
      - Another approach is to centers of current delineation and better define the soil taxonomic classes.

- **Gridded SSURGO data**
  - Status
    - Currently the NRCS has released 10-m grids (in house use primarily) and can link to interpreations
      - much faster than vector data
      - only modest roughness at polygon borders (10 m is not a bad choice)
  - Utility
    - very fast and handy
    - allows pulling out component data within a map unit.
    - works well with terrain data
    - can be integrated well with simulation models
  - Needs
    - Determine whether 10-m is optimal scale
    - Make more widely available.
    - develop a plan to deal to update when there are modifications to the soil survey.
    - develop appropriate disclaimers for the data associated with the pixel size.
    - consider creating DEMs on the exact same grid for in-house NRCS use and cooperators.

Recommmendation

South Region requests Soil Business leadership to give recommendations on computer field equipment to be compatible with future CDSI and field operations.

Detailed Reports

- Ellis (UF) is exploring non-TIN processing of county-wide bare-earth LiDAR data sets to produce smoother visualization of landscapes. Traditional conversion of LiDAR returns to raster DEMs utilizes TIN-based processing to spatially interpolate between returns. This processing is used in automatic LiDAR-DEM scripts likely because of the computational efficiency of TINs. Geostatistics is widely accepted as a spatial interpolation technique for environmental data. Ellis' work focused on geostatisitcally modeled LiDAR bare-earth returns to create DEMs for wetland delineation. Visualization of the surrounding landscape, however, was reported to be improved in the smoother geostatistical models when compared to the TIN-based models. While the scale of investigation was much finer than what is currently needed for soil survey, this approach warrantsattention. It is likely that the geostatistical processing has an application dependent on LiDAR return density and map scale.