Arc Soil Inference Engine (ArcSIE) and Digital Soil Mapping in MLRA SSA 12-5:

A SSURGO Success Story

Asheville, NC

5/26/2011
ArcSIE is a proven tool, designed for *field soil scientists* to implement knowledge-based raster soil mapping.
Raster Soil Mapping

DEM

Cabot soil
Knowledge Represented as a Rule

Elevation 200–600m is typical for soil A.

As elevation deviates from this range, the soil’s similarity to type A gradually decreases.
Raster Values must be Logically Integrated to Create... 

.....the SSURGO Product
Real advancement of SIE began in 2004 in Essex County, VT

- Dr. Xun Shi, Dartmouth College
- National Geospatial Development Center* staff
- VT-NRCS Project Soil Survey Office staff

- 2007, the first version of ArcSIE, an ArcMap extension, was released and CCE certified.

* Now Geospatial Research Unit
ArcSIE in the Context of Digital Soil Mapping in Essex County, VT

- First initial soil survey in the US completed to SSURGO standards using entirely digital techniques, and (mostly) raster results from automated mapping software
MLRA Soil Survey Region 12 (Glaciated Northeast)
Typical Landscape and Land Use
Basic Steps

- Process Environmental Data
- Delineate Landforms and Soil Parent Materials
- Perform Soil Inference in Suitable Areas
- Use other DSM Techniques as Appropriate
- Construct Polygon Map (SSURGO)
Hillshade from 1 meter LiDAR DEM - Used for Visualization and Manual Delineation of Parent Materials/Landforms

Approximately 5 km horizontal
Parent Material/Landform Maps Provide the Basis for all Subsequent Soil Mapping
These Delineations are Thoroughly Critiqued and Field Checked
Basal Till Soils are Modeled with ArcSIE
Bedrock Controlled Landforms – Manual Delineations, Automated Map Unit Phases
Outwash, Alluvial, and Lacustrine Soils are Mapped Using More Traditional Methods

...and organic soils are digitized on-screen.
ArcSIE Predictive Model Demo Area, Basal Till Catena
(approximately 4 km by 3 km)
We define the typical soil formative environment in the model, and the resulting fuzzy membership values represent the similarity of the soil at each pixel location to a particular soil series.
Wetness Index Rule for the Majority of Poorly Drained Cabot Soils
ArcSIE Fuzzy Results for Cabot Soil
Hardening (Defuzzification)

Fuzzy Results Maps

- Cabot
- Colonel
- Dixfield

Hardened Map
SIE Results are Validated in the Field
Integrate Slope Phases with Hardened Results

[Image of Raster Calculator]

[Hardened Results]
[Image of Hardened Results]

[Slope Phases]
[Image of Slope Phases]
Hardened Results by Slope Phase
Combine Some Results to Form Logical Map Units

The image shows a Raster Calculator window with various layers and an expression being constructed. The expression is `con([hardph] == 22,12)`.
Review of ArcSIIE Process Steps

Inference by Soil Series

Integrate Slope Phases

Harden Results

Create Logical Map Units
Create Minimum-size Delineations Using the “Remove Slivers” Tool

In Essex County, VT, 5 acres.
Raster Results are Further Processed and then Vectorized
Map Unit Composition is Determined Through Field Investigations
Typical Applicability of Automated Digital Soil Mapping Processes
**Positives-**

- Mapping production increased by approximately 100%
- Maps are of consistently better quality

**Negatives-**

- Requires well trained and equipped staff
- Dependent on LiDAR elevation data (for order 2 surveys in the glaciated NE)
We can now preserve and communicate most of the knowledge and data about the survey area.
Future Direction......

DSMII “Processes with ArcSIE” FY2011 Pilot

Continued technical support and formal training
_delivery of raster products to enhance SSURGO
Automated Soil Survey Update Utilizing Arc Soil Inference Engine (ArcSIE), May 3, 2011

Objective: To test a knowledge-based digital process for soil survey map updating. The process is supported by “Knowledge Discoverer”, a new component of ArcSIE.

Development of tools for map updating
Knowledge Discoverer Interface

Discover, verify, and revise the soil-landscape model implicit in the existing soil map. Then apply the revised model to create updated polygons.
Want to Know More?

Soil Inference Engine (SIE) Progress Report
USDA- Natural Resources Conservation Service
Geography Department, Dartmouth College
March, 2009


ArcSIE User’s Guide, and Vermont Digital Soil Mapping Cookbook

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