SOIL CONSIDERATIONS ACROSS THE LANDSCAPE

Hector Causarano
Soil Considerations Across the Landscape

Hector Causarano
Schematic diagram of the pattern of water flow on a terrain surface

Pennock, 2003
Digital Terrain Models

- Elevation
- Slope
- Aspect
- Profile Curvature

Elevation (m): 67.8 - 68.3, 68.3 - 68.9, 68.9 - 69.4, 69.4 - 70, 70 - 70.6, No Data
Pearson correlation coefficients between Terrain Attributes and Soil Organic Carbon

<table>
<thead>
<tr>
<th>Location</th>
<th>Elevation</th>
<th>Slope</th>
<th>Aspect</th>
<th>Wetness Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duran, MI</td>
<td>-0.72</td>
<td>-0.40</td>
<td>0.17</td>
<td>no data</td>
</tr>
<tr>
<td>Sterling, CO</td>
<td>no data</td>
<td>-0.45</td>
<td>-0.13</td>
<td>0.57</td>
</tr>
<tr>
<td>Syracuse, NY</td>
<td>0.08</td>
<td>-0.11</td>
<td>-0.22</td>
<td>no data</td>
</tr>
<tr>
<td>Shorter, AL</td>
<td>-0.17</td>
<td>-0.41</td>
<td>no signif</td>
<td>0.48</td>
</tr>
</tbody>
</table>

1 Mueller and Pierce (2003); 2 Moore et al. (1993); 3 Johnson et al. (2000); 4 Terra et al. (2004)
Derivation of wetness index from the DEM

Venteris et al. (unpublished)
Model for soil carbon based on wetness index

Legend
Carbon%
Organic_C
- -0.02 - 1.24
- 1.25 - 1.95
- 1.96 - 2.73
- 2.74 - 3.60
- 3.61 - 5.26

Wetness Index
High : 19.0
Low : 4.2

Venteris et al. (unpublished)
Soil Electrical Conductivity for mapping soil properties

Electrical resistivity

Electromagnetic induction

Terra et al. (2004)
Innovative Soil Survey

Multivariate Landscape Zones

DEM  terrain attributes  EC survey

zones  slope  Landscape zones

multivariate clustering

White et al. (in review)
### Correlation between EC and soil properties sampled at 0-30 cm depths

#### 1) Soil attribute vs. EC\_shallow

<table>
<thead>
<tr>
<th>Soil attribute</th>
<th>EC_shallow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vol. Water Content</td>
<td>0.22 ~ 0.87</td>
</tr>
<tr>
<td>Sand</td>
<td>-0.04 ~ 0.88</td>
</tr>
<tr>
<td>Clay</td>
<td>0.37 ~ 0.86</td>
</tr>
<tr>
<td>CEC</td>
<td>0.24 ~ 0.86</td>
</tr>
<tr>
<td>K</td>
<td>-0.05 ~ 0.24</td>
</tr>
<tr>
<td>Ca</td>
<td>0.44 ~ 0.78</td>
</tr>
<tr>
<td>Mg</td>
<td>0.28 ~ 0.93</td>
</tr>
</tbody>
</table>

#### 2) Total Carbon vs. Total Nitrogen

<table>
<thead>
<tr>
<th>Soil attribute</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Carbon</td>
<td>-0.36 ~ -0.42</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>-0.36 ~ -0.38</td>
</tr>
</tbody>
</table>

#### 3) Additional correlations

<table>
<thead>
<tr>
<th>Soil attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay</td>
<td>0.43</td>
</tr>
<tr>
<td>Total Carbon</td>
<td>-0.31</td>
</tr>
</tbody>
</table>

Adapted from: 1) Mueller et al. (2003); 2) Johnson et al. (2003), and Terra et al. (2004)
Field-Scale Mapping of Surface Soil Organic Carbon Using Remotely Sensed Imagery

Chen et al. (2000)

Color image

Fitted curves between soil organic C and image-intensity values.

Predicted soil organic C
Overlay of soil organic C, terrain attributes, remote sensing and electrical conductivity data

Causarano et al. (unpublished)
Soil organic C maps, Gold Hill

Kriging

Multiple linear regression with factor scores

Artificial neural networks

Prediction efficiency = 38.1%

Prediction efficiency = 40.9%

Prediction efficiency = 61.7%
Summary and Conclusions

- Soil properties are related to landscape forms and position.
- Terrain attributes, field-scale electrical conductivity and remote sensing can explain variability in soil properties.
- Factor analysis and multiple linear regression help to determine the most significant variables impacting a soil property at the field-scale.
- Cluster delineation is appealing because it objectively delineate homogeneous areas in the field.