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Agricultural Outlook Forum
U.S. Department of Agriculture

Presented: March 1-2, 2007

SOIL CONSIDERATIONS ACROSS THE LANDSCAPE

Hector Causarano

An aerial photograph showing a landscape with agricultural fields, a road, and a pond. The fields are divided into sections by a road and a canal. The soil colors vary, indicating different soil types or treatments. The text "Soil Considerations Across the Landscape" is overlaid in yellow.

Soil Considerations Across the Landscape

Hector Causarano



Terra et al., 2003 and 2004

Soil Survey

Order 2 (SSurgo)



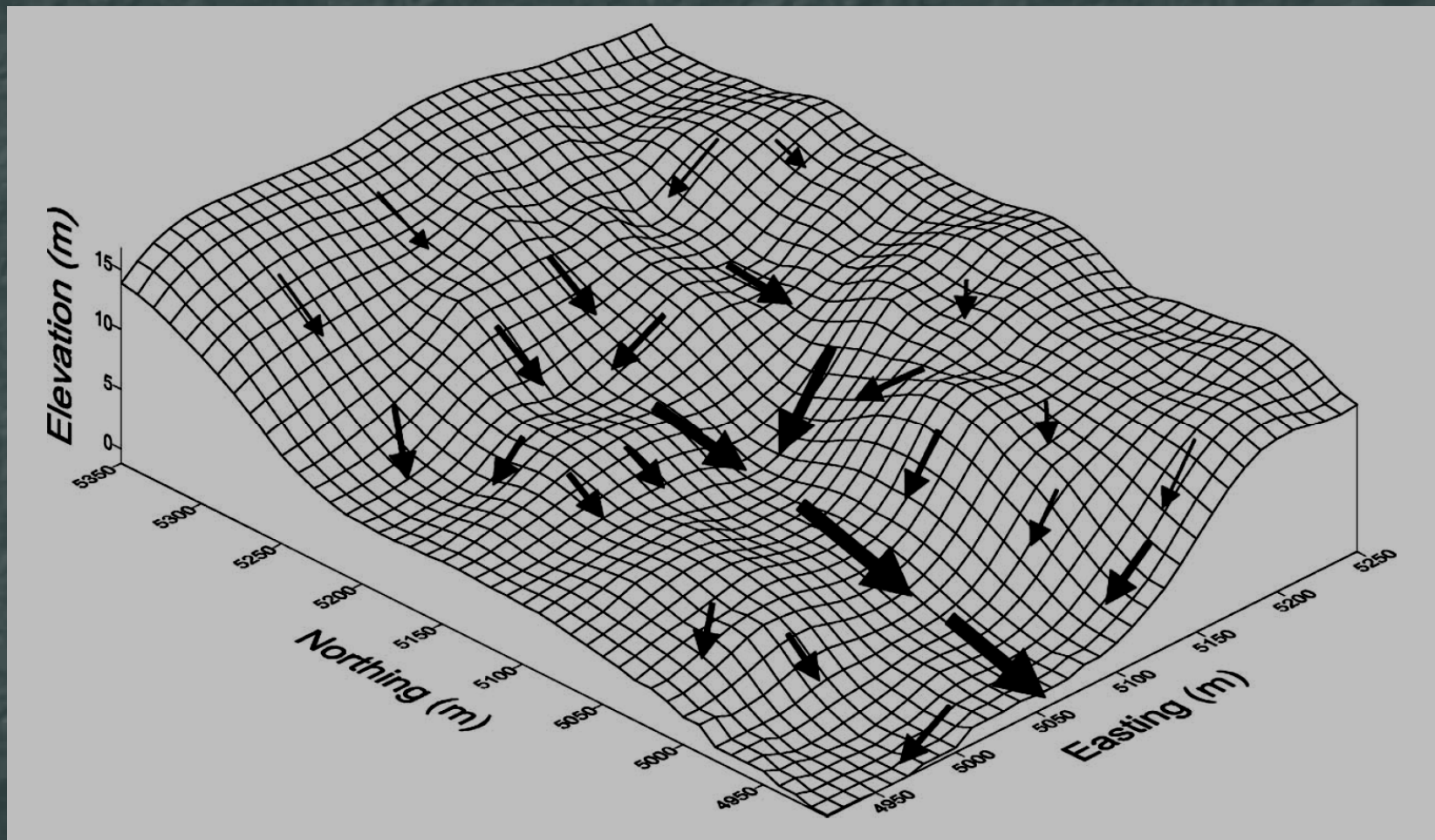
Scale 1:24,000

Order 1

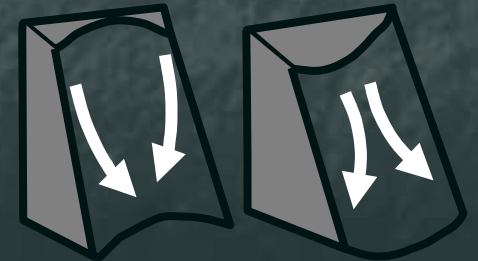
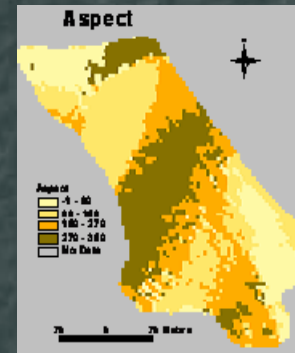
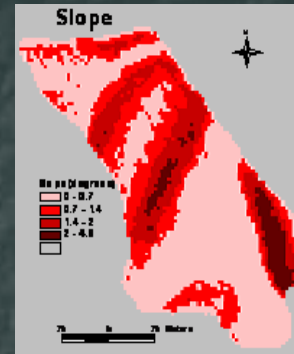
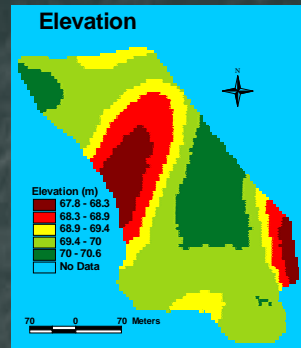


Scale 1:5,000

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



Digital Terrain Models

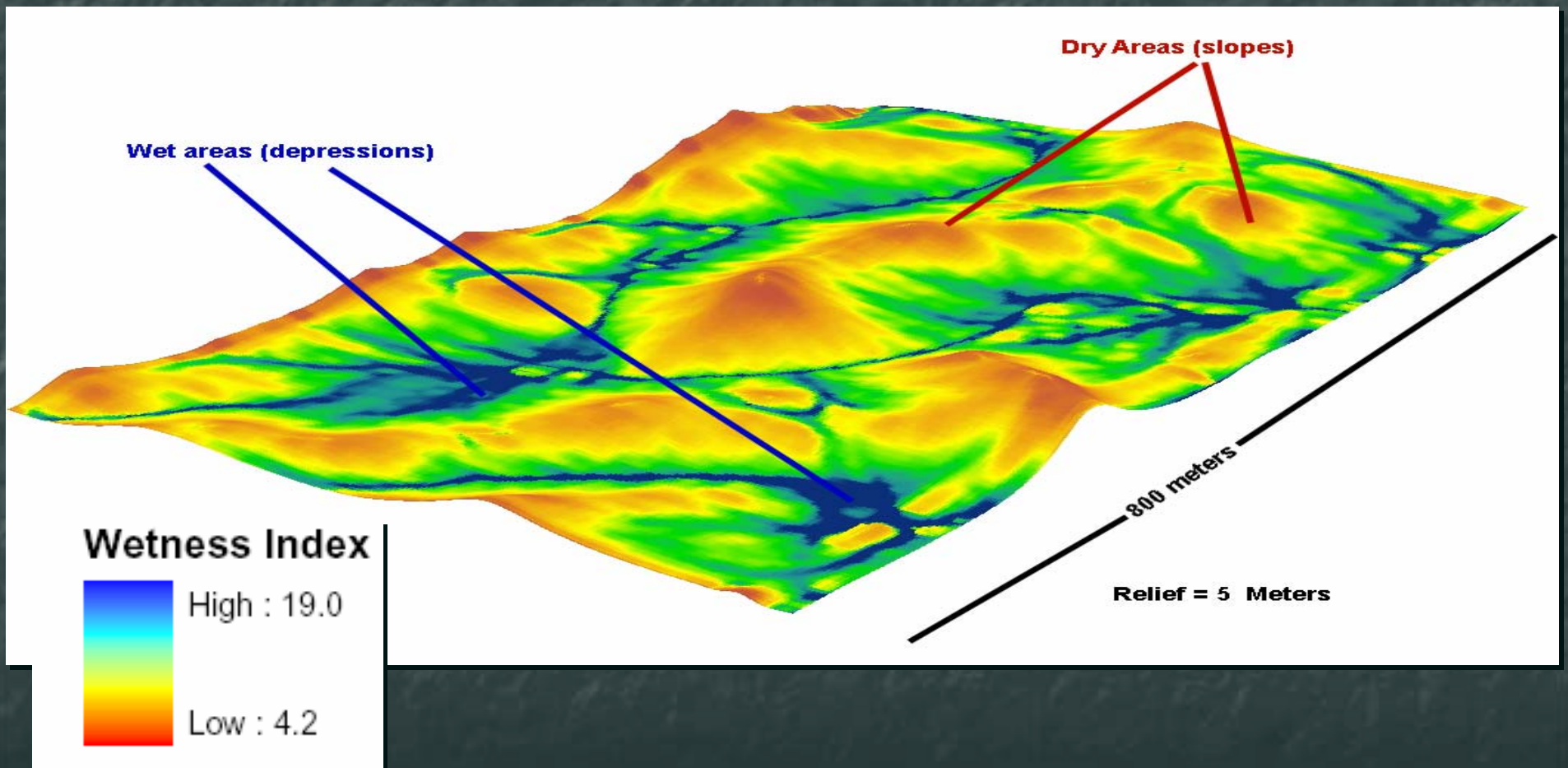


Pearson correlation coefficients between Terrain Attributes and Soil Organic Carbon

| Location | Elevation | Slope | Aspect | Wetness Index |
|---------------------------|-----------|-------|-------------|---------------|
| Duran, MI ¹ | -0.72 | -0.40 | 0.17 | no data |
| Sterling, CO ² | no data | -0.45 | -0.13 | 0.57 |
| Syracuse, NY ³ | 0.08 | -0.11 | -0.22 | no data |
| Shorter, AL ⁴ | -0.17 | -0.41 | no signific | 0.48 |

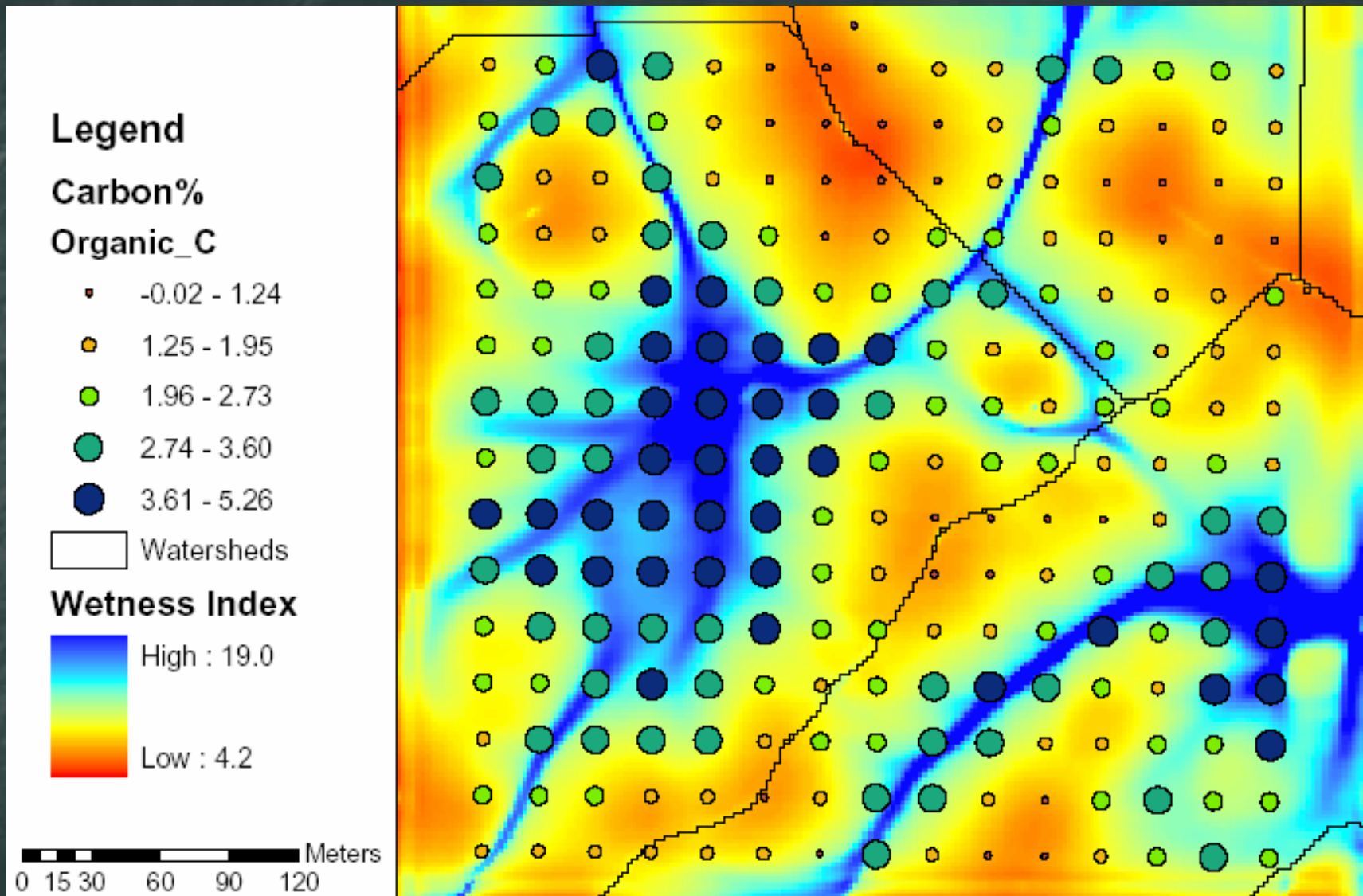
¹ Mueller and Pierce (2003); ² Moore et al. (1993); ³ Johnson et al. (2000); ⁴ Terra et al. (2004)

Derivation of wetness index from the DEM



Venteris et al. (unpublished)

Model for soil carbon based on wetness index



Venteris et al. (unpublished)

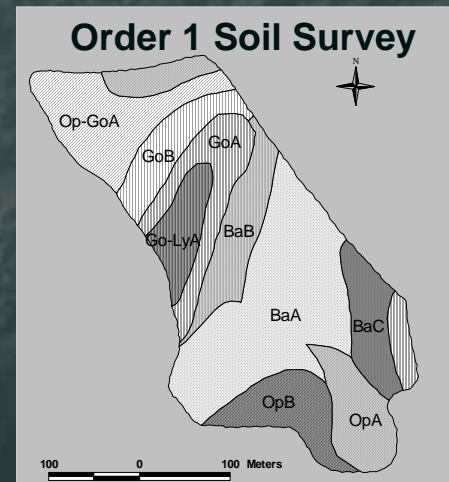
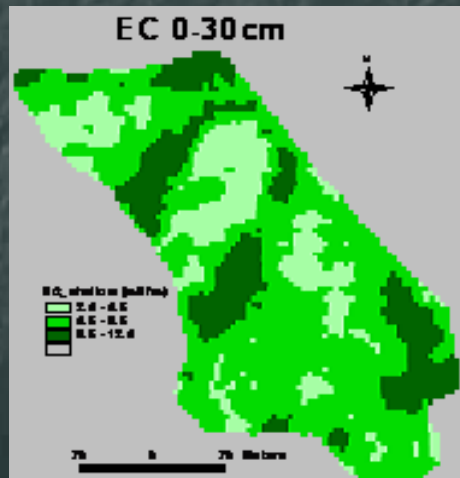
Soil Electrical Conductivity for mapping soil properties



Electrical resistivity



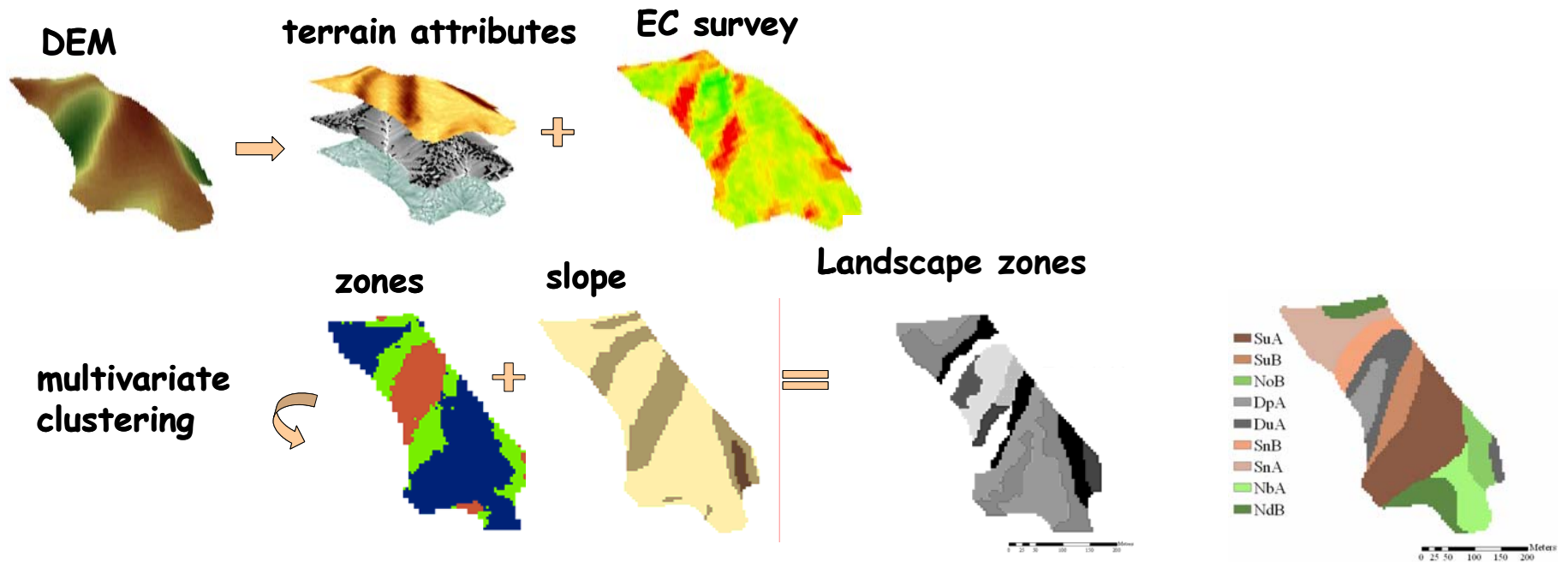
Electromagnetic induction



Terra et al. (2004)

Innovative Soil Survey

Multivariate Landscape Zones



Correlation between EC and soil properties sampled at 0-30 cm depths

1)

| Soil attribute | EC _{shallow} |
|--------------------|-----------------------|
| Vol. Water Content | 0.22 ~ 0.87 |
| Sand | -0.04 ~ 0.88 |
| Clay | 0.37 ~ 0.86 |
| CEC | 0.24 ~ 0.86 |
| K | -0.05 ~ 0.24 |
| Ca | 0.44 ~ 0.78 |
| Mg | 0.28 ~ 0.93 |

2)

| | |
|----------------|---------------|
| Total Carbon | -0.36 ~ -0.42 |
| Total Nitrogen | -0.36 ~ -0.38 |

3)

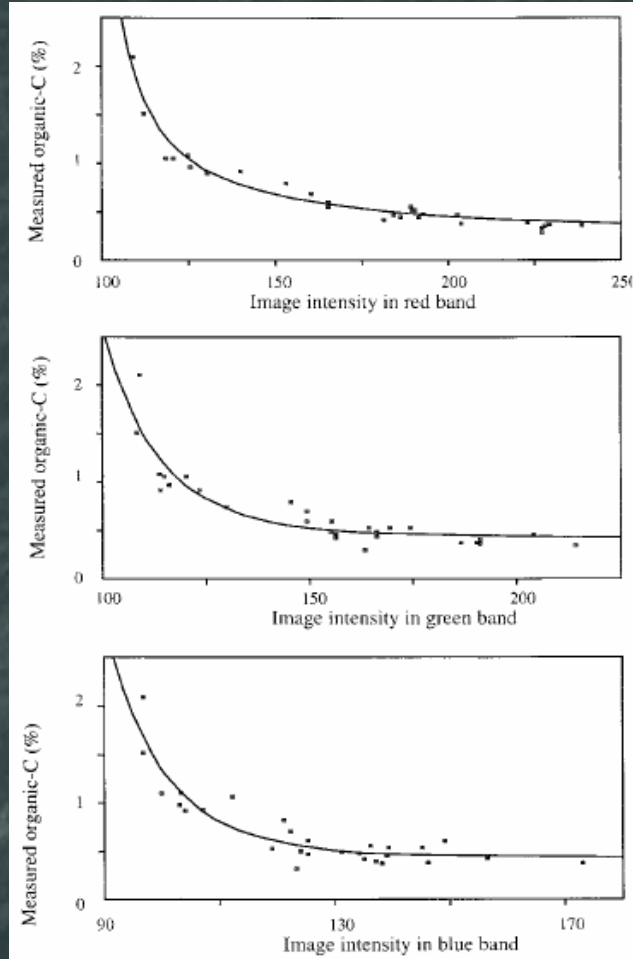
| | |
|--------------|-------|
| Clay | 0.43 |
| Total Carbon | -0.31 |

Adapted from: 1) Mueller et al. (2003); 2) Johnson et al. (2003), and Terra et al. (2004)

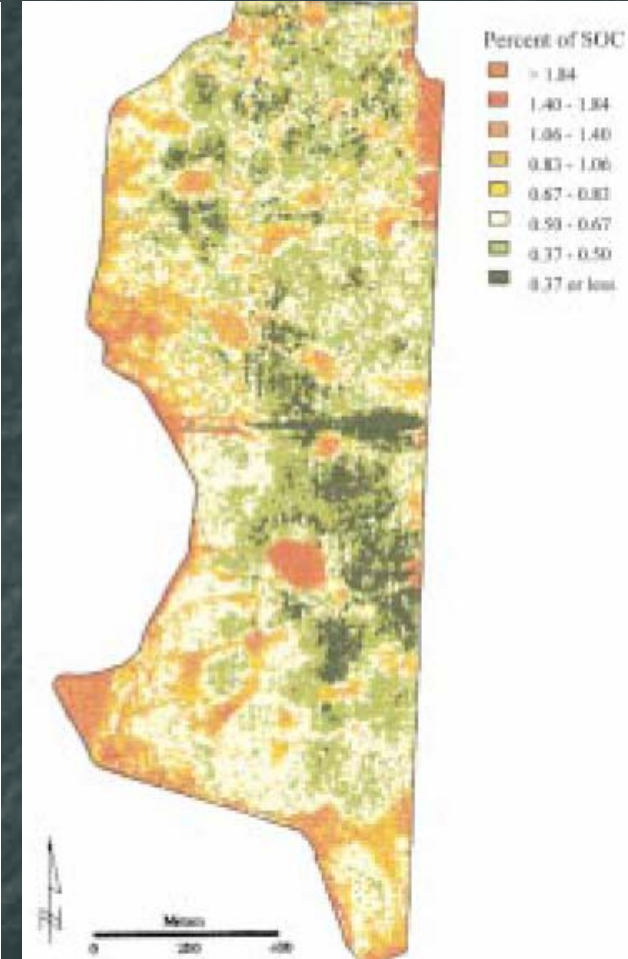
Field-Scale Mapping of Surface Soil Organic Carbon Using Remotely Sensed Imagery



Color image

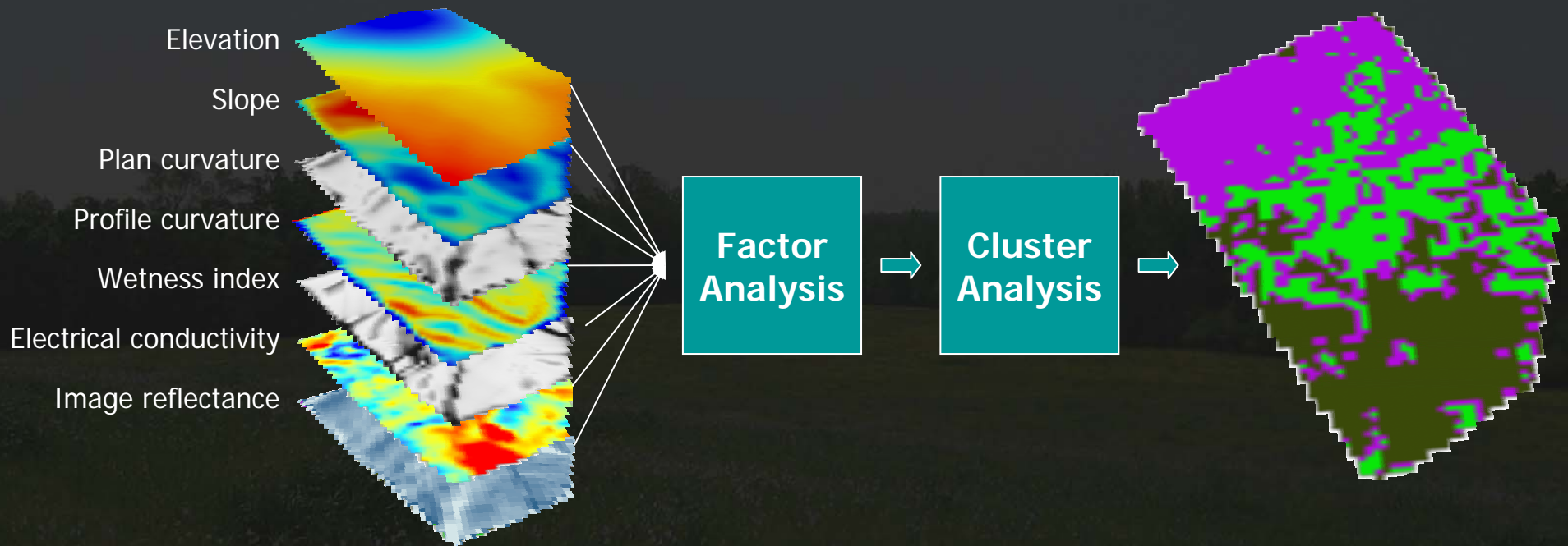


Fitted curves between soil organic C and image-intensity values.



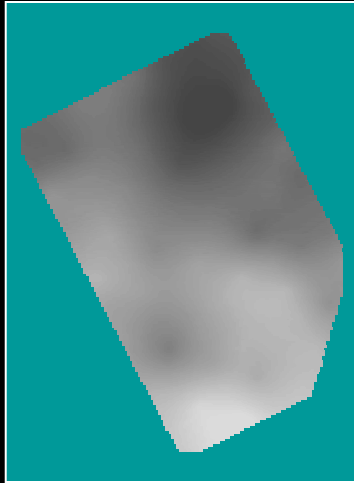
Predicted soil organic C

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

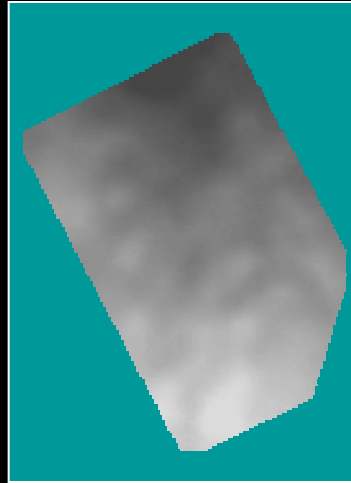


Soil organic C maps, Gold Hill

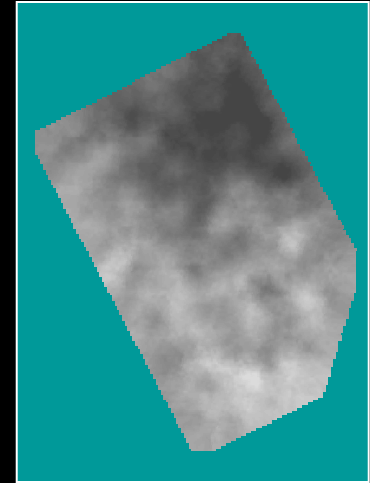
Kriging



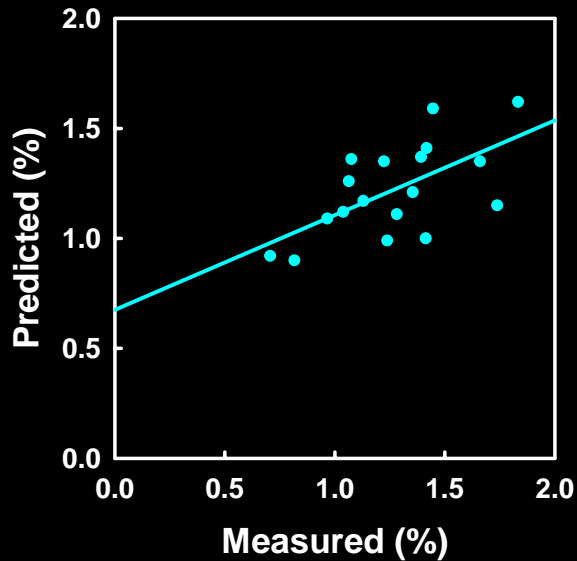
Multiple linear regression
with factor scores



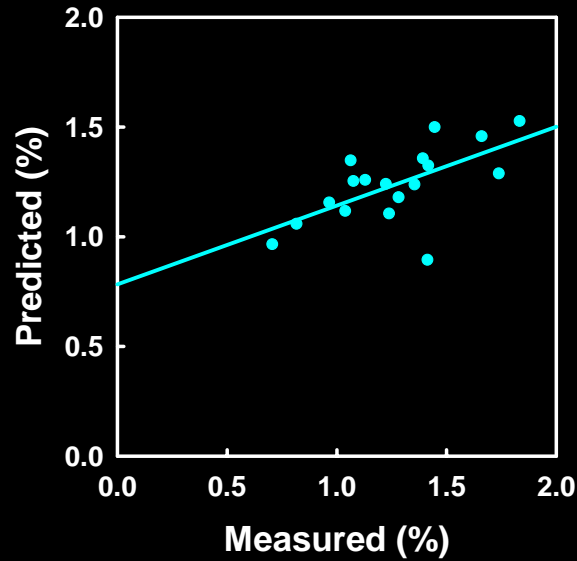
Artificial neural networks



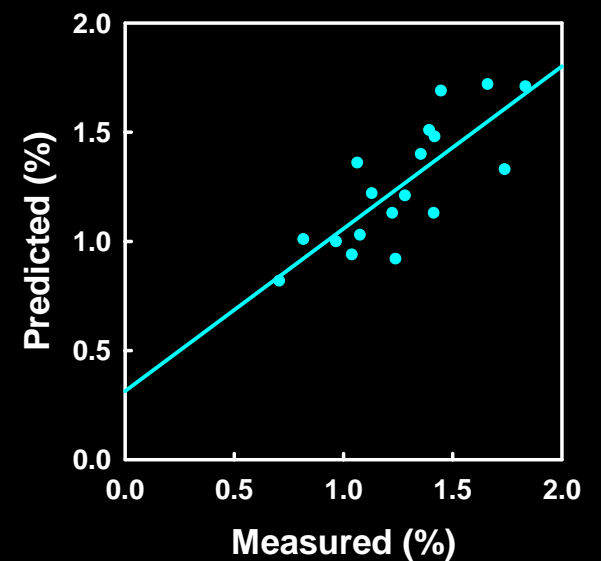
Prediction efficiency = 38.1%



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.**