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Agricultural Outlook Forum  
U.S. Department of Agriculture

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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. A small pond is visible in the upper right corner.

# **Soil Considerations Across the Landscape**

**Hector Causarano**



Terra et al., 2003 and 2004

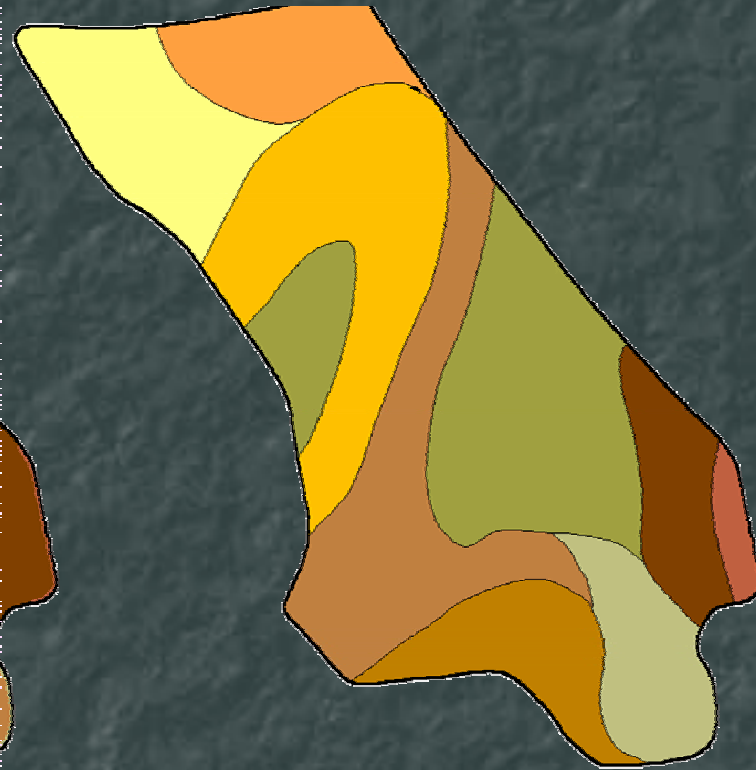
# Soil Survey

Order 2 (SSurgo)



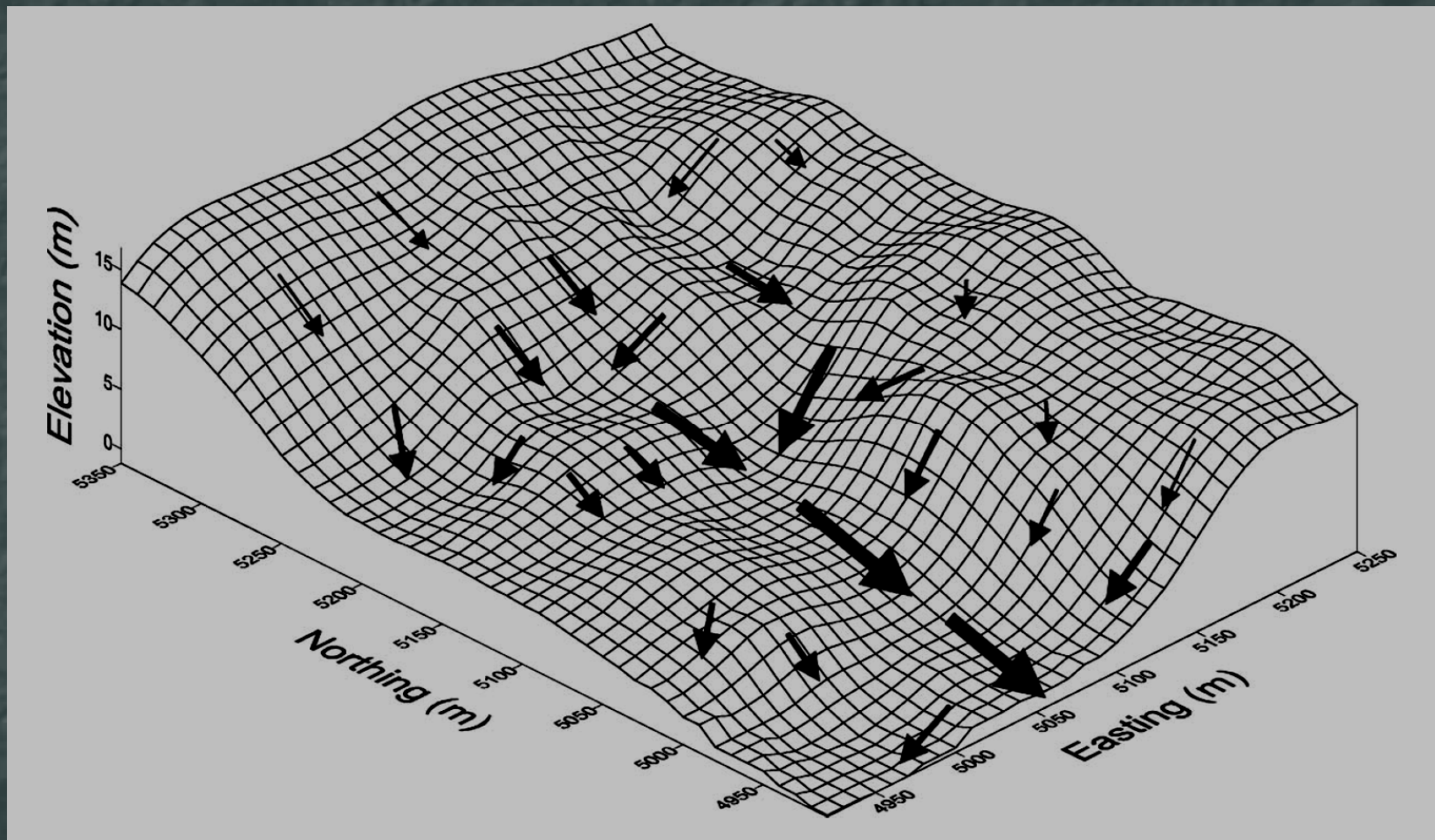
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Order 1

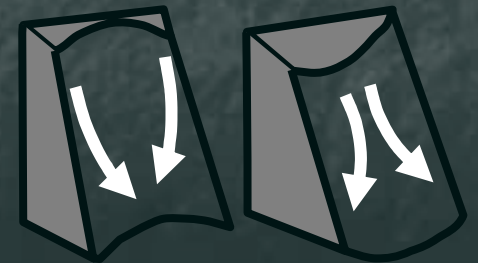
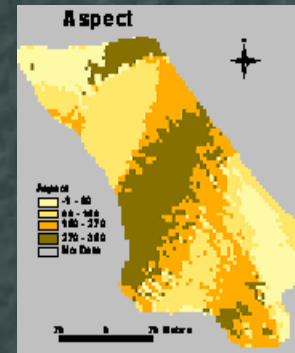
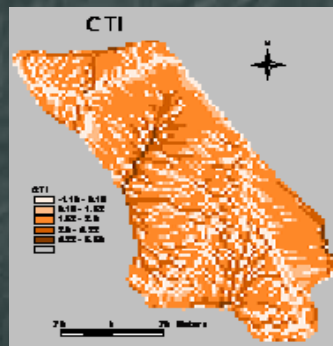
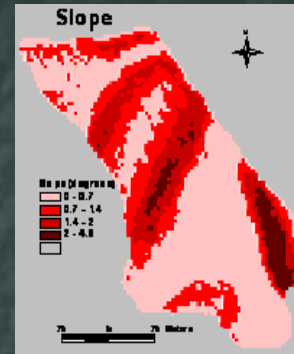
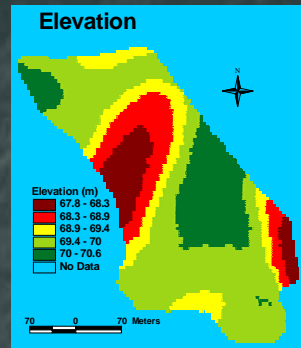


Scale 1:5,000

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



# Digital Terrain Models



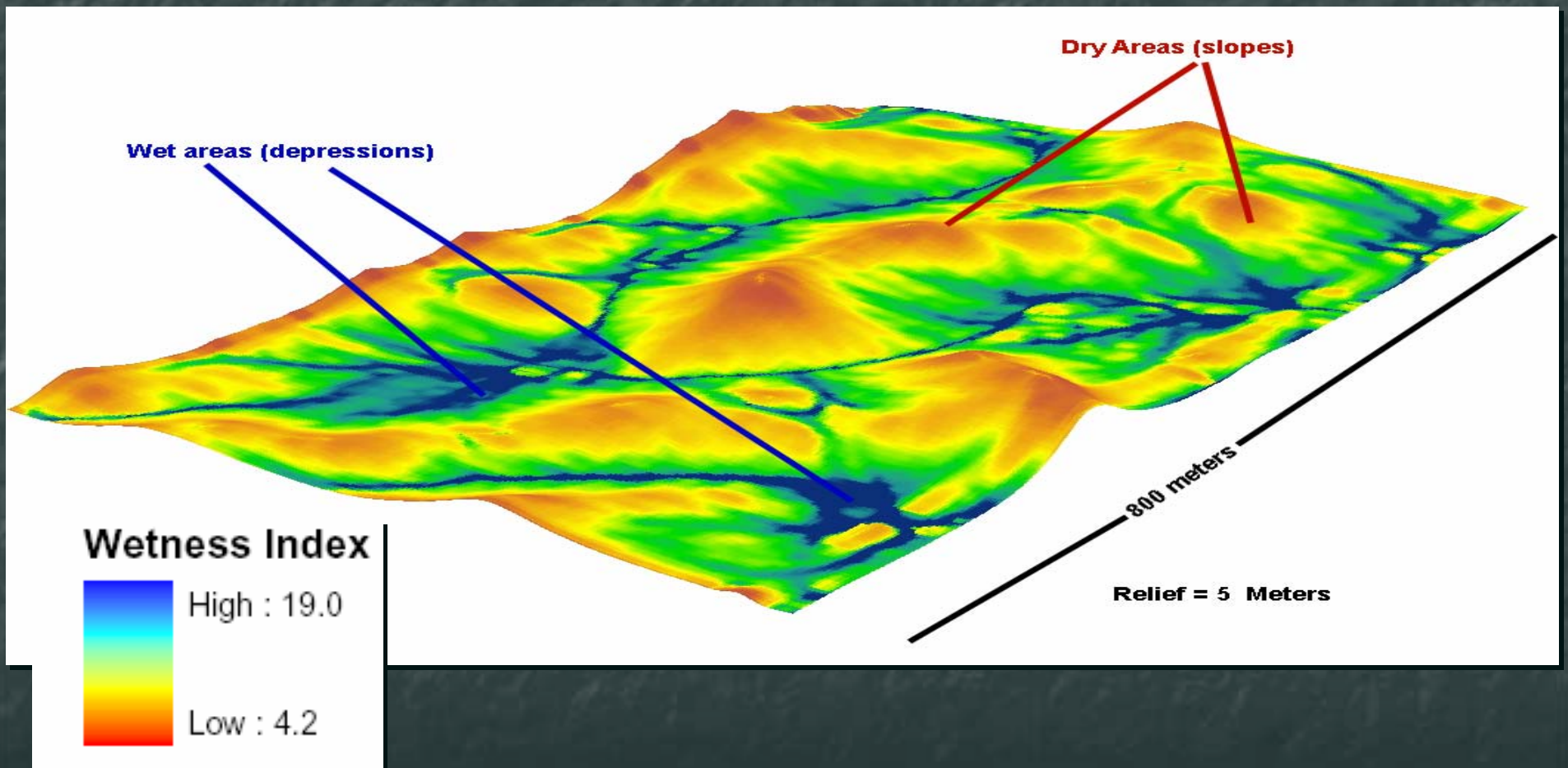
## Pearson correlation coefficients between Terrain Attributes and Soil Organic Carbon

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

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

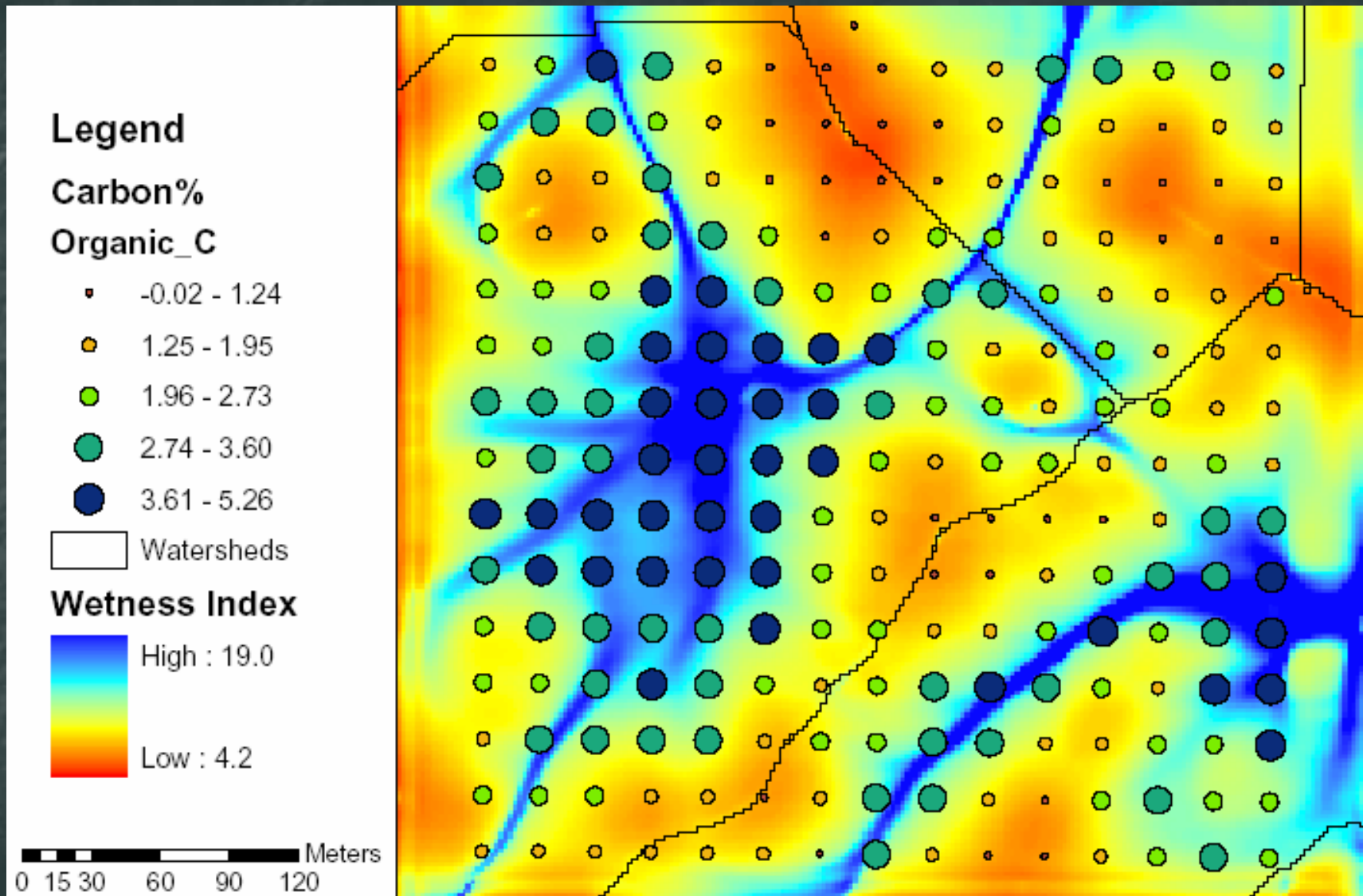


## Derivation of wetness index from the DEM



Venteris et al. (unpublished)

# Model for soil carbon based on wetness index



Venteris et al. (unpublished)

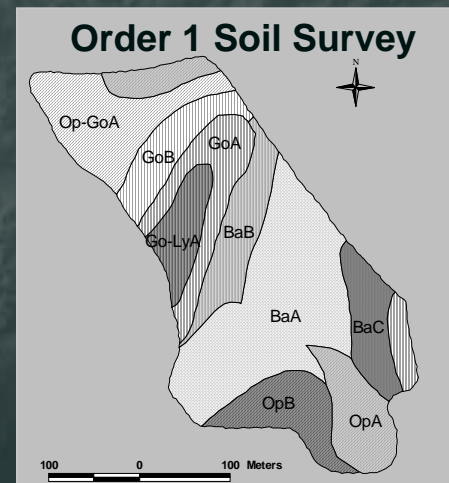
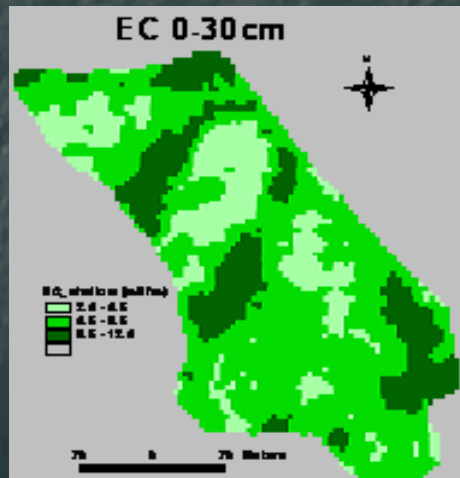
# Soil Electrical Conductivity for mapping soil properties



Electrical resistivity



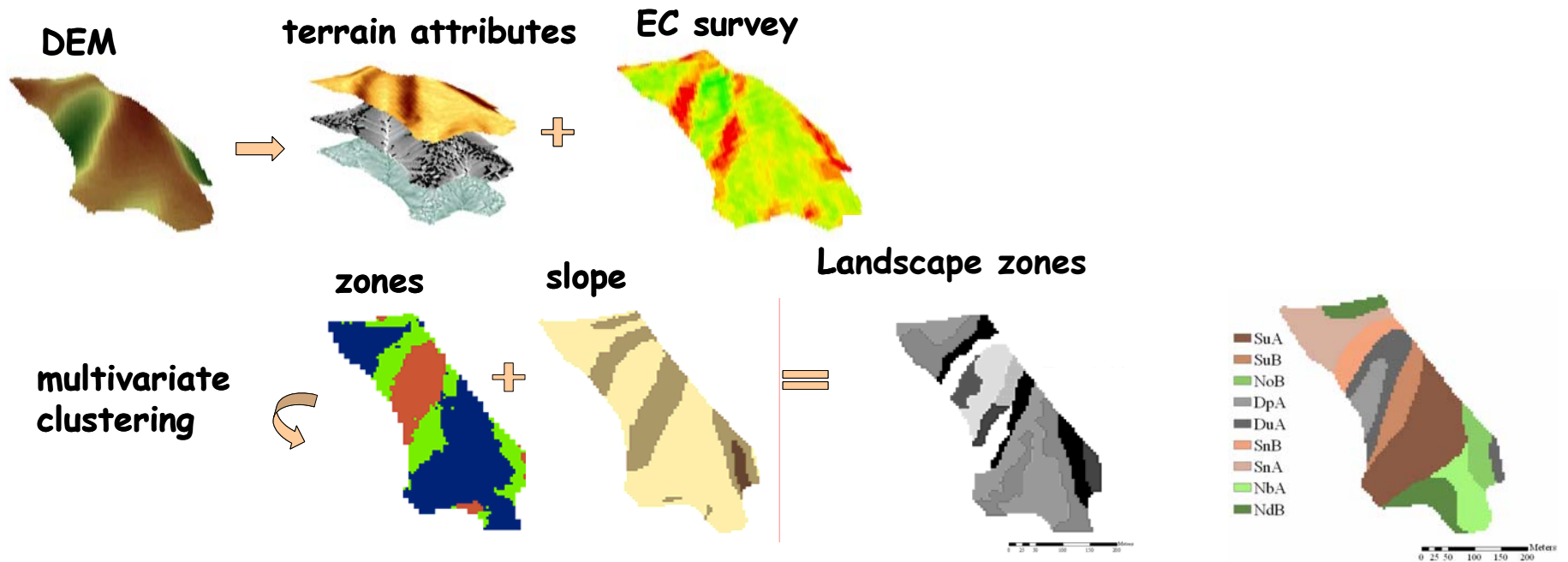
Electromagnetic induction



Terra et al. (2004)

# Innovative Soil Survey

## Multivariate Landscape Zones



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

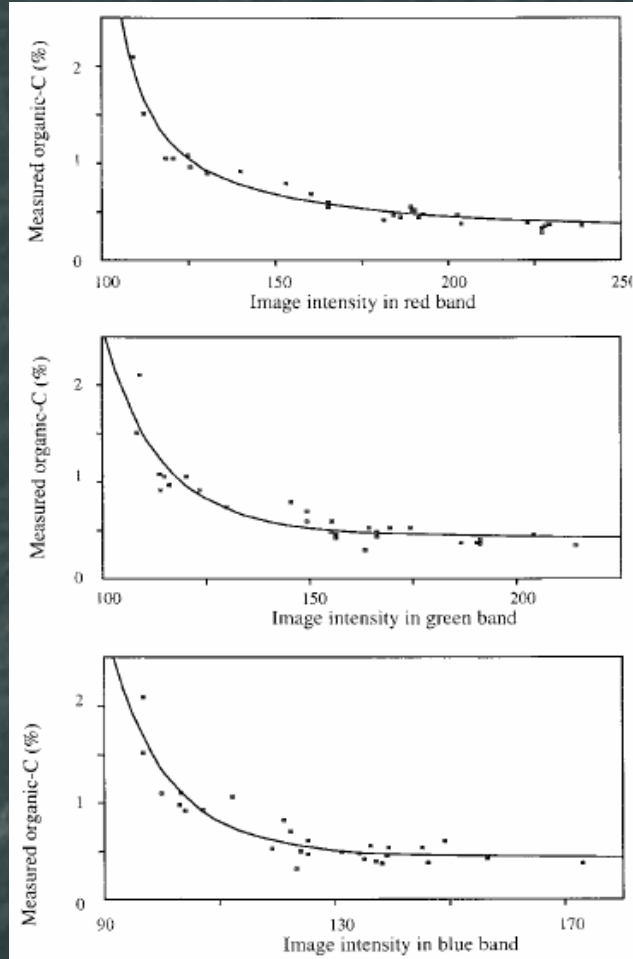
1)	Soil attribute	EC <sub>shallow</sub>
	Vol. Water Content	0.22 ~ 0.87
	Sand	-0.04 ~ 0.88
	Clay	0.37 ~ 0.86
	CEC	0.24 ~ 0.86
	K	-0.05 ~ 0.24
	Ca	0.44 ~ 0.78
	Mg	0.28 ~ 0.93
2)	Total Carbon	-0.36 ~ -0.42
	Total Nitrogen	-0.36 ~ -0.38
3)	Clay	0.43
	Total Carbon	-0.31

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

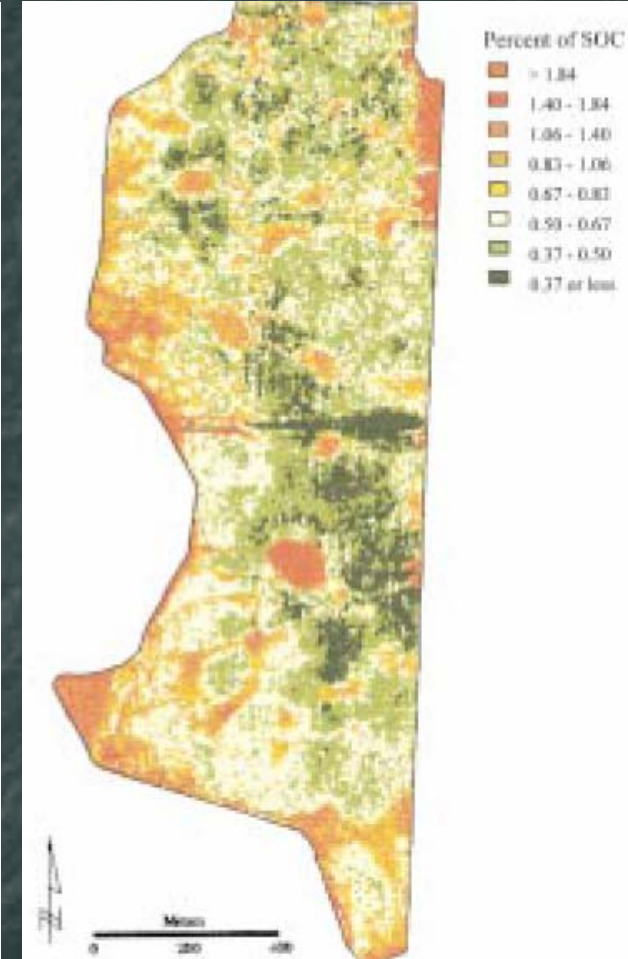
# Field-Scale Mapping of Surface Soil Organic Carbon Using Remotely Sensed Imagery



Color image

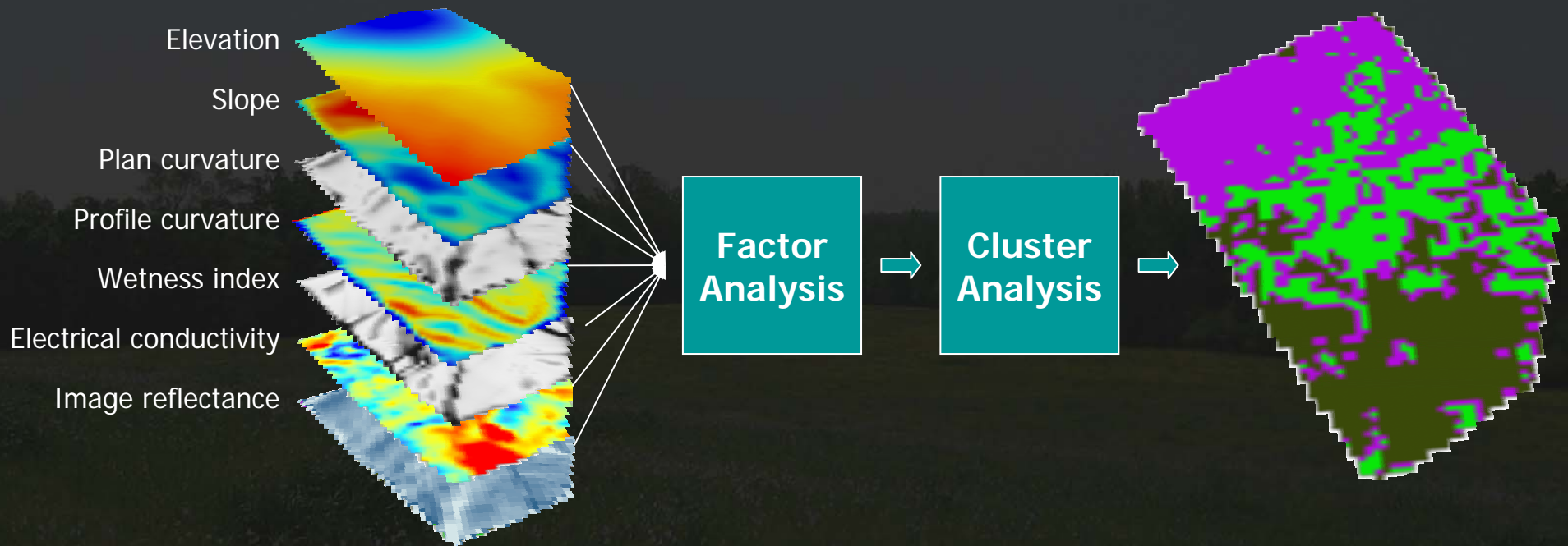


Fitted curves between soil organic C and image-intensity values.



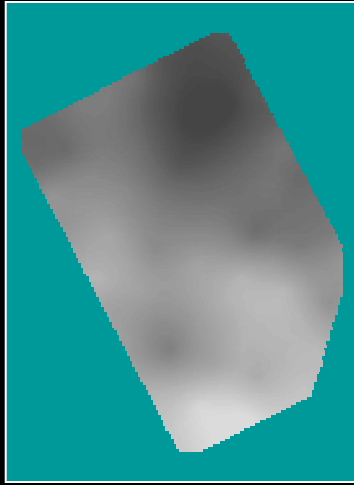
Predicted soil organic C

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

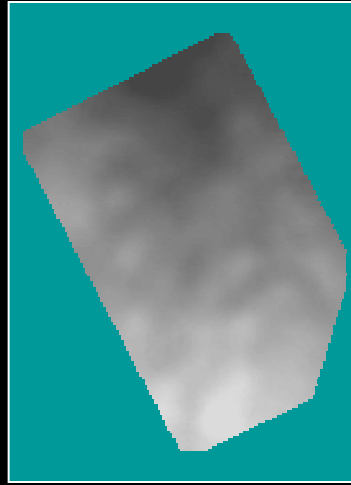


# Soil organic C maps, Gold Hill

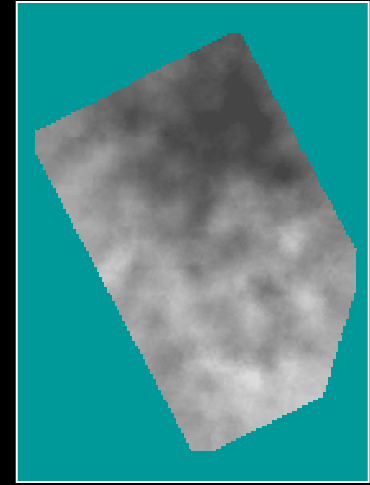
Kriging



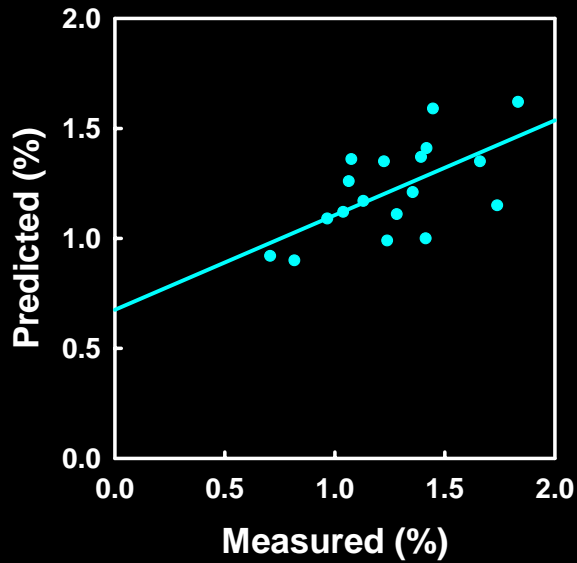
Multiple linear regression  
with factor scores



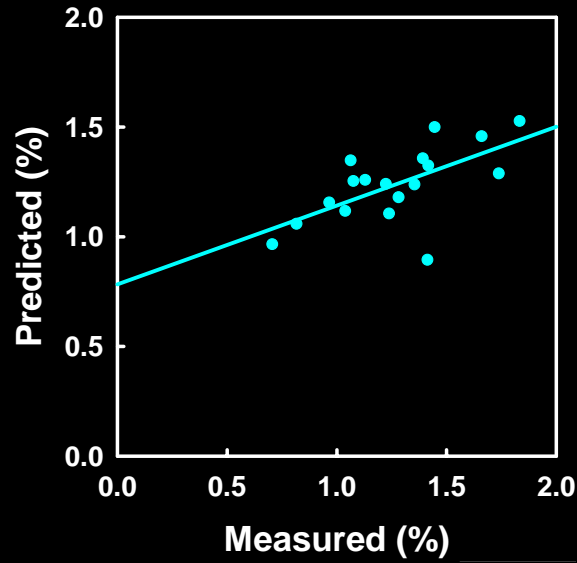
Artificial neural networks



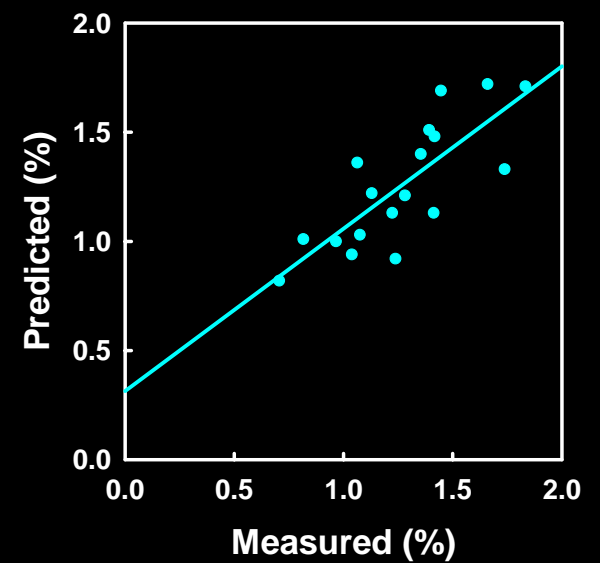
Prediction efficiency = 38.1%



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.**