

Geomorphons

Phillip Owens

Bob Brown

Zamir Libohova

DSM – Methods

- Conceptual with Expert Knowledge based on Geomorphology:

- Iwahashi and Pike (Iwahashi and Pike, 2007).

- Iwahashi, J., Pike, R., 2007. Automated classifications of topography from DEMs by an unsupervised nested-means algorithm and a three-part geometric signature. *Geomorphology* 86, 409–440.

- Schmidt and Hewitt (Schmidt and Hewitt, 2004).

- Schmidt, J., Hewitt, A., 2004. Fuzzy land element classification from DTMs based on geometry and terrain position. *Geoderma* 121, 243–256.

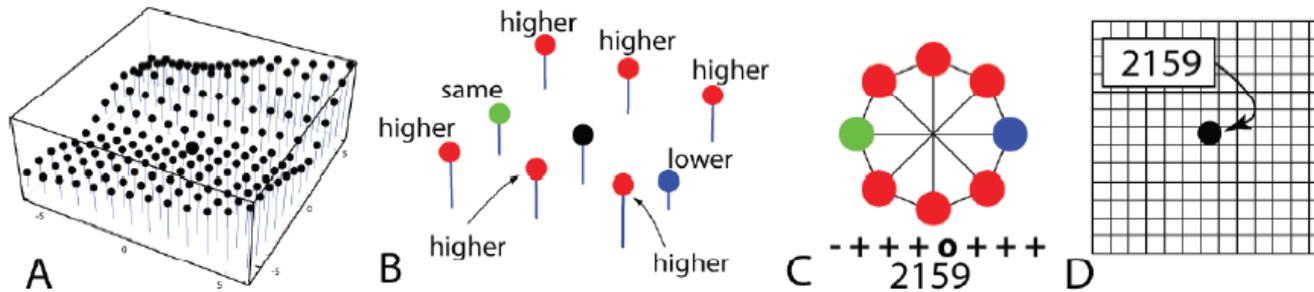
- Geomorphon (Jasiewiczza and Stepinski, 2012).

- Jasiewiczza, J., Stepinski, T.F., Geomorphons - a pattern recognition approach to classification and mapping of Landforms. *Geomorphology*

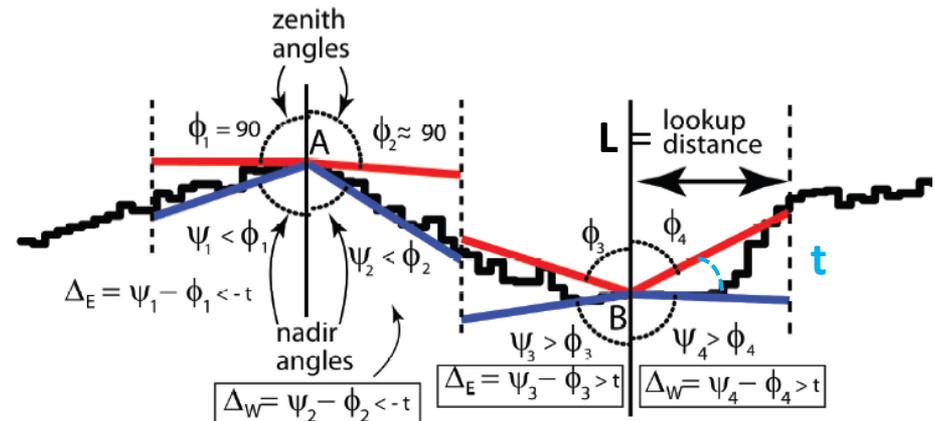
Geomorphon

Main Principle:

Pattern recognition by characterizing the terrain in the 3x3 neighborhood around the central cell not from simple differences in elevations

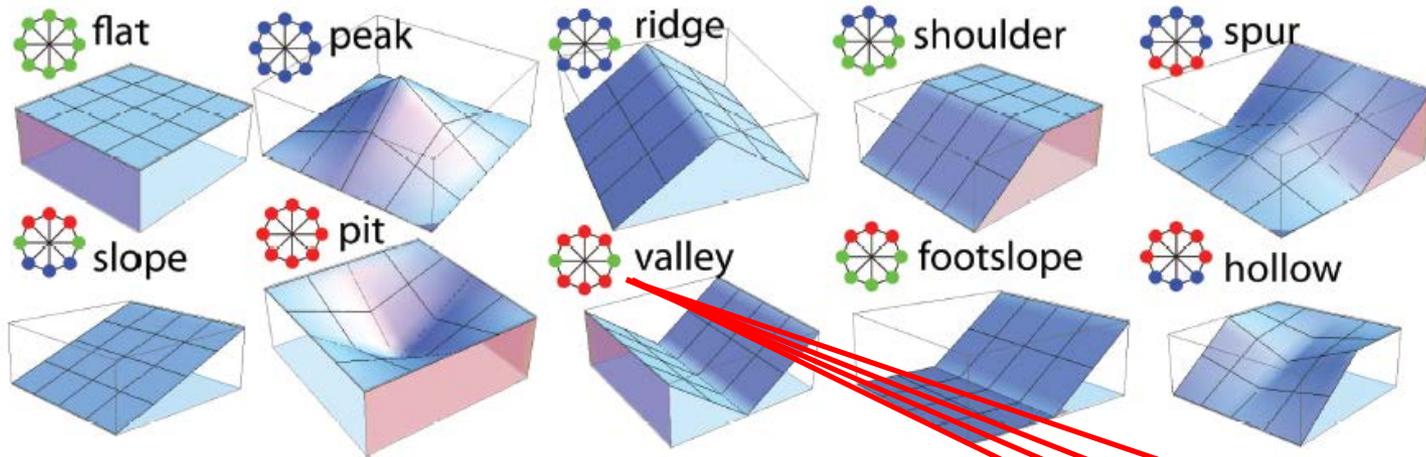


but rather from a Δ quantity which is derived from characterization of the local surface using the line-of-sight principle.

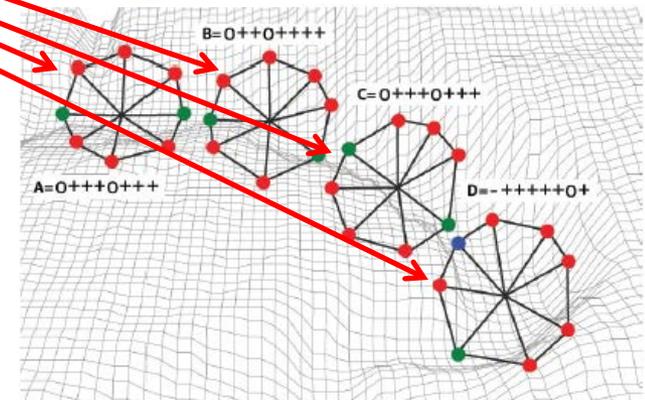


Geomorphon

10 most common landform elements used in many geomorphology classifications and that relate to soils and their distribution are represented by these “geomorphon” or patterns. There are $3^8=6561$ theoretical “geomorphon” but only 498 are common.



Multiple different “geomorphon” show the presence of a valley. Notice how similar the “geomorphon” or patterns are for points A through D.

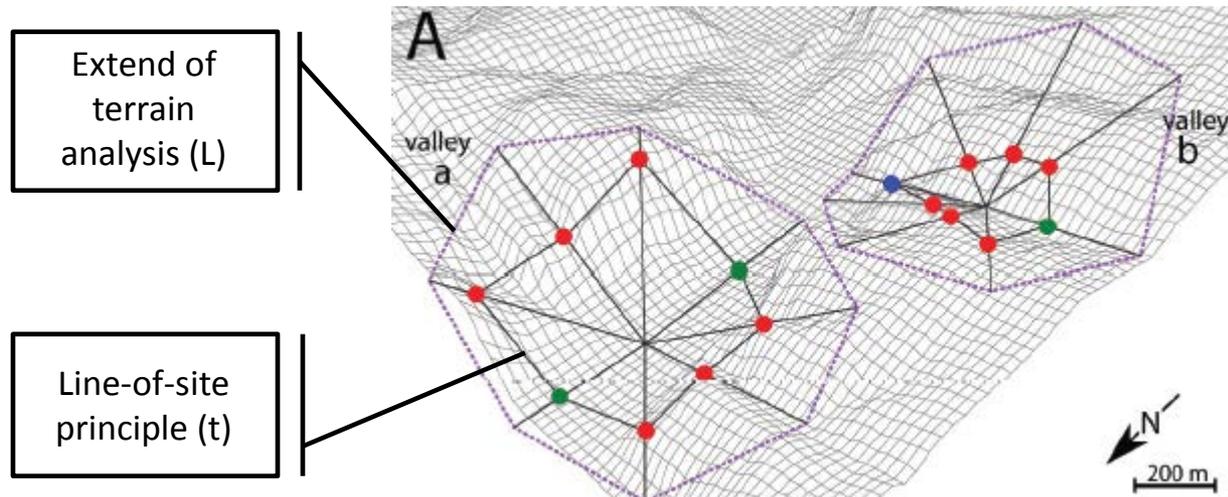


Source: Jasiewiczza and Stepinski, 2012

Geomorphon

Advantages:

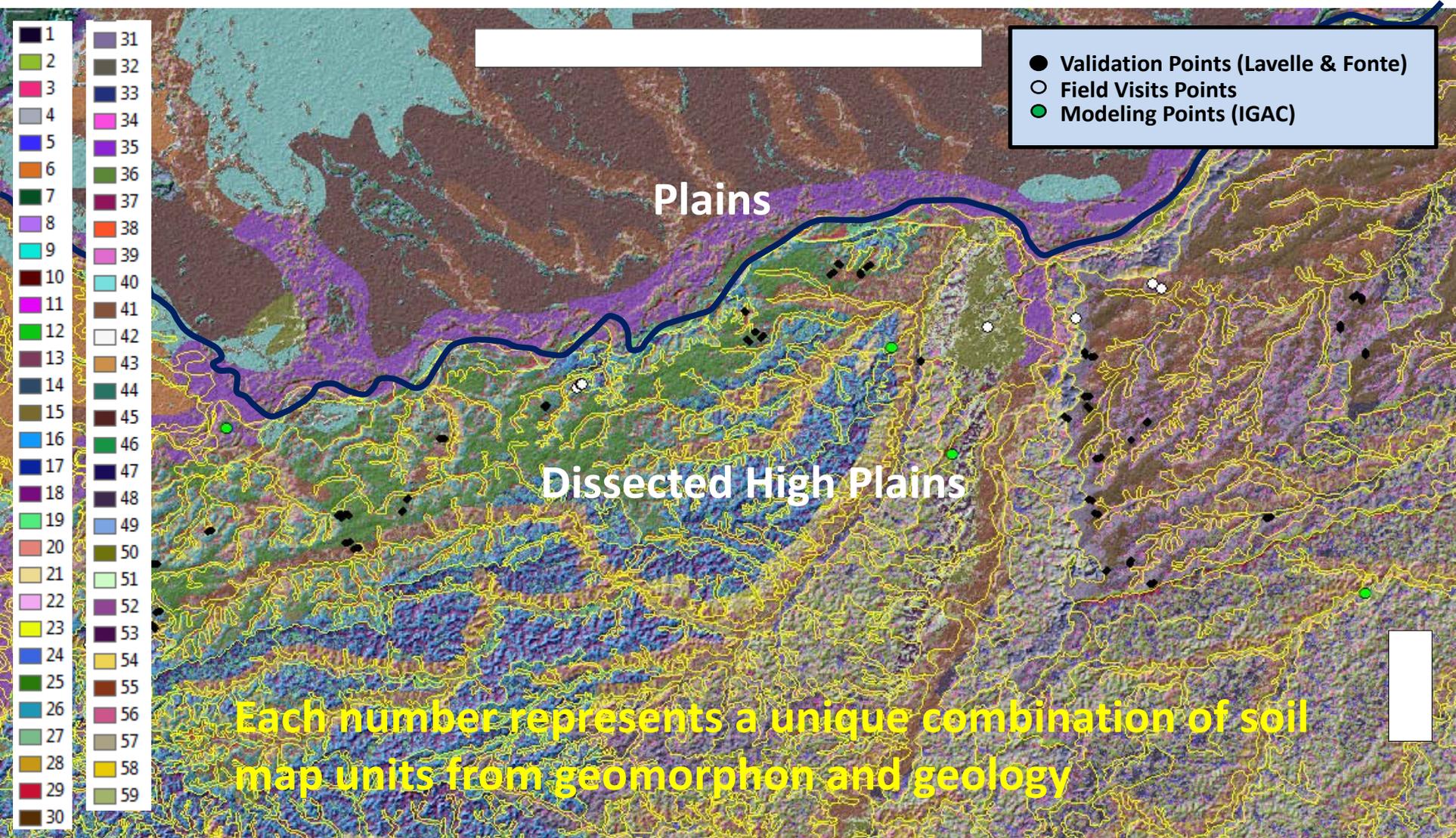
- Flexible size neighborhood (scale flexibility) window that adjusts automatically based on the geometry of the local terrain (L and t);



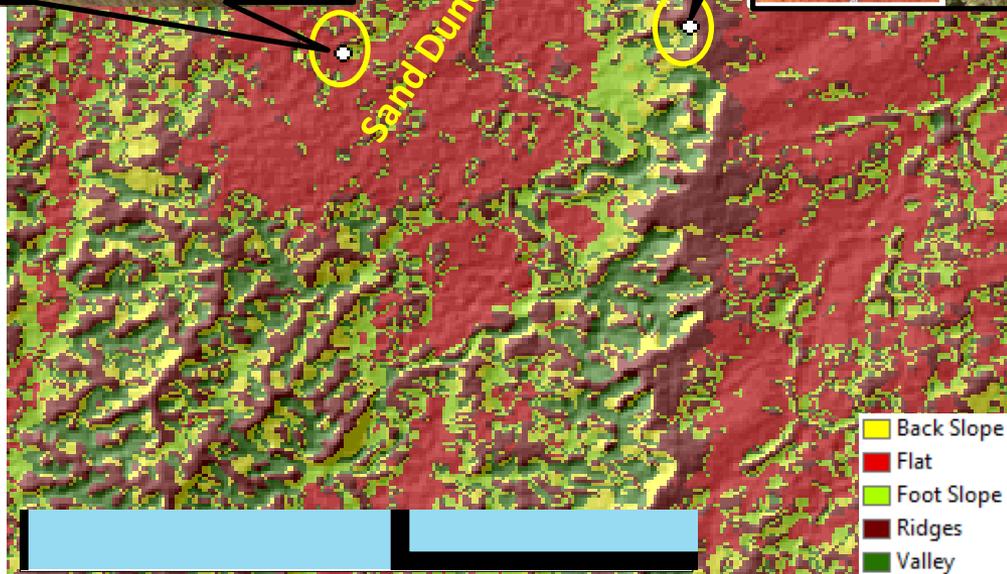
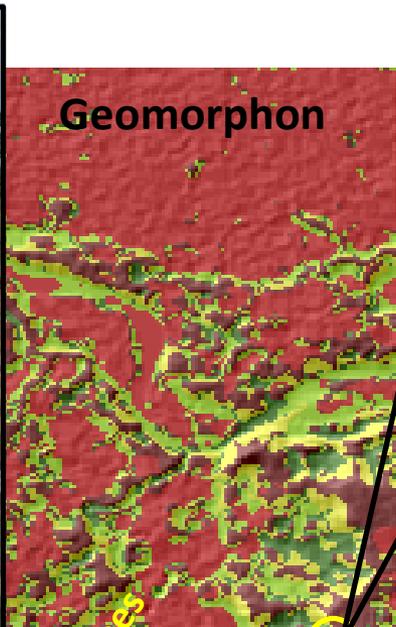
- Both point a and b have the same scale (L) set at 15 cells but the analysis of the pattern (geomorphon extraction) is conducted based on the line-of-site (t) window which adjust itself based on the local terrain.

Examples

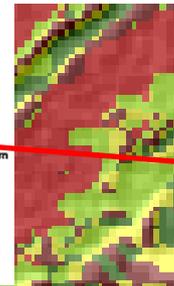
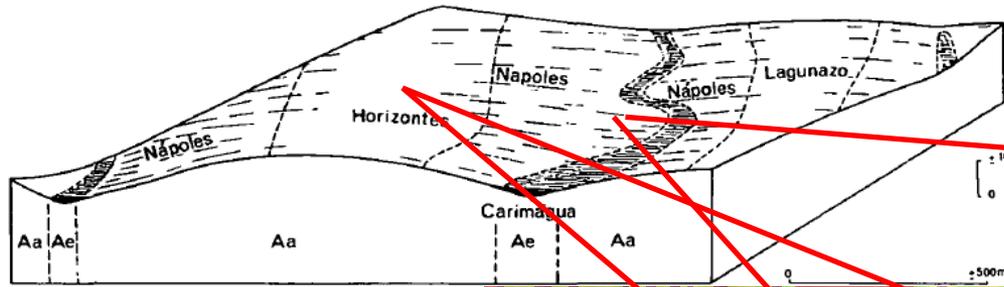
Llanos Soil Map (Preliminary)



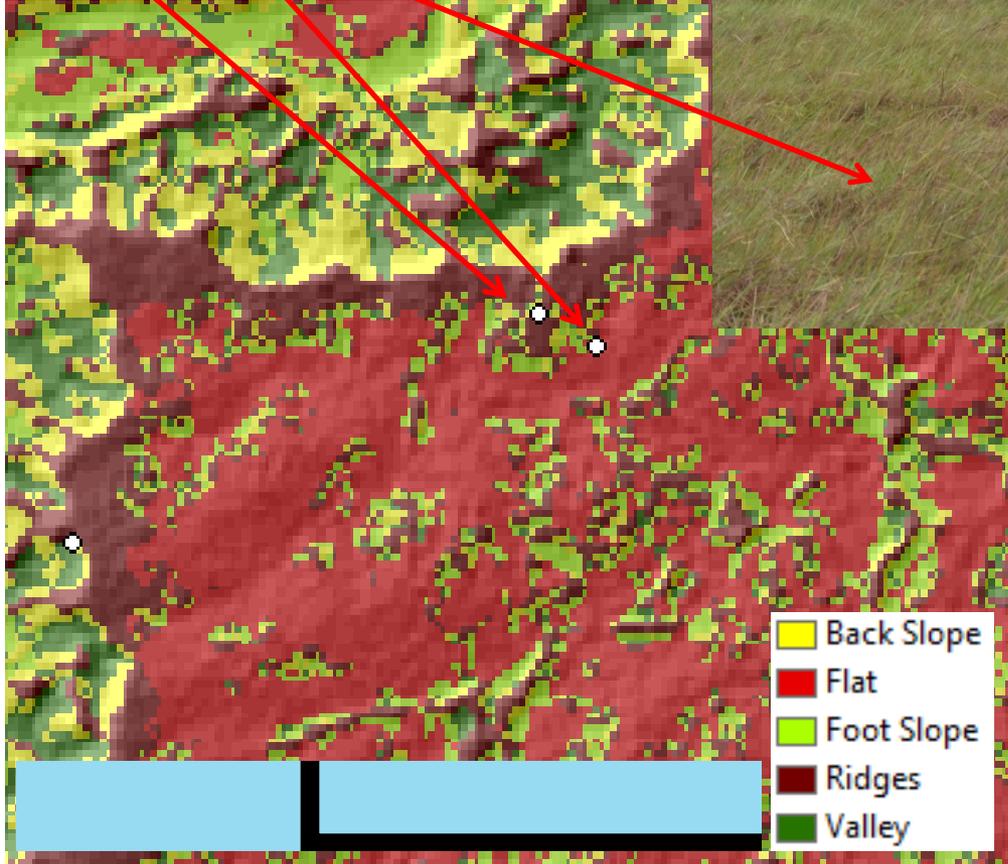
High Plains – Level, Well Drained



High Plains – Level, Well-Drained



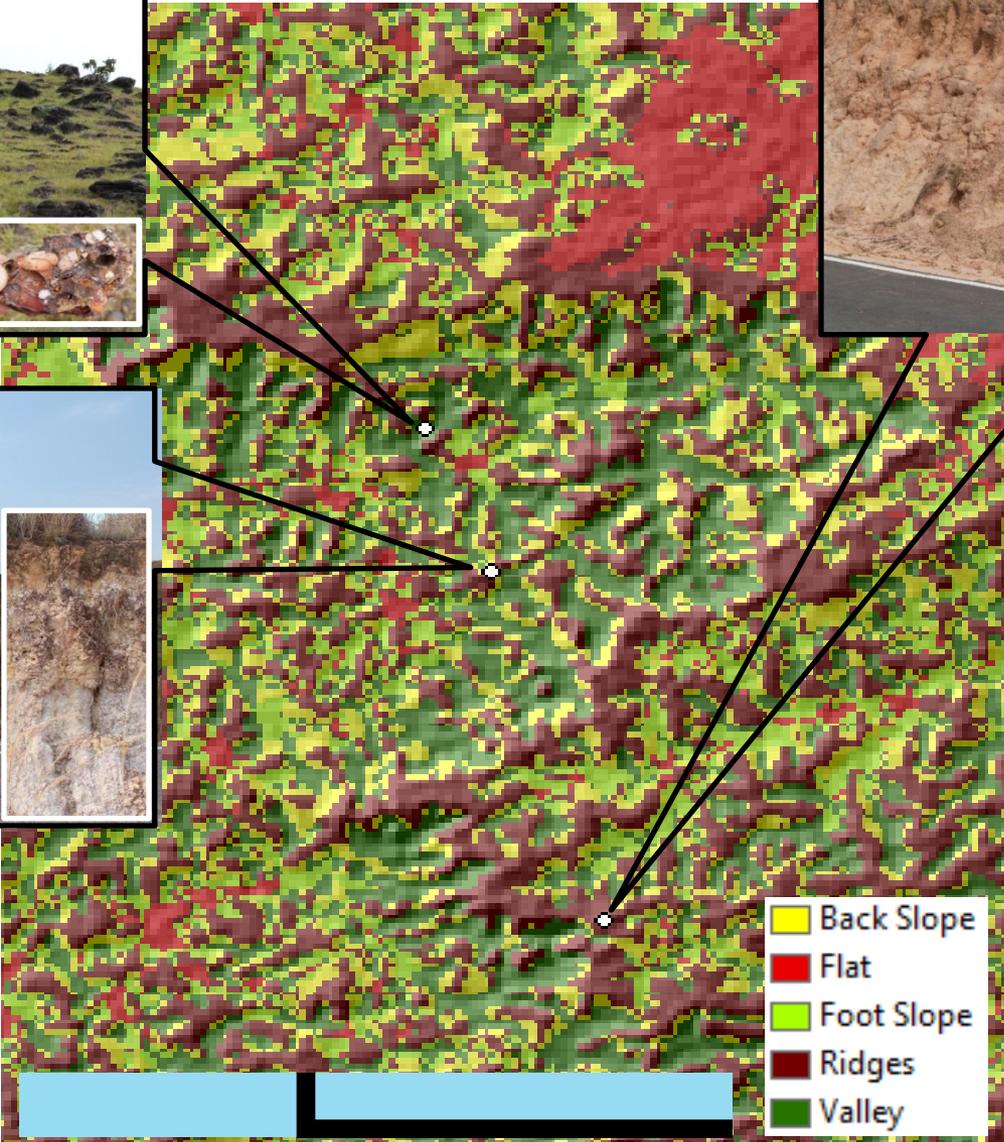
Jenette Goodman



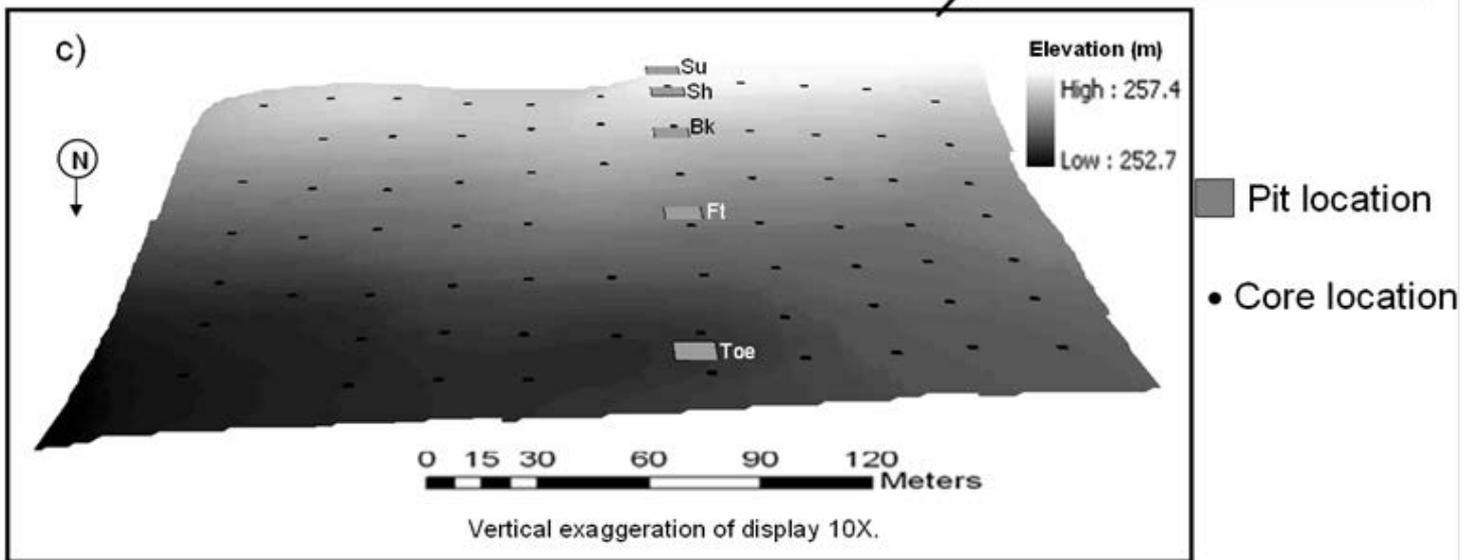
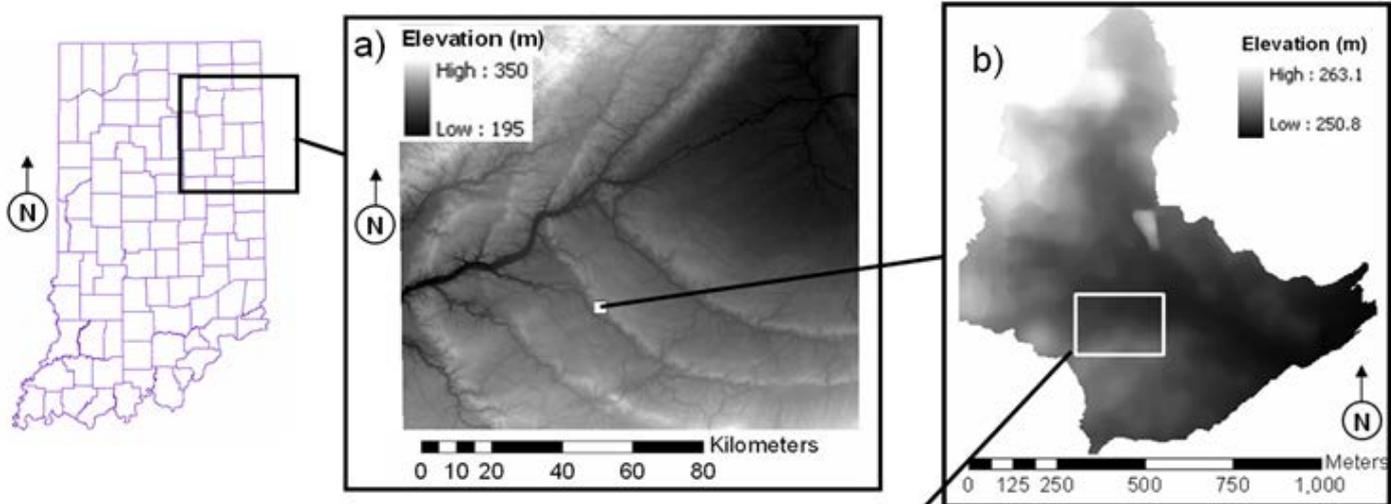
Source: Goosen, 1971

High Plains-Soil Associations

Strongly Dissected

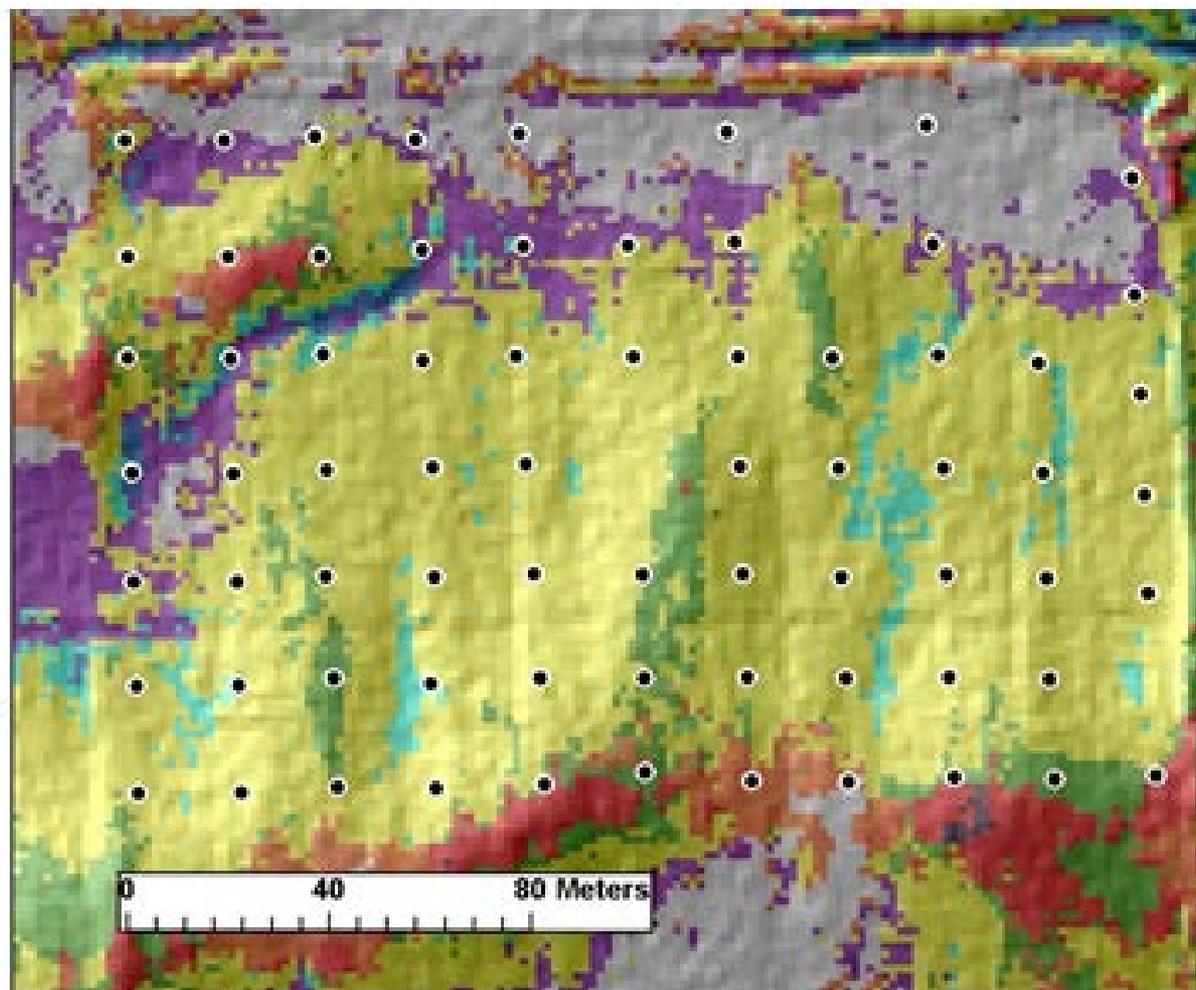


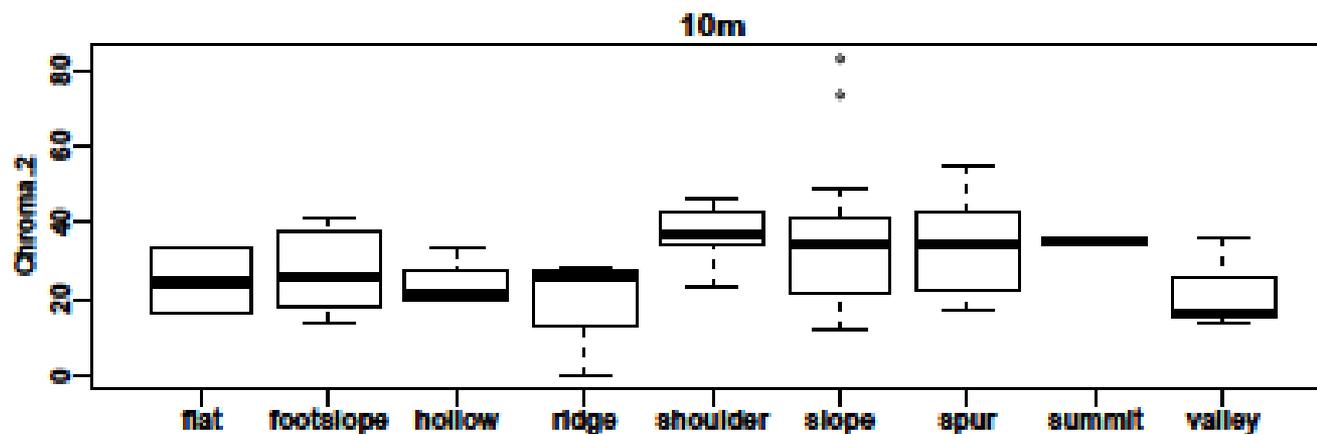
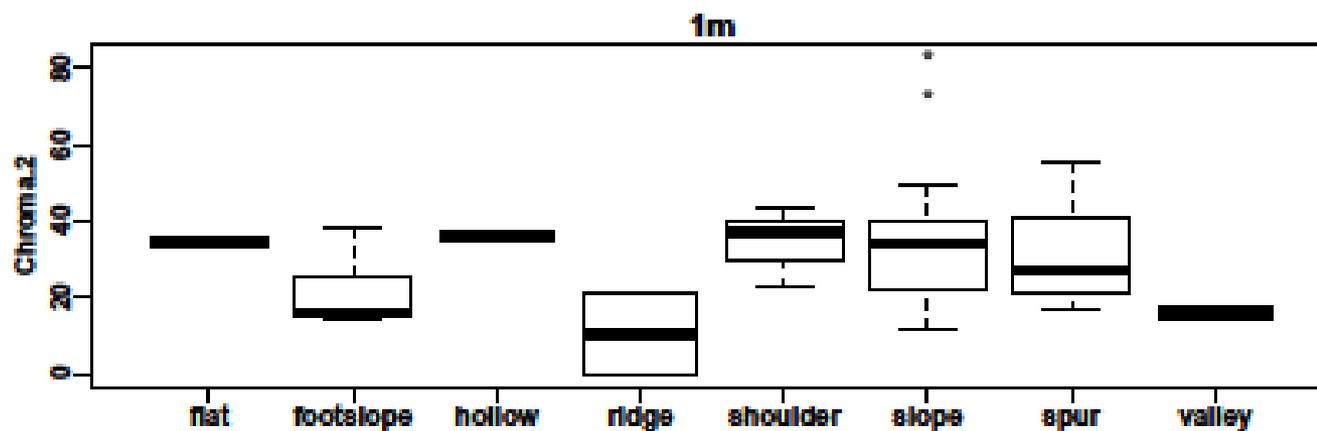
- Back Slope
- Flat
- Foot Slope
- Ridges
- Valley



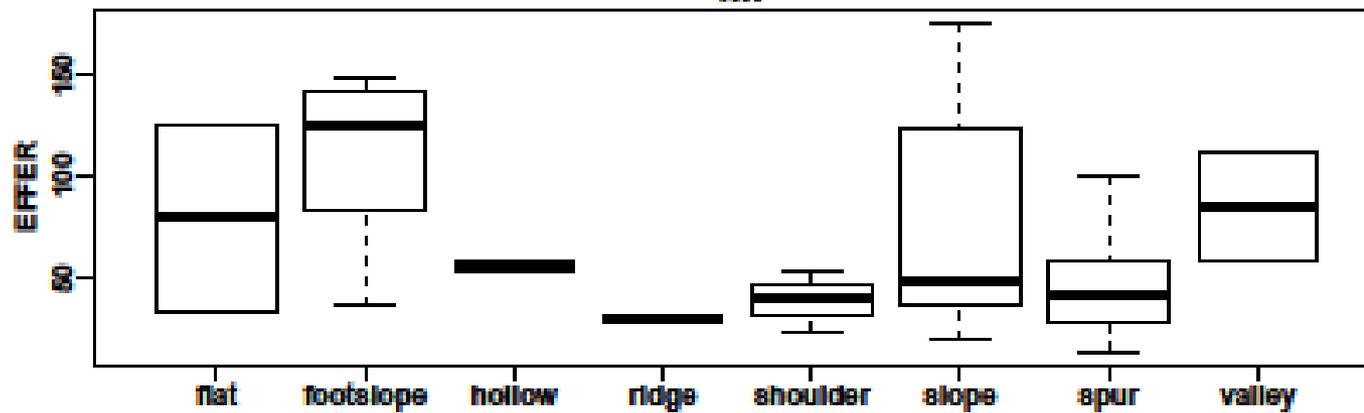
Geomorphon

- flat
- summit
- ridge
- shoulder
- spur
- slope
- hollow
- footslope
- valley
- depression

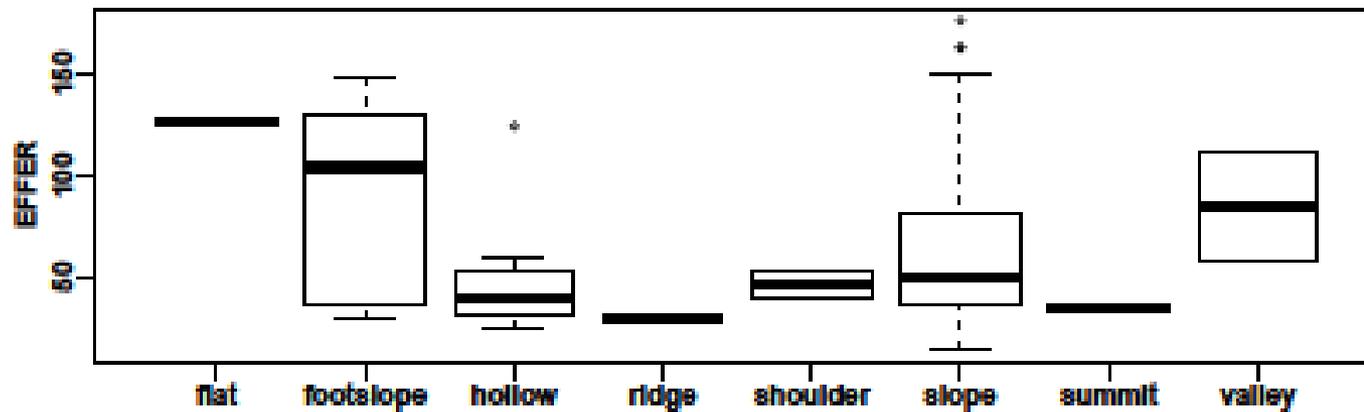




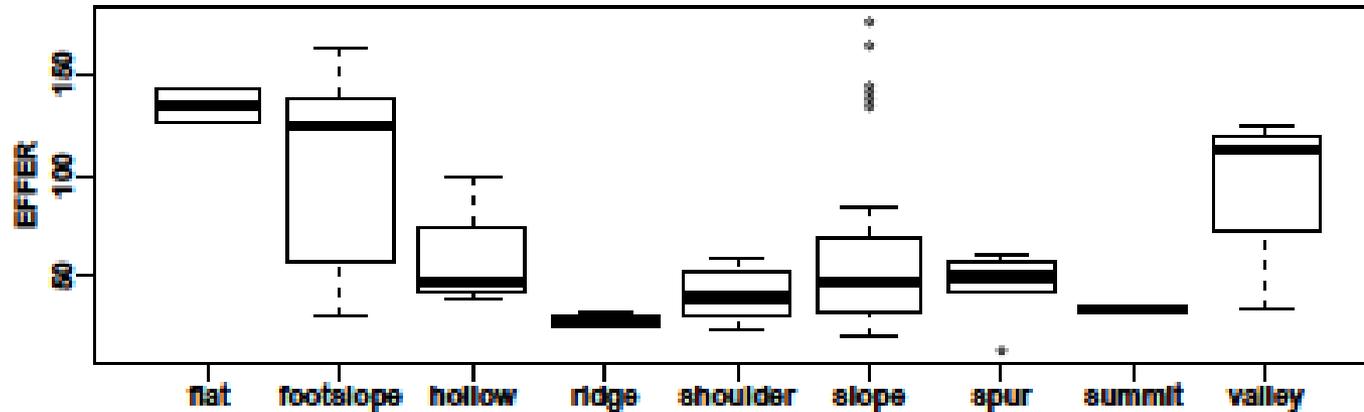
1m



5m



10m



Conclusion

- Initial analysis is promising.
- More research needed to evaluate resolution effects on soil-landscape relationships
- Some classifications are not valid at the field scale such as the valley.