Soil Development Prediction Using Terrain Analysis in a Sandy Area of Southwest France

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Numerous studies have shown that the distribution of soil properties can largely be explained by landscape morphology and especially by the amount and flux of water in a given landscape. Digital terrain analysis provides a systematic basis for calculating topographic attributes and for relating them to soil attributes in order to improve the prediction within existing soil maps. Recent researches have shown such applications of quantitative soil-landscape models for soil mapping and for soil attribute prediction.

In southwest France, acid soils have developed from Quaternary sandy eolian deposits. The objective of this study was to determine if topographic situation influences pathways of soil development in order to improve the prediction accuracy on the presence/absence of some diagnostic horizons.

We used a digital elevation model (DEM) to calculate topographic attributes on a XXX ha area. Morphological analysis was run using this DEM (precision=1m; cell size 250x250m). The following classical morphological indicators were determined using the elevations from the eight nearest neighbors to each point; elevation (m), slope (degrees), plan curvature (across slope curvature degrees/m), profile curvature (dowslope curvature, degrees/m), flow accumulation area (m^2) (from a drainage model derived from the DEM), total curvature, range of elevations (m) on a square of 3x3 cells, standard deviation of elevations (m) on a square of 3x3 cells, and wetness index. In addition, we calculated the drainage feature proximity and the relative elevation from the nearest drainage feature.

Field data were soil descriptions from auger borings, which were separated into 3 groups on the basis of the existence of diagnostic horizons. The model uses multivariate discriminant analysis on digital eleveation model attributes in order to predict soil profile developments.

The results suggest that drainage feature proximity and the relative elevation from the nearest drainage features are the main factors controlling horizons local variability. This study shows that using spatial available landform attributes which might influence horizons distribution, and combining them into spatial models, can provide a useful tool to improve geographical prediction of soil profile development.