The Relationship of Soil Variability to Slope Aspect in The Beauce Region (France)

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Easy access of Digital Elevation Model (DEM) allows to quantify relationships between soil variables and terrain attributes. Slope is certainly one of the most important and widely used criteria. Gradient and derived parameters (curvatures) are related to flow velocity and runoff rate. Aspect is also the starting point for many derived parameters using flow path (drainage network, contributive area, etc.). Aspect is commonly used in soil landscape modelling, mainly for hydrological processes. Direct relationships between aspect and soil variables are rarely analysed as the result of other energy factors like solar radiation or wind.

A first objective of this study is to identify relationships between aspect and soil depth in a small area of the Beauce Region in France. A second objective is to search for energy factors (flow path, solar radiation, wind intensity) which could improve understanding of soil genesis.

We described 340 field observations for 1600 ha of an experimental area used for water and nitrate supply monitoring. For each observation, several soil variables were coded, one of these was the presence and the thickness of a silty-clayey-loam (SLC) horizon. Relief is very smooth in this region (mean slope around 0.5%). We established a DEM at 20x20m grid thanks to 9000 field elevation measurements. Main terrain attributes were derived from this DEM and assigned to the pedological observations. Statistical and graphical methods were used to analyse the relationship between the SLC horizon and the terrain morphology. Special statistics were used for aspect due to the circular nature of this variable.

The results show a high relationship between presence of SLC and aspect whereas hydrological parameters are not correlated with this horizon. The mean angle of the aspect frequency of the SLC horizon is calculated and compared to the mean angles of wind direction and solar radiation balance. It shows a low difference between the wind direction and the aspect frequency of the SLC horizon. This result confirms the role of wind in the spatial pattern of soils. It needs other results to better know the combination of several factors (role of vegetation) and the age of the reshaping.

A generalization of this approach was attempted on a larger area. The same relationship was found showing the importance of wind reshaping in the Bassin Parisien. However other factors, mainly the diversity of parent materials, lead to a more difficult interpretation of the wind factor. However, aspect remains as a good criteria to model the spatial pattern of soils at regional scale.