Soil organic matter prediction using environmental factors

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Organic matter is one of the most important properties affecting soil chemical and physical fertility, but it influences
also soil hydrologic parameters. It is easily measured by chemical analyses, but in large scale studies its prediction
is desirable. This study aims at predicting the spatial distribution of the soil organic matter concentration (SOM)
in forest topsoils in Piedmont (North West Italy) using continuous predictors (in forms of auxiliary maps). As
predictors we selected: the digital elevation model (DEM, 50 meter resolution), the mean annual precipitation,
the soil dryness index and normal difference vegetation index (NDVI, 1 km resolution). Using the Geographic
Information System SAGA, the terrain attributes were computed from the DEM, namely are: elevation, slope,
aspect and mean curvature associated with hydrological parameters namely, the compound topographic index
(CTI) and stream power index (SPI). From the long term monthly average of NDVI the mean annual value and
the coefficient of variation (CV) were also derived. This data set was used to estimate the SOM concentration by
regression analysis. To test the relationship between the SOM and the environmental variables, 66 soil profiles
were used. Several variables were found to be significantly correlated with SOM concentration: elevation, slope,
mean NDVI, CV(NDVI), precipitation and dryness index, with correlation coefficients, r, of the linear regressions
ranging from 0.12 to 0.63. However, only precipitation and mean NDVI were retained when a stepwise multiple
regression was used. Although these two predictors contribute only partially to explain SOM variability ($R^2=0.42$).
The importance of vegetation is clearly depicted by the significant effect of NDVI, while the precipitation may
contribute to the explanation in a less direct way because of the complex links between climate and organic matter
transformation in soils.