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Prediction of soil organic carbon in forest areas of the Piedmont region, Northern Italy, using environmental variables: vegetation and topographic patterns effect.

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Soil organic carbon (SOC) is one of the most important parameters affecting soil hydraulic properties. It is easily measured by chemical analyses, but it is highly variable in space. Therefore the definition of a methodology allowing for SOC spatial prediction with a reasonable accuracy is crucial in large scale studies.

This study aims at predicting the spatial variability of the soil organic carbon concentration (%SOC) in forest topsoils in Piedmont (North-western Italy) using spatially referenced environmental factors related to terrain morphology, climate, and vegetation.

In this region 122 soil profiles were available with soil organic carbon concentrations at depths of 0 –10 cm, 10 –20 cm, 20 –30 cm, 0 -20 cm and 0 –30 cm and in the horizons A, B and C.

For each point terrain attributes were derived from a 50 meters pixel digital elevation model (DEM), using the SAGA geographic information system. In addition basic NDVI statistics, such as the mean, minimum and maximum values, and the Fourier series phases (F1 and F2) and amplitudes (A1 and A2) for the 12 months and 6 months periods were evaluated from the long term monthly average NDVI series obtained by SPOT-Vegetation data. Mean annual precipitation estimates were also available for each sample.

A multiple regression analysis were applied to investigate the relationship between the %SOC in different layers and horizons and the environmental descriptors. The relationships that we found show that the NDVI parameters and the precipitation are statistically significant predictors ($P<0.01$)of the %SOC, with R^2 ranging between 0.24 and 0.45 due to the landscape heterogeneity.

In order to improve the model performance, the data set was split according to three classification types:

1) vegetation type (broadleaves, mixed and grasses), as derived by a land cover map;

2) site morphology identified by four classes of curvature;

3) a combination of both factors producing vegetation type / curvature classes.

For these subdivisions the regression analysis was applied to the %SOC on the upper 30 cm layer. Results show that NDVI and topographic parameters play an important role in the new relationships and the prediction was ameliorated producing R^2 equal to 0.68 ($P<0.01$) for grasses and flat surfaces and up to 0.85 for broadleaves with plane profile curvature. The results are also suitable to be transpose to ungauged locations.