Geophysical Research Abstracts
Vol. 13, EGU2011-1075, 2011
EGU General Assembly 2011

Predicting soil organic matter by artificial neural network in landscape scale using remotely sensed data and topographic attributes

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Soil organic matter (SOM) is an important source of nutrients for plant growth in meaningless, and is itself influenced by land use, soil type, parent material, time, climate and vegetation. It is also one of the important factors affecting soil quality, sustainability of agriculture, soil aggregate permanence and crop yield. Estimation of SOM with limited in situ data, at an acceptable level of accuracy, is important because the sampling and laboratory measurement of SOM is a time and labor-consuming procedure. The objectives of this study were (i) to evaluate the artificial neural network (ANN) model to predict the SOM using auxiliary data including the land use types, topographic attributes and remotely sensed data and (ii) to identify the most factors for detecting the variability of SOM in the hilly regions of Lordeagn region located in western Iran. The land uses(LU) in the selected region included three land uses of natural Oak forest (NF), degraded forest (DF) and clear cutting forest under cultivated rainfed (CR) were recorded at time of soil sampling. A total of 100 soil samples (0-10 cm depth) were collected from the site as such as different slope positions and land uses were considered in modeling. Normalized difference vegetation index (NDVI) was derived from the Landsat Enhanced Thematic Mapper (ETM) imagery. The primary topographic attributes (slope, elevation, aspect, profile curvature, and plan curvature) and compound attributes (wetness index, stream power index, sediment transport index, solar radiation) were calculated from a 10×10 m digital elevation model (DEM). The ANN models were developed, where the SOM content was considered as input variable and kind of land use (NF, DF, and CR), NDVI and topographic attributes as output variables. The developed models were validated by using additional samples (25 points). In first model (Model1), solely land uses were included, in Model2 land uses and NDVI, and in Model 3 three mentioned inputs variables were included. The results showed that the ANN models explained 64, 78 and 89 % of the total variability in SOM, for the Model 1, 2 and 3, respectively, in the study area. The sensitivity analysis, based upon the third model (Model 3) revealed that the LU, NDVI, slope, sediment transport index and wetness index were identified as the most important variables that explained the most variability in the SOM content in the site studied. To achieve a nonlinear function relating SOM to terrain attributes and land use type, and remotely sensed data in hilly region of the semiarid region of Iran, the results of this study indicated that the designed ANN models were able to establish the relationship between the land uses, terrain attributes, remote sensing data and SOM content. The use of ANN modeling with additional hill slopes with greater variability in terrain attributes considering the complex hill slope characteristics in combining with management factors, should help broaden the usefulness and predictive capabilities of the ANN-based SOM prediction. Overall, our results indicated that the integration of the intelligent models such as ANN along with the use of auxiliary data including land sue map, the remotely sensed data and topographic attributes could be used as an alternative to the more time and labor consuming direct methods to predict SOM in the landscape scale.