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Effects of slash-and-burn land management on soil spectral properties estimated with VIS-NIR-SWIR spectroscopy

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Slash-and-burn land management is typical for low-income tropical countries, such as Ecuador. It involves conversion of forest into areas used for agriculture. At first trees are cut and the wood debris is burnt. After initial clearing, biomass burning is performed after each production cycle. Usually, cultivation cycles are followed by the fallow period. In the medium and long term, these practices have negative effect on soil fertility and there is the need for clearing more forest for agricultural use. This is one of the reasons for continuing deforestation with the consequent loss of biodiversity. Changes in physico-chemical properties due to periodic burning are accompanied by changes in soil spectral properties and can be determined using VIS-NIR-SWIR spectroscopy, which can be a cost-effective alternative for traditional methods of soil analysis. The purpose of the study is to assess the viability of VIS-NIR-SWIR spectroscopy for characterization of soils from land areas under slash-and-burn management system. Eighteen samples from soil surface layer were collected from two corn fields in the province of Los Rios, Ecuador, in September 2015. One of the areas has experienced six slash-and-burn cycles, while in the other the samples were collected at the end of the first corn cultivation cycle. Spectral measurements of sieved and air-dried samples were performed in the laboratory of the University of Zaragoza using ASD Fieldspec®4 spectroradiometer (350-2500nm spectral range) and ASD Illuminator Lamp as a light source. Statistically significant differences were observed between soil spectra of the samples from two soil groups. Reflectance of repeatedly burnt soils was 20% higher (mean value for the entire spectrum) for 65% of the samples, being especially important in VIS (>45%) and NIR (∼35%), probably due to the lower organic matter (OM) content. OM models built using Partial least Squares Regression demonstrated high predictive capacity (R2>0.8). Thus, the study confirms VIS-NIR-SWIR soil spectroscopy can be used as a tool for monitoring changes in soils in areas of slash-and-burn land management systems.