Geophysical Research Abstracts
Vol. 17, EGU2015-6525, 2015
EGU General Assembly 2015

Prediction of iron oxide contents using diffuse reflectance spectroscopy

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Determining soil iron oxides using conventional analysis is relatively unfeasible when large areas are mapped, with the aim of characterizing spatial variability. Diffuse reflectance spectroscopy (DRS) is rapid, less expensive, non-destructive and sometimes more accurate than conventional analysis. Furthermore, this technique allows the simultaneous characterization of many soil attributes with agronomic and environmental relevance. This study aims to assess the DRS capability to predict iron oxides content –hematite and goethite - , characterizing their spatial variability in soils of Brazil. Soil samples collected from an 800-hectare area were scanned in the visible and near-infrared spectral range. Moreover, chemometric calibration was obtained through partial least-squares regression (PLSR). Then, spatial distribution maps of the attributes were constructed using predicted values from calibrated models through geostatistical methods. The studied area presented soils with varied contents of iron oxides as examples for the Oxisols and Entisols. In the spectra of each soil is observed that the reflectance decreases with the content of iron oxides present in the soil. In soils with a high content of iron oxides can be observed more pronounced concavities between 380 and 1100 nm which are characteristic of the presence of these oxides. In soils with higher reflectance it were observed concavity characteristics due to the presence of kaolinite, in agreement with the low iron contents of those soils. The best accuracy of prediction models [residual prediction deviation (RPD) = 1.7] was obtained for goethite within the visible region (380-800 nm), and for hematite (RPD = 2.0) within the visible near infrared (380-2300 nm). The maps of goethite and hematite predicted showed the spatial distribution pattern similar to the maps of clay and iron extracted by dithionite-citrate-bicarbonate, being consistent with the iron oxide contents of soils present in the study area. These results confirm the value of DRS in the mapping of iron oxides in large areas at detailed scale.