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Detection of 'archaeological features' among reflectance spectra of natural soils and archaeological soils using principal component analysis (PCA)

Yoon Jung Choi (1,2), Johannes Lampel (1), David Jordan (3), Sabine Fiedler (2), and Thomas Wagner (1)

(1) Satellite Remote Sensing Group, Max Planck Institute for Chemistry, Mainz, Germany (y.choi@mpic.de), (2) Institute of Geography, Johannes Gutenberg University Mainz, Mainz, Germany, (3) School of Natural Sciences and Psychology, Liverpool John Moores University, Liverpool, UK

Archaeological terminology 'soil-mark' refers to buried archaeological features being visible on the ground surface. Soil-marks have been identified by archaeologists based on their personal experience and knowledge. This study suggests a quantitative spectral analysis method to detect such archaeological features.
This study identifies 'archaeological spectra' (reflectance spectra from surfaces containing archaeological materials) among various soil spectra using PCA (principal component analysis). Based on the results of the PCA, a difference (D) between the original spectrum and modified spectrum, which represents the principal component (PC) values of natural soils, can be determined. If the difference D between the two spectra is small, then the spectrum is similar to the spectral features of natural soils. If not, it identifies that the spectrum is more likely to be non-natural soil, probably an archaeological material.
The method is applied on soil spectra from a prehistoric settlement site in Calabria, Italy. For the spectral range between 400 to 700nm, the difference value D for archaeological material ranges from 0.11 to 0.73 (the value varies depending on the number of PCs used). For natural soil, D ranges only from 0.04 to 0.09. The results shows D value is significantly larger for archaeological spectra, which indicates that the method can be applied to identify archaeological material among an unknown group of soil spectra, if a set of samples of natural soils exists.
The study will present results of applying this method to various wavelength ranges and spectra from different sites. The major aim is to find optimised settings of the PCA method which can be applied in a universal way for identifying archaeological spectra.