SOIL ORGANIC CARBON PREDICTION IN CROPLANDS BY AIRBORNE APEX IMAGES USING LUCAS TOPSOIL DATABASE

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The quantitative prediction of soil properties using the first generation of hyperspectral satellite sensors is hampered by the very low signal to noise ratio (SNR) in the SWIR region for Hyperion imagers on board of the NASA EO-1 platform or by the restricted spectral range (415–1050 nm) for the Compact High Resolution Imaging Spectrometer (CHRIS) on the European Space Agency's PROBA platform. In the near future at least five satellites equipped with hyperspectral imagers are due to be launched: the German Environmental Mapping and Analysis Program (EnMap), the Italian PRecursore IperSpettrale della Missione Applicativa (PRISMA), the U.S. NASA Hyperspectral Infrared Imager (HyspIRI), the Japanese Hyperspectral Imager Suite (HISUI) and the China Commercial Remote-sensing Satellite System (CCRSS). A calibration/validation protocol is necessary to investigate the potentiality of these forthcoming hyperspectral imagers. In this regard, the PROSOIL project aims to exploit the potential of new generation of hyperspectral imagers, developing a standardized multivariate calibration approach valid for large areas and that requires minimal user inputs. For these purposes, LUCAS topsoil database was used to calibrate robust multivariate prediction models for the prediction of the OC content of 146 topsoil samples collected in croplands in Central Belgium and Gutland-Oesling region (Grand Duchy of Luxembourg). The predicted OC values at the sampling points were joined with hyperspectral remote data in order to predict OC over all bare soils of the two study areas.

A subset from LUCAS database was created selecting only the samples collected on croplands (LUCAS_agri). This subset was spilt into 7 classes, for this purpose, a matrix composed of all the soil variables of the LUCAS_agri database was clustered using the k-means algorithm and the optimal number of clusters was chosen through the ‘gap’ method. In order to make possible the comparison between the spectra acquired according with LUCAS protocol and those acquired with a new protocol 5Belgium and Luxembourg), we scanned again 153 samples of the LUCAS_agri dataset, transforming the LUCAS spectra into “new protocol” spectra by means of the External Parameter Orthogonalization (EPO) method.

The classified soil spectra of the LUCAS_agri were used as training data to classify soil spectra of the samples collected in Belgium and Luxembourg using an artificial neural network (ANN). After the class assignment, a partial least square regression (PLSR) model was carried out for each class of the LUCAS_agri dataset, which was used to predict OC content of the samples of the two study areas belonging to the same class. The predicted OC values obtained by the LUCAS_agri models were joined with airborne APEX hyperspectral data to obtain the OC maps of 90 fields. The APEX sensor was used as the new generation of hyperspectral satellites are not yet launched. The next step of the PROSOIL project will concern the simulation of satellite images starting from APEX data to test if the OC prediction from hyperspectral satellite sensors of new generation is feasible.

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