EGU21-15450
https://doi.org/10.5194/egusphere-egu21-15450
EGU General Assembly 2021

Testing PRISMA hyperspectral satellite imagery in predicting soil carbon content based on synthetized LUCAS spectral data

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The estimation of the soil organic carbon (SOC) content plays an important role for carbon sequestration in the context of climate change and soil degradation. Reflectance spectroscopy has proven to be promising technique for SOC quantification in the laboratory and increasingly from air and spaceborne platforms, where hyperspectral imagery provides great potential for mapping SOC on larger scales.

The PRISMA (PRecursore IperSpettrale della Missione Applicativa) is an earth-observation satellite with a medium spatial resolution hyperspectral radiometer onboard, developed and maintained by the Italian Space Agency.

The Pan-European Land Use/ Land Cover Area Frame Survey (LUCAS) topsoil database contains soil physical, chemical and spectral data for most European countries. Based on the LUCAS points located in Hungary, a synthetized spectral dataset was created and matched to the spectral characteristic of PRISMA sensor, later used for building up machine learning based models (random forest, artificial neural network). SOC levels for the sample area was predicted using generated models and mainly PRISMA imagery.

Our sample imagery data was generated from five consecutive, cloud-free PRISMA images covering 4500 km^2 in the central part of the Great Plain in Hungary, which is one of the most important agricultural areas of the country, used mainly for crops on arable lands. The images were recorded in 2020 February when most croplands are not covered by vegetation therefore our tests were implemented on bare soils.

We tested the prediction accuracy of hyperspectral imagery data supplemented by various environmental datasets as additional predictor variables in four scenarios: (i) using solely hyperspectral imagery data (ii) spectral imagery data, elevation and its derived parameters (e.g. slope, aspect, topographic wetness index etc.) (iii) spectral imagery data and land-use information and (iv) all aforementioned data in fusion.

For validation two types of datasets were used: (i) measured data at the observation sites of the Hungarian Soil Information and Monitoring System and (ii) the recently compiled national SOC maps., which provides a suitable and formerly tested spatial representation of the carbon stock of

the Hungarian soils.

Acknowledgment: Our research was supported by the Cooperative Doctoral Programme for Doctoral Scholarships (1015642) and by the OTKA thematic research projects K-131820 and K-124290 of the Hungarian National Research, Development and Innovation Office and by the Scholarship of Human Resource Supporter (NTP-NFTÖ-20-B-0022). Our project carried out using PRISMA Products, © of the Italian Space Agency (ASI), delivered under an ASI License to use.