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

Zsófia Kovács, Mátyás Árvai, Annamária Laborczi, Gábor Szatmári, János Mészáros, Péter László, László Pásztor
Goals

- the prediction accuracy of PRISMA (PRecursore IperSpettrale della Missione Applicativa - Hyperspectral Precursor of the Application Mission) satellite hyperspectral imagery data supplemented by various environmental datasets as additional predictor variables in four scenarios:
  - using solely hyperspectral imagery data
  - spectral imagery data, elevation and its derived parameters (e.g. slope, aspect, topographic wetness index etc.)
  - spectral imagery data and land-use information and
  - all aforementioned data in fusion.
Study area

- Image acquisition: 23-04-2021
- Spectral bands (VNIR 400-1010 nm; SWIR 920-2505 nm) filtered leaving out atmospheric absorption wavelengths or bands with too much striping error:
  - 400-475 nm
  - 905-1010 nm
  - 1095-1160 nm
  - 1320-1490 nm
  - 1780-2030 nm
  - 2300-2505 nm
- Spatial resolution: 30 m
LUCAS spectral data resampled for PRISMA spectral bands (without atmospheric absorption bands)

<table>
<thead>
<tr>
<th>Pearson correlation</th>
<th>Wavelength range (nm)</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.81</td>
<td>590-664 nm</td>
<td>Ben-dor et al. 1997.; Castaldi et al. 2019; Rossel et al. 2010</td>
</tr>
<tr>
<td>-0.88</td>
<td>900-1200 nm</td>
<td>Rossel et al. 2010</td>
</tr>
<tr>
<td>-0.85</td>
<td>2100-2300 nm</td>
<td>Ben-dor et al. 1997,2009; Biney et al. 2020</td>
</tr>
</tbody>
</table>
Image pre-treatment (cloud masking, spectral smoothing, NDVI, NBR filtering of dry bare soil pixels)

Subsampling LUCAS spectrum to PRISMA filtered spectral band

LUCAS

SOC-PRISMA sampled spectrum correlations

PRISMA

Sampling

Generated 10 x 2000 random sampling

Sampling

Data frame with SOC predictor variables

RF modelling

Loop 10x

Predicted SOC maps

Averaged predicted SOC map

Validation

National SOC maps (carbon stock Hungarian soils)

Processing pipeline
## Results

<table>
<thead>
<tr>
<th>Datatype</th>
<th>MEAN</th>
<th>MIN</th>
<th>MAX</th>
<th>SD</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum</td>
<td>-0.006</td>
<td>-2.866</td>
<td>5.549</td>
<td>0.785</td>
<td>0.588</td>
</tr>
<tr>
<td>Spectrum+ Indices</td>
<td>-0.028</td>
<td>-2.990</td>
<td>5.448</td>
<td>0.783</td>
<td>0.586</td>
</tr>
<tr>
<td>Spectrum+ Indices + DEM</td>
<td>-0.011</td>
<td>-2.783</td>
<td>3.937</td>
<td>0.495</td>
<td>0.869</td>
</tr>
</tbody>
</table>

![Scatter plot with regression line]
Thank you for your kind attention

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.