ABSTRACT

While the mapping of LAI green (LAIG) is well established, current operational products are not calibrated for LAI brown (LAIB), i.e. LAI estimation over senescent vegetation. With Sentinel-2 mission (S2), new opportunities are opened to estimate LAIb. The HORIZON 2020 SENTINEL Synergy for Agriculture (SENSAGRI) project aims to develop an agricultural prototype service for the simultaneous retrieval of both LAIG and LAIB. By using LAI ground measurements data from multiple campaigns together with available S2 data, independent LAIG and LAIB models were optimized using Gaussian processes regression (LAIG: R2 = 0.91, RMSE= 6.6%; LAIB: R2 = 0.76, RMSE= 23.5%). These models can then be combined into LAIGB composite maps. The uncertainty estimates were used to map only those LAI estimated values that fall within a 40% uncertainty threshold.

OBJECTIVES

1. To develop independent GPR models for an explicit quantification of LAIG and LAIB based on S2 data.
2. To implement these models in an automated processing chain.
3. To convert S2 images into LAIGB composite maps of various European sites.

METHODS

1. Gaussian Processes Regression (GPR)

   Training datasets
   - LAI green
   - LAI brown

   Model development
   - MALTAB ARTMO

   Validation
   - Cross validation [CV] statistics of GPR models LAIG and LAIB. All statistics are averaged 4-fold.

<table>
<thead>
<tr>
<th>Model</th>
<th>RMSE LAIG [m²/m²]</th>
<th>NRMSE LAIG (%)</th>
<th>RMSE LAIB [m²/m²]</th>
<th>NRMSE LAIB (%)</th>
<th>R² LAIG</th>
<th>R² LAIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAIG</td>
<td>0.62</td>
<td>6.63</td>
<td>28.42</td>
<td>91.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAIB</td>
<td>0.54</td>
<td>13.54</td>
<td>63.02</td>
<td>76.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. LAIG and LAIB processing into a composite map

   - LAI mean estimate μ [m²/m²]
   - SD [m²/m²]
   - CV [%]

   Training datasets
   - Malts

   Mask
   - Level 2A
   - 30 bands (VNP & SWIR)
   - 20 m pixel size

   Validation
   - Cross validation [CV] statistics of GPR models LAIG and LAIB. All statistics are averaged 4-fold.

   Composite map

RESULTS

Crop temporal evolution

A set of S2 images from the Valladolid region ranging from January to June 2017 were selected and subsequently processed into LAI maps in order to evaluate the temporal evolution of two different crop parcels described by LAIG and LAIB (mean and standard deviation).

CONCLUSIONS

- LAIG and LAIB GPR models have been successfully implemented into a processing chain for independent LAI retrieval from available S2 images. The uncertainty estimates were used as a threshold to ensure that only vegetated surfaces are quantified into LAIg and LAIB.
- The robustness and portability of the GPR models have been positively evaluated by mapping LAIGB composites over multiple European locations. All maps show a relatively good performance.
- The temporal performance of the GPR models suggests a reasonable LAI seasonal evolution with sensing that emerges from April onwards.

REFERENCES