A European parcel level crop type map based on Sentinel 1 and LUCAS Copernicus in-situ observations

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5 May 2020
• On-site data collection
• Land use / land cover
• Environmental information
• EU-wide (28 countries)
• Standard survey methodology: Two phase sampling, classifications, data collection processes.
• Adapted to policy needs: Flexible, ad-hoc modules.
• Reduced statistical burden: No questionnaires for farmers, land owners.
LUCAS Copernicus in-situ survey - polygons

The training dataset is built from Copernicus LUCAS 2018

- LUCAS Copernicus component is a pilot to provide in-situ data for training and validation algorithm for remote sensing data
- Exact location of the observation (VS theoretical for normal LUCAS)
- Pure Land Cover extent within 50 m from the points (N, E, S, W)
- 63,364 LUCAS points surveyed with the Copernicus requirements
- Cleaning and construction of polygons

Table 2. Filtering of the LUCAS points in order to obtain high-quality LUCAS points (conditions 1 to 6) and LUCAS Copernicus polygons (conditions 1 to 8).

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
<th>Variable</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Observation selected only if the point was visible (i.e. direct observation)</td>
<td>OBS_TYPE = 3</td>
<td>215210</td>
</tr>
<tr>
<td>2</td>
<td>Observation is on the point</td>
<td>OBS_DIR = 1</td>
<td>32807</td>
</tr>
<tr>
<td>3</td>
<td>Parcel area &gt;0.1 Hectare</td>
<td>PARCEL_AREA_HA &gt;1</td>
<td>319513</td>
</tr>
<tr>
<td>4</td>
<td>Land cover class covers more than 80% of the observation</td>
<td>LCI_PERC &gt;0.8</td>
<td>292371</td>
</tr>
<tr>
<td>5</td>
<td>LUCAS survey was possible</td>
<td>CRPND_CANDO = 1</td>
<td>62364</td>
</tr>
<tr>
<td>6</td>
<td>Next land cover in N, E, S, W is further than 5 meters</td>
<td>min(CRPN_LCN, CRPNC_LCN, CRPNC_LCNw, CRPNC_LCNs) &gt; 5 OR DIST &gt; 40</td>
<td>59210</td>
</tr>
<tr>
<td>7</td>
<td>Distance to theoretical point should be smaller than 45 meters</td>
<td>LCI (level 2) = CRPNC_LCN</td>
<td>60347</td>
</tr>
<tr>
<td>8</td>
<td>Land cover class observed at the Copernicus point has the same Land cover (level 2) as the LUCAS point</td>
<td>LCI (level 2) = CRPNC_LCN</td>
<td>193023</td>
</tr>
</tbody>
</table>

Filtered LUCAS points (fulfilling conditions 1 to 6) | 154027
Filtered LUCAS Copernicus polygons (fulfilling condition 1 to 8) | 42835
Sentinel 1 GRD

Sentinel-1 GRD accessed in Google Earth Engine

- 10 days average VV and VH backscatter
- 1st January to 31st of July 2018
- 10-meter resolution
Crop type mapping at European scale (prototype)

2018 map at 10m with S1 data (01-03 to 31-08)
First crop type map at the scale of Europe using Sentinel-1 data and in-situ LUCAS Copernicus survey

- **Input data**: Sentinel-1 GRD
  - 10 days average VV and VH backscatter
  - 1st January to 31st of July 2018
  - 10 meter resolution

- **Training dataset**: LUCAS Copernicus in-situ survey 2018
  42,795 polygons (6,905 for cropland)

- **Supervised classification**: Random Forest Classifier
  Hierarchical legend
  - Level 1) land cover
  - Level 2) crop types

- **Validation**: LUCAS Copernicus in-situ survey 2018
  111,212 points (26,273 for cropland)
Prediction of the Classification

- Prediction at scale for Europe on the JEODPP (JRC infrastructure)
- Example for a tile (border Germany and Austria)
Main crop type accuracy

LUCAS point as Validation dataset
Prediction at the end of July (22 decades of VV and VH backscatter)
Producer accuracy, User accuracy and F-1 score for main crops

<table>
<thead>
<tr>
<th></th>
<th>Cereals</th>
<th>Root crops</th>
<th>Non permanent industrial crops</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Common Wheat</td>
<td>Durum Wheat</td>
<td>Barley</td>
</tr>
<tr>
<td>Producer Accuracy (omission) %</td>
<td>81</td>
<td>53</td>
<td>51</td>
</tr>
<tr>
<td>User Accuracy (commission) %</td>
<td>58</td>
<td>57</td>
<td>60</td>
</tr>
<tr>
<td>F1 score %</td>
<td>68</td>
<td>55</td>
<td>55</td>
</tr>
</tbody>
</table>
Conclusions

LUCAS Copernicus component has high potential for remote sensing community to generate timely LC information and more:

- Location and validation of Land Cover boundaries
- Training and validation database for automatic image recognition
- Extending a professional survey using citizen science approaches
- Contributing to global free & open in-situ databases for EO analysis
- Linking sample and areal based Land Cover extent estimates
- Trigger better integration of statistical and geospatial domains