Multi-Scale and Multi-Temporal satellite data fusion for land cover mapping via Deep Learning

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Outline

Data Description

Deep Learning Architecture

Results and Findings

Conclusion and Future Works
Data Description

Reunion Island Study Site:
- Covered Area: 2512 Km²
- French Department located in Indian Ocean

Goal of the Land cover mapping task: **A 13 classes classification**

We used two sources of the data:
- Time Series of Optical Satellite Images (Sentinel-2)
  - Acquired between April 2016 and May 2017
  - 34 images at 10m of resolution
- A Very High Spatial Resolution (VHSR) Image SPOT6/7
  - Acquired in April 2016
  - 1 image at 1.5m of resolution (resampled at 2m)

Reunion Dataset Characteristics

<table>
<thead>
<tr>
<th>Class</th>
<th>Label</th>
<th># Objects</th>
<th># Pixels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crop Cultivations</td>
<td>380</td>
<td>12090</td>
</tr>
<tr>
<td>2</td>
<td>Sugar cane</td>
<td>496</td>
<td>84136</td>
</tr>
<tr>
<td>3</td>
<td>Orchards</td>
<td>299</td>
<td>15477</td>
</tr>
<tr>
<td>4</td>
<td>Forest plantations</td>
<td>67</td>
<td>9783</td>
</tr>
<tr>
<td>5</td>
<td>Meadow</td>
<td>257</td>
<td>50596</td>
</tr>
<tr>
<td>6</td>
<td>Forest</td>
<td>292</td>
<td>55108</td>
</tr>
<tr>
<td>7</td>
<td>Shrubby savannah</td>
<td>371</td>
<td>20287</td>
</tr>
<tr>
<td>8</td>
<td>Herbaceous savannah</td>
<td>78</td>
<td>5978</td>
</tr>
<tr>
<td>9</td>
<td>Bare rocks</td>
<td>107</td>
<td>18659</td>
</tr>
<tr>
<td>10</td>
<td>Urbanized areas</td>
<td>125</td>
<td>36178</td>
</tr>
<tr>
<td>11</td>
<td>Greenhouse crops</td>
<td>50</td>
<td>1877</td>
</tr>
<tr>
<td>12</td>
<td>Water Surfaces</td>
<td>96</td>
<td>7349</td>
</tr>
<tr>
<td>13</td>
<td>Shadows</td>
<td>38</td>
<td>5230</td>
</tr>
</tbody>
</table>

Total of 322 748 pixels (2656 objects) over 13 classes
Method Description

M3Fusion: Multi-{Scale/Modality/Temporal} data fusion architecture

Sentinel-2 Time Series at High Spatial Resolution

T1 T2 T3 Tn

25 x 25 patch extracted from Spot 6/7 VHSR image

RNN

Feature Fusion

Fusion Classifier

CNN

CNN Auxiliary Classifier

RNN Auxiliary Classifier
Map Production

Random Forest Map

M3Fusion Map
Conclusion and Future Works

Conclusion:

- A deep architecture to merge Multi-Scale and Multi-Temporal Data
- To our knowledge, this is the first DL method to make this kind of Data Fusion (S2-SPOT6/7)
- Performance results underline the quality of the proposed approach

Future Works:

- Perform the same kind of analysis in other study sites
- Study more in depth the fusion process performed by our Architecture