How to estimate SOC from satellite images in the upcoming no-tillage era?

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Background

At least a revisit time of 5-7 days for soil properties mapping (Mzid et al. 2021)

Vaudour et al. 2021

Figure 1. Histogram of publications of satellite-derived SOC studies according to year.
Proposed solution

“To destroy an enemy make him your friend.”

- VEGETATION vs SOC -> indirect
- Crop, Weather condition, diseases, growing stage...
- Looking for VIs correlated to SOC - > NDVI, GNDVI, SATVI, EVI
- Sum of the yearly maximum values for each VI -> covariates

\[
\sum \left( \text{maxVI}_1 + \text{maxVI}_2 + \text{maxVI}_3 \right) = \text{VEG}_{-\text{cov}}
\]
## SCENARIO

<table>
<thead>
<tr>
<th>Conventional tillage</th>
<th>BS (S2 bands), VEG (4 VIs), GP</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No or Minimum tillage</td>
<td>VEG, GP</td>
<td>3</td>
</tr>
</tbody>
</table>

### COVARIATES

**BS (S2 bands)**

**VEG (4 VIs)**

**GP**

### Models

<table>
<thead>
<tr>
<th>n°572</th>
</tr>
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</table>

**SOCRATE dataset**

**TRAINING 80%**

**CUBIST MODEL**

**TESTING 20%**
### Results

#### RPIQ

<table>
<thead>
<tr>
<th>COVARIATES</th>
<th>GLOBAL</th>
<th>CAMBISOLS</th>
<th>LUVISOLS</th>
<th>FLUVISOLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>1.63</td>
<td>1.87</td>
<td>0.8</td>
<td>2.50</td>
</tr>
<tr>
<td>BS+VEG</td>
<td>1.61</td>
<td>2.14</td>
<td>1.26</td>
<td>2.19</td>
</tr>
<tr>
<td>BS+GP</td>
<td>1.73</td>
<td>2.76</td>
<td>1.26</td>
<td>3.1</td>
</tr>
<tr>
<td>BS+GP+VEG</td>
<td>1.82</td>
<td><strong>3.06</strong></td>
<td><strong>1.27</strong></td>
<td>2.19</td>
</tr>
</tbody>
</table>

#### RPIQ

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</tr>
</thead>
<tbody>
<tr>
<td>VEG</td>
<td>1.18</td>
<td>1.10</td>
<td>1.35</td>
<td>1.03</td>
</tr>
<tr>
<td>GP</td>
<td><strong>1.63</strong></td>
<td><strong>2.13</strong></td>
<td>1.44</td>
<td>1.89</td>
</tr>
<tr>
<td>VEG+GP</td>
<td>😞 1.63</td>
<td>😞 2.08</td>
<td>😊 <strong>1.63</strong></td>
<td>😊 <strong>2.38</strong></td>
</tr>
</tbody>
</table>
Conclusions

- Stratified models > Global models
- Better accuracy for conv. tillage scenario except for LUVISOLS
- For no tillage scenario VEG covariates can allow to increase accuracy in LUVISOLS and FLUVISOLS

Next steps

- More indices or new approaches
- Add other covariates
- More years
- ‘Local’ models
- Collect suggestions
Thank you for your attention

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