The influence of soil moisture on the spatial and temporal variability of soil electrical conductivity

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Overview

- Soil electrical conductivity (EC) is a soil quality indicator associated to attributes of interest for site-specific soil management such as soil moisture and texture.
- EC is important for tropical agricultural soils, especially because they usually have low levels of dissolved salt.
- Since EC, texture and moisture are expected to be correlated, the present study performed spatial monitoring of soil moisture in two experimental fields with different texture over two consecutive years and evaluated the influence of moisture on soil EC.

Material and Methods

- Field 1 covers 18.9 ha, with altitude of 826 m and dystrophic red latosol (oxisol) with moderate A horizon and medium texture.
- Field 2 covers 22.2 ha, with altitude of 533 m, and predominance of alic red latosol (oxisol) with moderate A horizon and medium texture.
- Soil EC was measured with a Veris 3100® direct-contact sensor (Veris Technologies, Inc., Salina, KS, USA).
- Only the shallow soil layer (0 to 0.3 m) is presented here.
- Field 1 (subtropical) was studied in October 2003 and June 2004 and Field 2 (tropical) in October 2003 and October 2004.

Material and methods

- While the sensor was pulled over the fields, soil samples were collected and georeferenced to determine moisture content in the 0.3 m layer.
- To determine soil texture by Bouyoucos’s method, 5 sub-samples were collected at each sampling site.
- After an exploratory and discrepant data analyses the spatial dependence analyses were conducted and data were interpolated by ordinary block kriging using Vesper 1.6 at 10 m x 10 m pixels.
- EC, moisture and clay content values were interpolated to obtain coefficients of determination ($r^2$).

Results

Field 1

<table>
<thead>
<tr>
<th>Year</th>
<th>EC (mS m$^{-1}$)</th>
<th>Soil moisture (%)</th>
<th>Clay content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Experimental Field Location

Field 1

Field 2
Results

Semi-variogram models and parameters fitted to the soil attributes studied

<table>
<thead>
<tr>
<th>Year</th>
<th>Attribute</th>
<th>Model</th>
<th>C0</th>
<th>Sill (C1)</th>
<th>SC (C2)</th>
<th>%/CV</th>
<th>R2</th>
<th>Field 1</th>
<th>Field 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>03</td>
<td>EC</td>
<td>Sph.</td>
<td>0.1352</td>
<td>2.9042</td>
<td>135.9</td>
<td>4.60</td>
<td>Strong</td>
<td>6.80E-03</td>
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<tr>
<td>03</td>
<td>Moisture</td>
<td>Sph.</td>
<td>0.0001</td>
<td>0.0633</td>
<td>168.7</td>
<td>0.16</td>
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<td>6.71E-05</td>
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<td>04</td>
<td>EC</td>
<td>Sph.</td>
<td>0.1358</td>
<td>2.9779</td>
<td>140.8</td>
<td>5.07</td>
<td>Strong</td>
<td>3.06E-02</td>
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<tr>
<td>04</td>
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<td>Sph.</td>
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<td>19.3800</td>
<td>168.9</td>
<td>0.05</td>
<td>Strong</td>
<td>30.76</td>
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<td>Sph.</td>
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<td>153.0</td>
<td>0.13</td>
<td>Strong</td>
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<tr>
<td>03</td>
<td>Cl.</td>
<td>Exp.</td>
<td>0.8234</td>
<td>3.1516</td>
<td>24.5</td>
<td>62.79</td>
<td>Med.</td>
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<td>0.0122</td>
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<td>Exp.</td>
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<td>4.76</td>
<td>Strong</td>
<td>2.22E-06</td>
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<tr>
<td>04</td>
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<td>Exp.</td>
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<td>0.0204</td>
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<td>50.41</td>
<td>Strong</td>
<td>3.19E-05</td>
<td></td>
</tr>
</tbody>
</table>

- **Sph.** = Spherical model
- **Exp.** = Exponential model
- **Med.** = Median
- **SC (C2)** = Spatial Correlation
- **%/CV** = Percentage of variation
- **R2** = Coefficient of determination

Conclusions

- Soil moisture content exhibits a high degree of spatial dependence.
- A correlation between soil moisture and EC was found only in experimental Field 1, which had a higher soil moisture range.
- An important result is data repetition over the years, suggesting that EC is a qualitative indicator in areas with high spatial variability in soil texture.
- In Field 2, where soil moisture range was lower, EC was not associated to moisture level.

Acknowledgements

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