Gamma and Electro Magnetics

A multi-sensor approach for the mapping of water related soil properties

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“A multi-sensor approach for the mapping of water related soil properties”

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The motive

• To talk about multi-sensor systems is cool.
• Not too much published research on gamma and EM/EC:
  ➢ Australia: complementary.
  ➢ Sweden: comparison.
• TSC has a lot of combined EM/Gamma data.
• Different approach: combined survey, individual mapping.

Project outline

• Two water management projects from 2007.
• Agricultural area north east part of the Netherlands.
• Integral approach: government & land users & suppliers.
• Testing new technology: Sentek soil water probes & HRDSM.

Sensors (1)

Sensor output:

0-30 cm
➢ Top soil HRDSM physical soil properties gamma based (TSC the Mole)

0-50 cm
➢ Top soil real time water content every 10 cm (Sentek EasyAg)

0-80 cm
➢ Compaction subsoil (DJ Compaction tester)

0-100 cm
➢ Soil profiles (Geonics EM38)

Sensors (2)
Analysis
Assumptions TSC:
• Gamma ray best for quantitative soil property mapping top soil.
• EM best for qualitative mapping subsoil soil profiles.
But are the data sets of gamma ray and EM independent to apply such an approach?

Analysis: data
Soil variation:
• Top soil:
  - Organic matter: 3.7% - 40.6%.
  - Loam content (50 µm): 6.5% - 27.8%.
• Sub soil:
  - Composition of layers.
  - Layer thickness.

Analysis: data
• Random selection 15 fields, analysis of:
  - Nuclide data:
    - Total Counts, ^{40}K, ^{238}U, ^{232}Th and ^{137}Cs.
  - EM data.
• Based on grid data:
  - 5 meter.
  - Average field size 5-6 ha.

Analysis
• Statistical analysis shows that hardly correlation exists between Gamma ray and EM data.
• Table below provides an overview of the outcome for all 15 fields:

<table>
<thead>
<tr>
<th></th>
<th>^{40}K-EM</th>
<th>^{238}U-EM</th>
<th>^{232}Th-EM</th>
<th>^{137}Cs-EM</th>
<th>Total Counts-EM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0.001</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Maximum</td>
<td>0.158</td>
<td>0.230</td>
<td>0.168</td>
<td>0.163</td>
<td>0.314</td>
</tr>
<tr>
<td>Average</td>
<td>0.033</td>
<td>0.065</td>
<td>0.023</td>
<td>0.030</td>
<td>0.073</td>
</tr>
</tbody>
</table>

Conclusions
• Both sensor systems provide independent data.
• For the investigated area with clear distinction in layers of top soil and subsoil a multi-sensor approach was useful.
• Top soil could be well mapped with passive gamma ray sensor technology.
• Sub soil could be well mapped with EM sensor technology.
Thank you for your attention.