Gamma and Electro Magnetics

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

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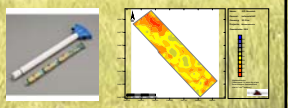
The motive

- 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)

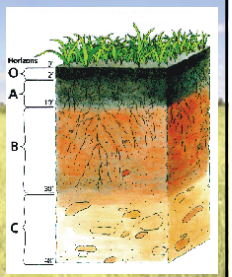
Sensor output:

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

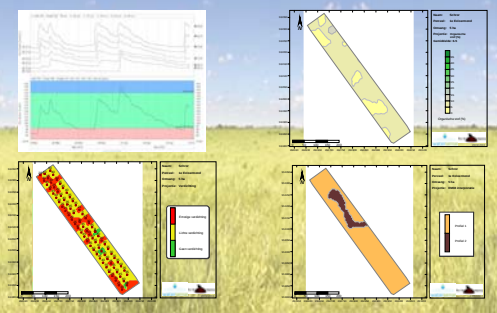
0-50 cm
- Top soil real time water content every 10 cm (Sentek EasyAg).

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

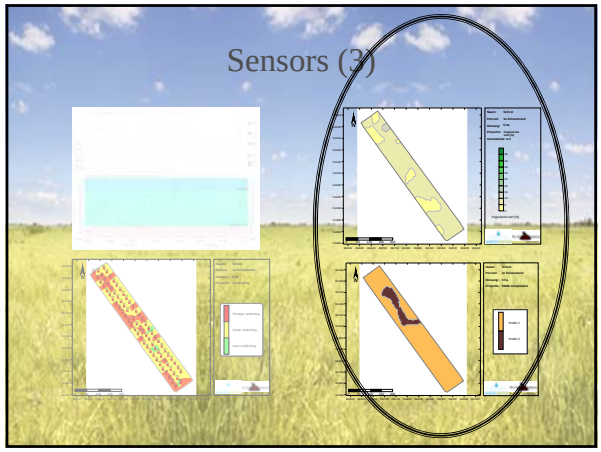
0-100 cm
- Soil profiles (Geonics EM38)



Sensors (2)



Sensors (3)



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

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

- Random selection 15 fields, analysis of:
  - Nuclide data:
    Total Counts, ^{40}K, ^{238}U, ^{232}Th and ^{137}Cs.
  - EM38 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:

R^2	^{40}K-EM	^{238}U-EM	^{232}Th-EM	^{137}Cs-EM	Total Counts-EM
Minimum	0.001	0.000	0.000	0.000	0.000
Maximum	0.158	0.230	0.169	0.163	0.314
Average	0.035	0.045	0.023	0.030	0.073

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.

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