Geo-information for farmlands in Spain

**Gamma-spectrometer results**, field observations during measurements and open data (LASAR-based DEM, geology, BING imagery).

The soil structure marked yellow ("time slice") shows higher reflection values in the 0-20 cm topsoil (right) in the north of the southern field. This corresponds with a higher concentration of stones, continuing below 20 cm depth. At the northwestern part of the field higher values correspond to compaction of the topsoil. The subsoil (right) on the southern field is more compacted than the topsoil and comparable to the subsoil at the northern field. This is expected based on the geology. On the northern field we also observed more stones at the soil surface, thus explaining the higher reflections in the topsoil time slice.

**Ground Penetrating Radar (GPR) for soil rooting depth, compaction, layering**

Time slice analysis of topsoil and subsoil aided by GPR imaging, gammaspectrometer results, field observations and open data (LASAR-based DEM, geology, BING imagery).

- Full-spectrum analysis using Gamma-ray spectrometrygammaspectrometer results, field observations during measurements and open data (LASAR-based DEM, geology, BING imagery).
- Efficient and detailed soil mapping.

The methodology was developed and applied within the ‘Crops for better soil’ LIFE+ project LIFE10/ENV/ES 471.

The aim of the project (2011–2016) was to demonstrate sustainable farming on 400 ha of land in the north of Spain. This was achieved by changing to organic farming, by introducing traditional crops suitable for local conditions and by enhancing crop rotation. This required a thorough understanding of the soil fields and its crop growth possibilities.

The results of the project are promising and show how farmers can improve financial yields and soil quality at the same time.

**Application example: Illana (Guadalajara, Castilla-La Mancha, Spain)**

The main maps of two neighboring fields in Illana are analyzed on soil characteristics.

- Derived maps
  - MAGNA 50 geological maps
  - Digital Elevation Model (DEM)
  - Geology (left)
  - Parent material is equal. The aerial photograph (right) shows a small river flowing to the north of the field.
  - The texture (right) right shows a consistent pattern on both sides of the road.

The soil structure marked yellow ("time slice") shows higher reflection values in the 0-20 cm topsoil (left) in the north of the southern field. This corresponds with a higher concentration of stones, continuing below 20 cm depth. At the northwestern part of the field higher values correspond to compaction of the topsoil. The subsoil (right) on the southern field is more compacted than the topsoil and comparable to the subsoil at the northern field. This is expected based on the geology. On the northern field we also observed more stones at the soil surface, thus explaining the higher reflections in the topsoil time slice.

**OUTLOOK LIFE PROJECT**

The project developed an approach for sustainable organic farming in semi- and conditions (Spain). Key in this approach is the methodology for fast, efficient and detailed soil mapping.

A business case successfully demonstrated how sustainable farming increase financial benefits for farmers and as a result, one farmer is converting 500 ha to organic farming and will continue experimenting.

**REFERENCES**

4. IGME http://mapas.igme.es/Services/default.aspx

**OUTLOOK**

We showed that soil mapping is not only about generating geo-information, but that generating knowledge of agricultural fields also requires effective communication. Maps of soil properties can be a tool for communicating about farmlands. The GIS-based knowledge of soils has an added value application in various types of land management. Varying from vineyards, irrigated high-value crops, field trials and agroforestry to organic crop lands.

**MULTI SENSOR SOIL SENSING TOOL**

For Farmland in Spain

F.M. van Egmond, R.L. Koomans, Medusa Explorations BV www.medusa-online.com

**GEO INFORMATION**

- **Agribox**
  - A fast, efficient, flexible and robust setup for mapping farmlands.
  - Gamma-spectrometer MS4000 (4L CsI Medusa)
  - GPS (500 MHz ZOND)
  - Data integration unit
  - Fieldbook

Open Data supplied by IGME

Open Data (LIDAR based DEM, geology, BING imagery).

**UNDERSTANDING SOILS**

Generating geo-information is a first step in the process of generating knowledge on soil properties. The information forms a good basis for communication with experts, farmers and agronomists.

**Field validation**

Adding information from local soil pits, quantifies the geo-information with knowledge of soil experts. The locations of these pits are selected based on the anomalies found in the geo-information.

**Expert knowledge**

Knowing the history of the field (management) and its characteristics as experienced by the farmer improves interpretation. Discussions between geo and soil experts and field experts (farmers) help both to understand the variations in the maps.

**Local assessment**

Qualitative information from the user and quantitative geo-information are explicitly incorporated in the analysis and communication. As a result the user will understand and trust the result and qualify the data as a true representation and quantification of his field. He is therefore more likely to use the data for management decisions in smart farming (precision agriculture). It allows him to enter his knowledge in his (GIS based) farm management system and use it in his field maps.

As a result of the analysis the information is summarised in a table which links to the maps with an id.