Crops for better soil

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Sensing Soil Phvsical Properties

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Physical soil properties

Soil physical properties measured in 2012 and 2015 to:

- Provide quantitative data for agronomic assessment and crop planning
- Assess any differences in soil properties due to the project methodology

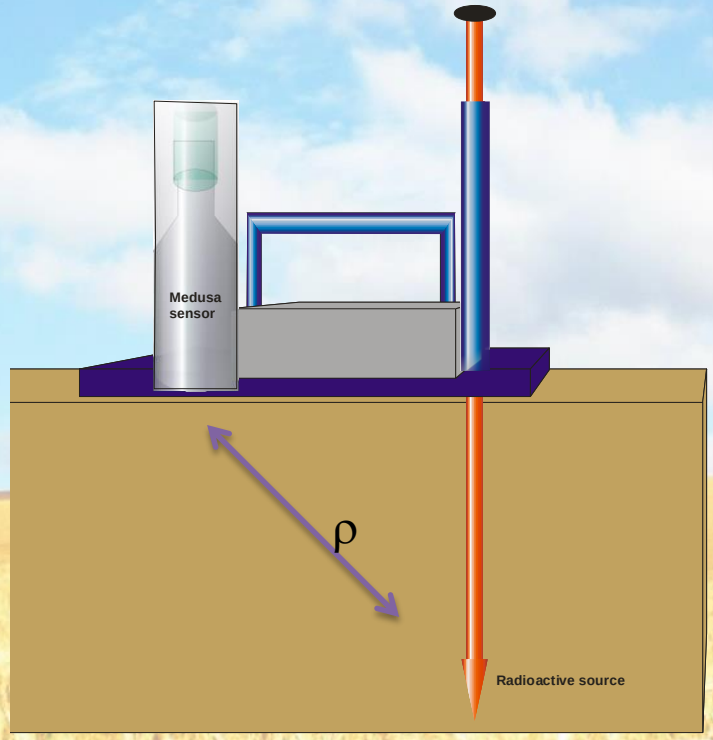
This was done by:

- Sampling by Universidad Polítecnica de Madrid
- Scanning with the Agribox by Medusa
    - Gammaspectrometer
    - GPR: radar

Futhermore we performed field tests with:

- A decompactador to test the effect of improved soil structure in Illana
- Other projects and Spanish partners to test the methodology in agro-forestry, orchards and vineyards

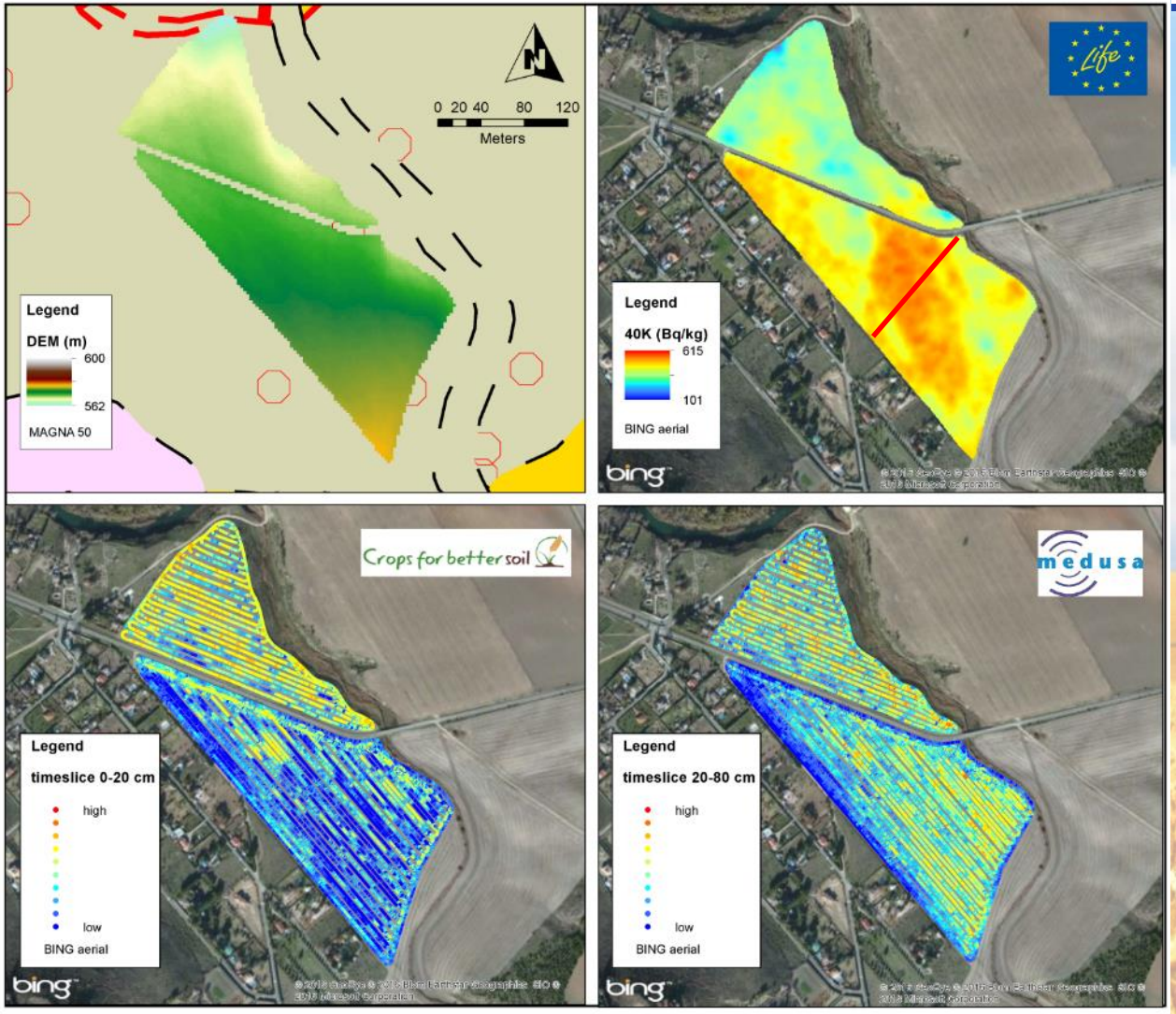
Actual Bulk Density - RhoC



Density over 15 cm

Actual Bulk Density - RhoC

Soil structure test - Descompactador



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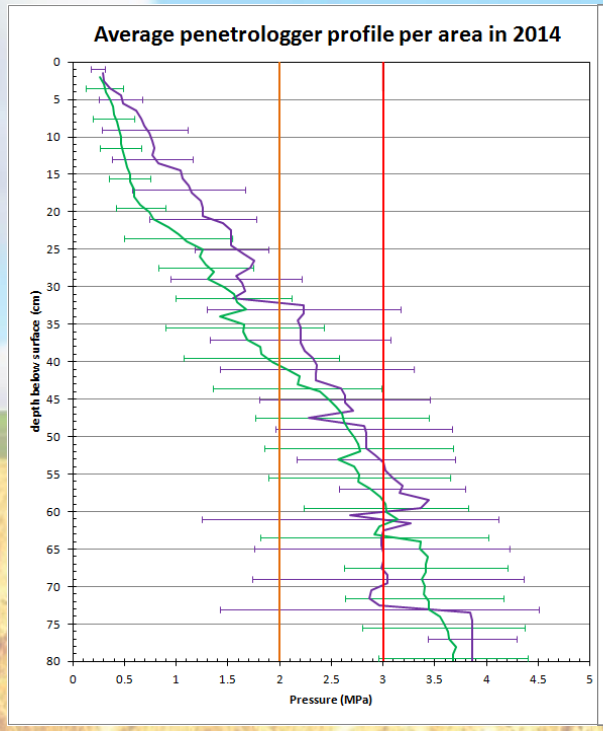
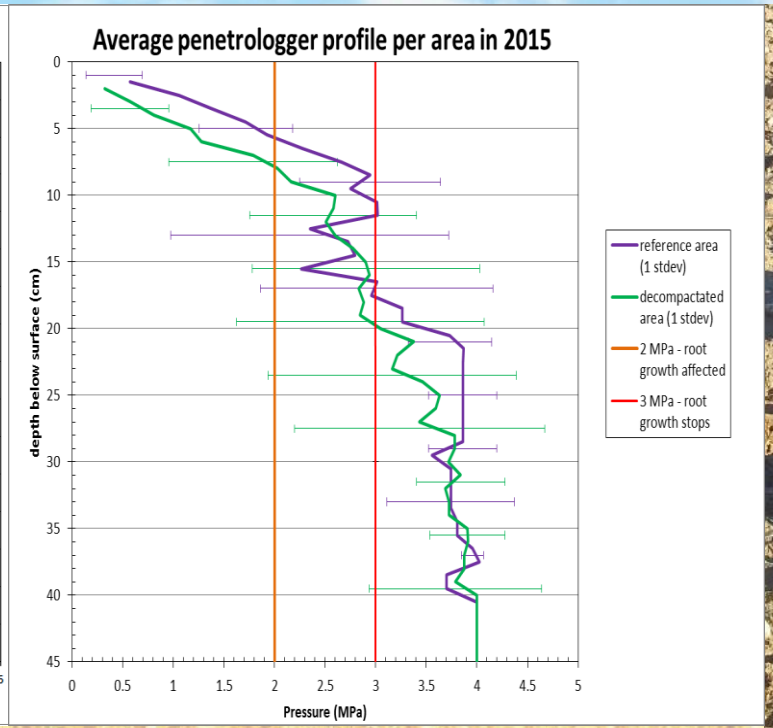
Soil structure test - Descompactador

	2013			2014		2015	
	not treated	treated	*ref_treated*	not treated	treated	not treated	treated
soil bulk density (g/cm^3)	1.54	1.32	*1.55*	1.41	1.57	1.70	1.60
soil rooting depth (cm)	10	32	*14*	57	64	22	21





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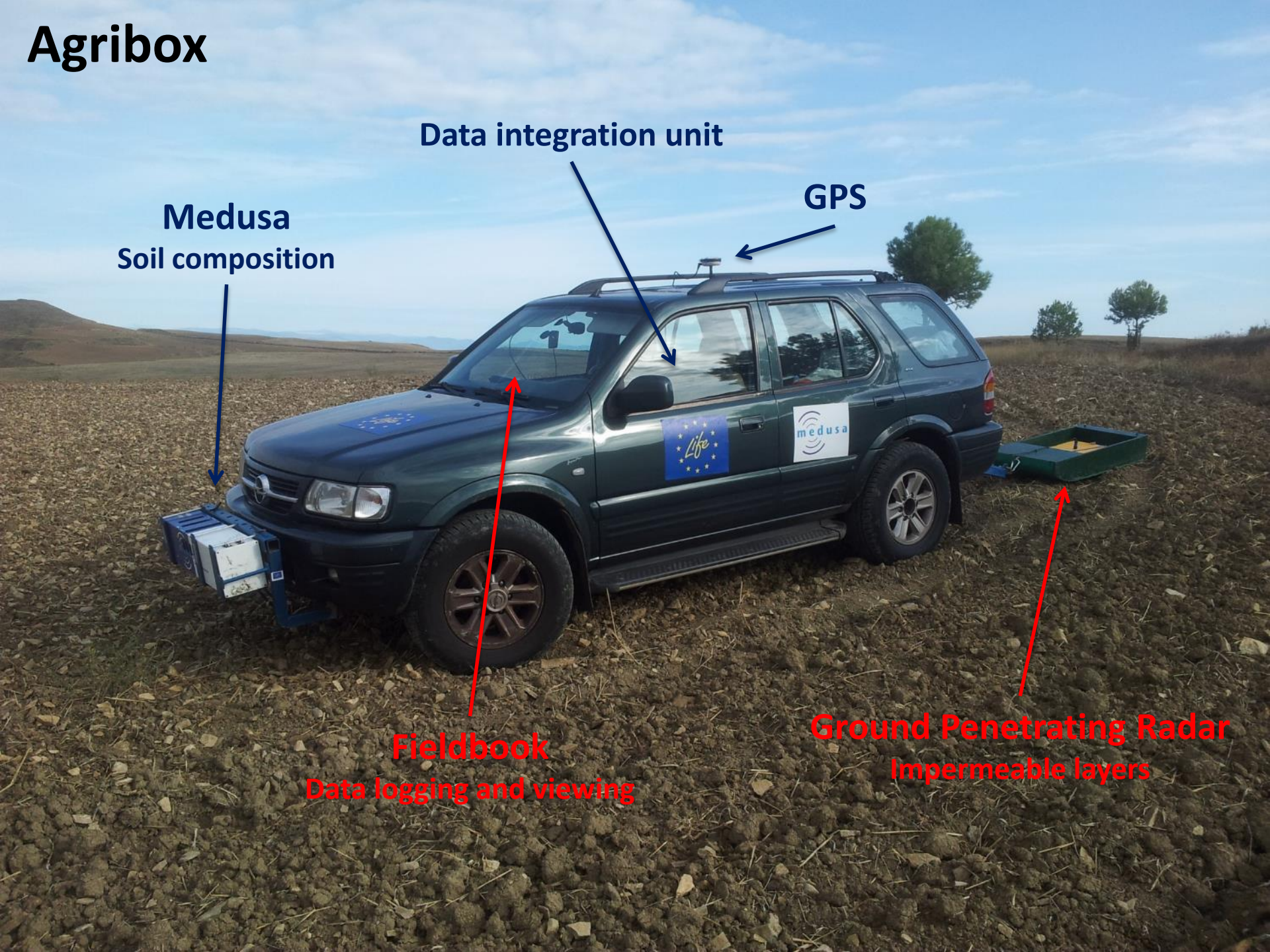
Physical soil properties - Agribox

Agribox


Data integration unit
GPS
Medusa
Soil composition
Fieldbook
Data logging and viewing
Ground Penetrating Radar
Impermeable layers

Agribox - Benefits

- System powered by the car engine
- Build-up time 5 minutes per field
- Flexible and robust
- Fast (4-6 hectare/hour)
- High data density, resulting in field covering data
- Much detail; enables precision farming and analysis of within field and between field analysis of soil variation
- Map of raw data visible during sensing:
  - Enhances communication between owner and operator
  - Improves the understanding of the geology and soil of the field.

Gammaspectrometer

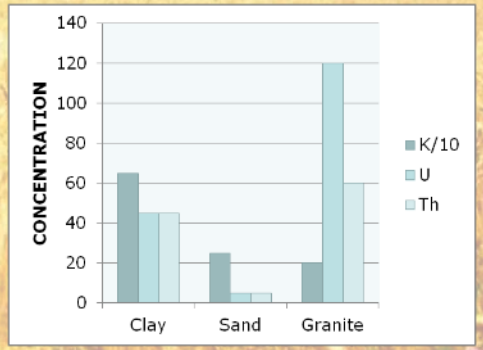
Measures natural background radiation as radionuclide concentrations (Bq/kg)

- Potassium (bulk) (^{40}K)
- Uranium (^{238}U)
- Thorium (^{232}Th)
- Caesium (^{137}Cs)

Measurement depth is average over **30 cm**

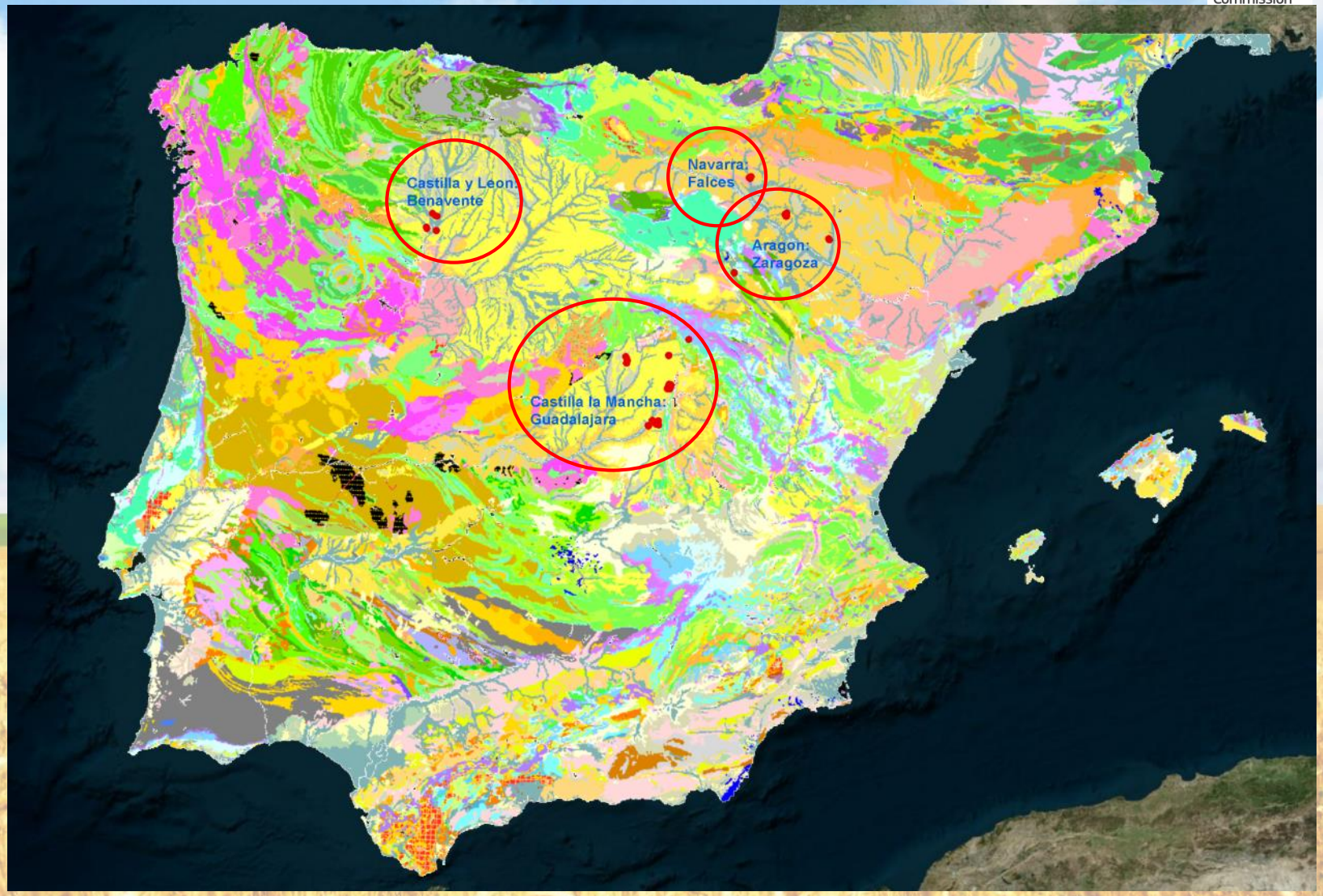
Determine fingerprint of minerals:

- Provenance dependent (origin of parent material)
- Concentration of K,U,Th in clay and sand are different
- ^{40}K, ^{238}U, ^{232}Th proxy for soil texture



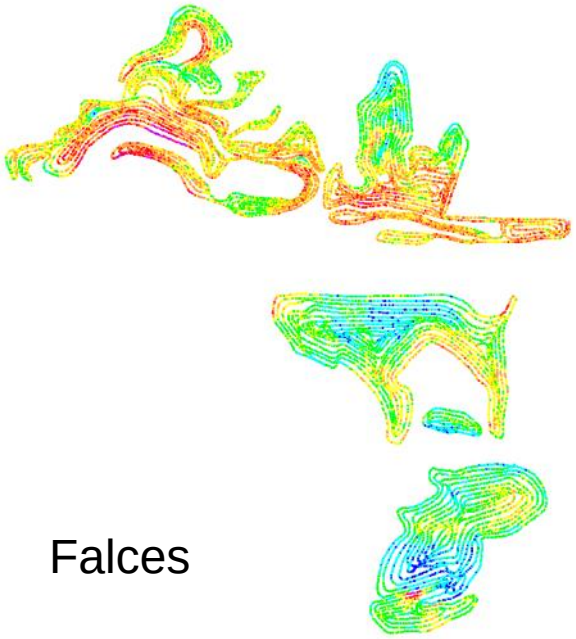
Application: **Soil composition**

Geology of Spain



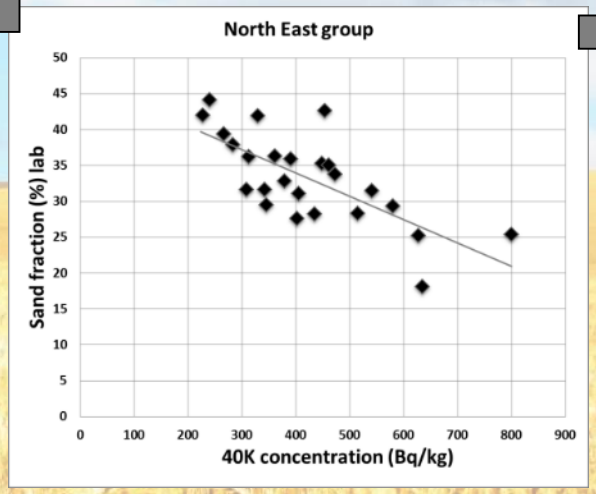
Gammaspectrometer

Soil sensing

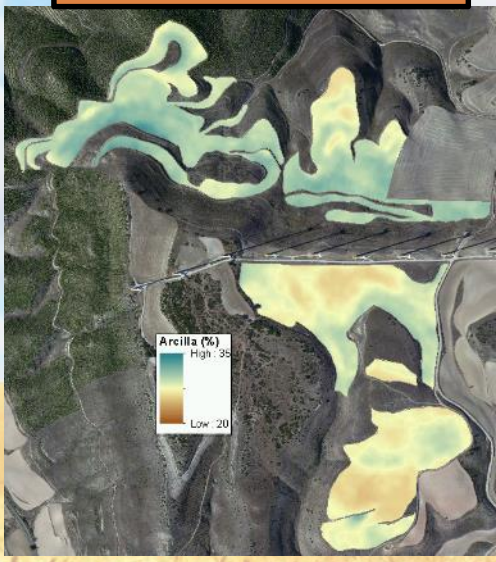


Falces

Clay content measurement



Clay content map



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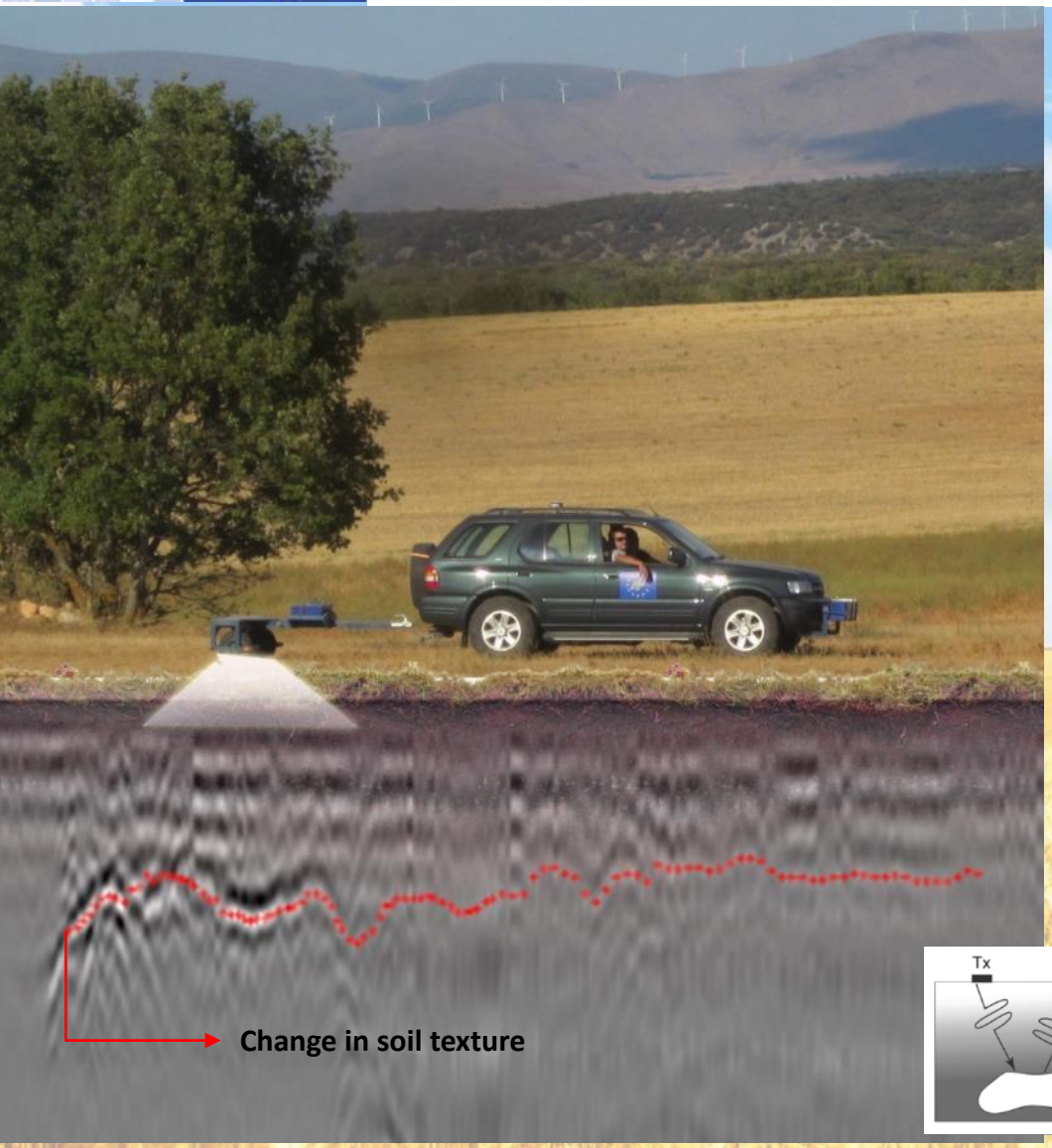
Ground Penetrating Radar (GPR)



Maps of compacted layers/ soil depth

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Understanding soil

Measurements

Mapping

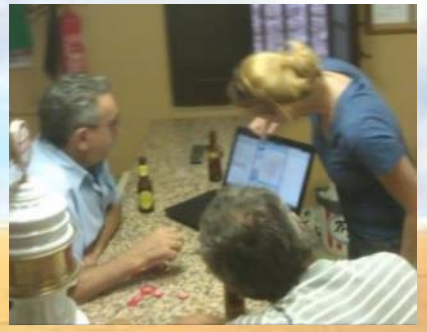
Open data

Interpretation of the soil based on pits

Lab analysis

Finca	arcilla	Mat. Org.	Etc.
1	Promedio	promedio	...
2	promedio	Promedio	...

Comprehensive maps of the soil



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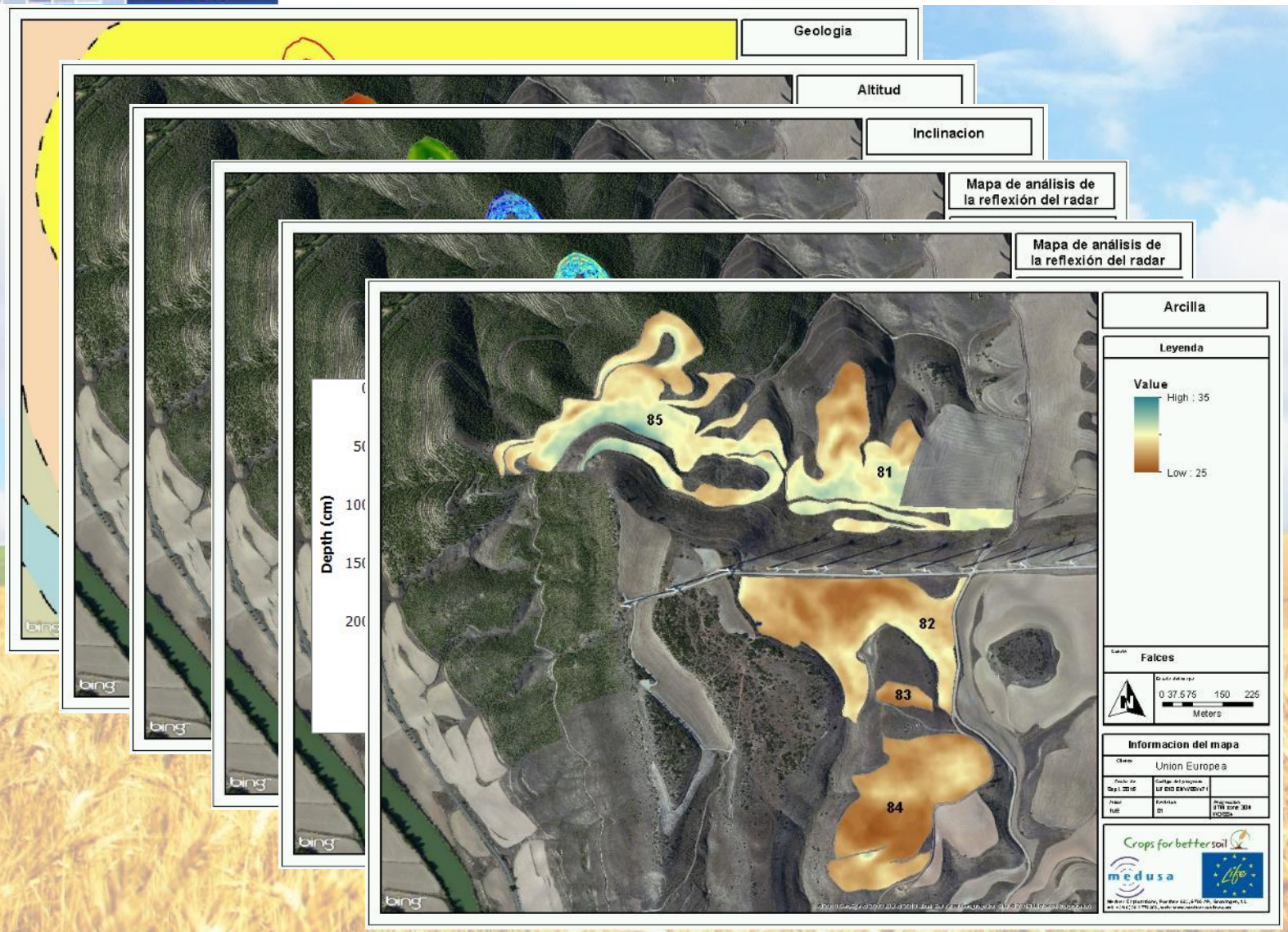
Example Falces - Navarra



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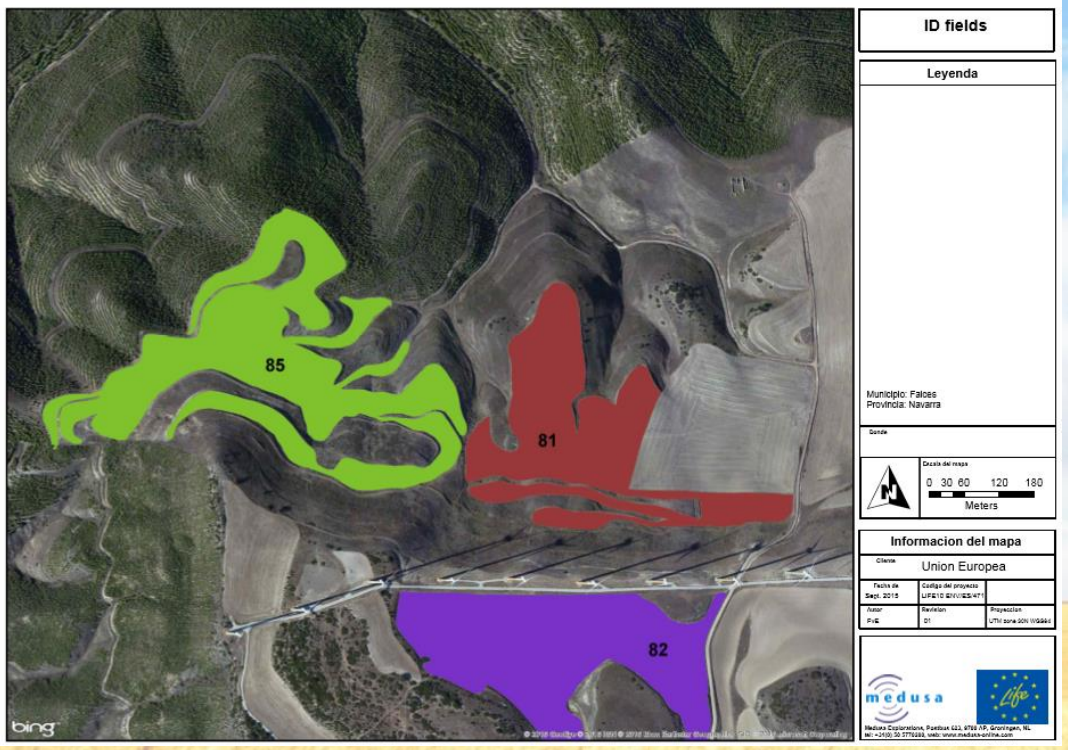
Look-up table soil properties



region	Navarra	Navarra	Navarra
area	Falces	Falces	Falces
farmer	Jesus Aranda Torres	Placido Tainta Ausejo	Jesus Aranda Torres
years organic 2012	20	5	20
field	81	82	85
slope	Level	Level	Flat
max slope	Steep	Moderately steep	Steep
geology	limestone with marls	limestone with marls	limestone with marls
texture	25-35 % clay	25-30 % clay	25-35 % clay
texture variation	more clayey uphill; freshly eroded sediments?	more clayey uphill	more clayey uphill; freshly eroded sediments?
changes in texture	no major differences	no major differences	no major differences
differences structure topsoil	rel. denser topsoil; patterns comparable	differences perhaps related to compaction	topsoil/ subsoil patterns are the same
differences structure subsoil	in NW part of the field geologic layer at 120-80 cm	middle of the fields has accumulated soil	some geologic layers visible
compaction	perhaps	little	little
compaction increased	-	probably not	-

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Conclusions

We developed and tested a measurement setup for effective and fast mapping of agricultural fields in Spain:

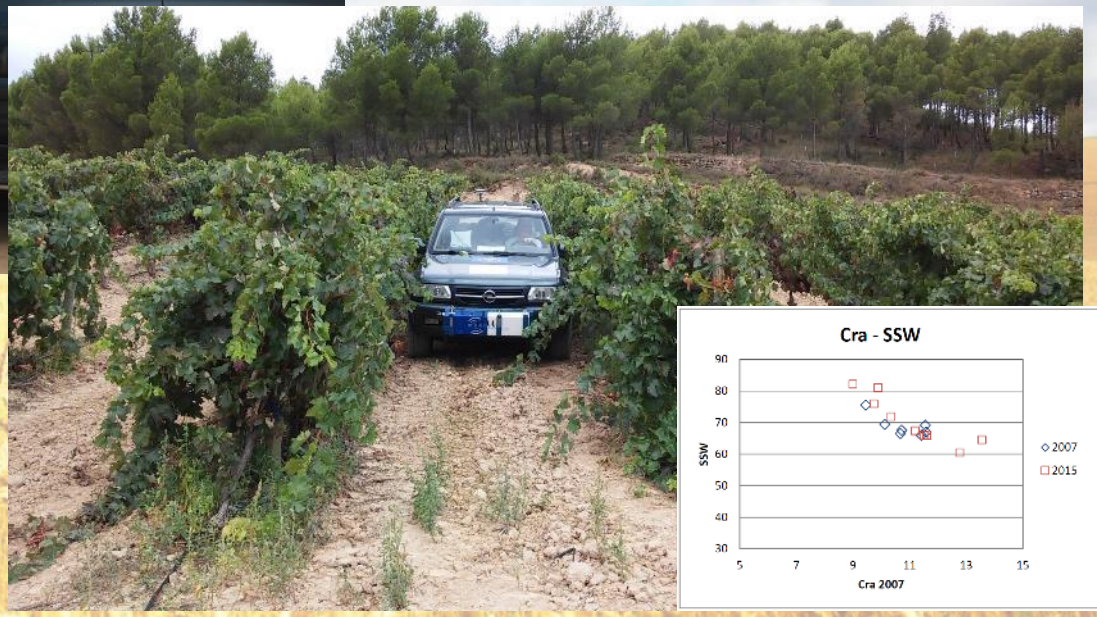
- Mobile platform with Gammaspectrometer, GPR
- Point measurements of actual soil bulk density
- Soil texture at high spatial resolution
- Information about compaction/soil depth
- Integrate various data sources to a conceptual map of understanding of the soil

We learned that the geophysical variation maps already prove to be valuable as a means of communication between farmers, agronomists and other project partners.

- The maps quantify the knowledge of the farmer
- They stimulate thoughts and discussions about the soil, its possibilities and hazards with respect to growing specific crops
- During the measurements and while discussing results we found that the *variation* in soil properties is already useful information.

We would like to explore this methodology for irrigated lands, vineyards, orchards, more high value crops: Outlook

Outlook - Vineyards



- Variety allocation
- Crop growth
- Irrigation regime
- Pruning regime
- Selection of grape quality

Outlook - Agroforestry

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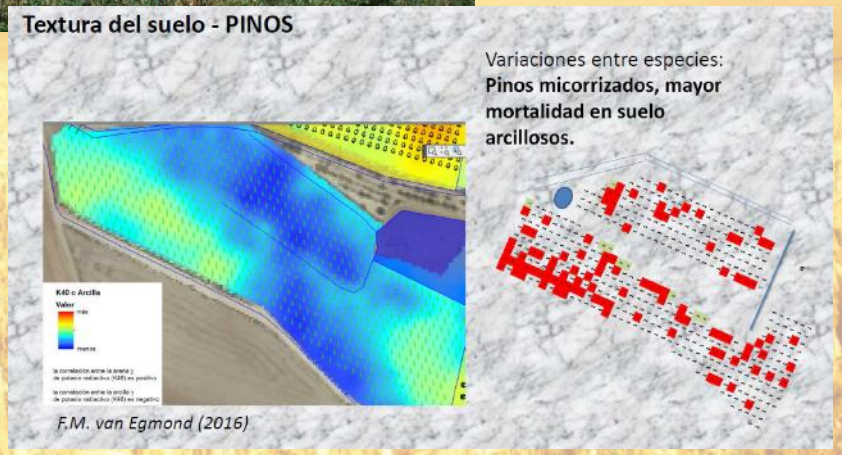
Edena
Alternativas Ecológicas

- Variety allocation
- Crop growth



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Outlook - Agroforestry

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Field testing – Comparable soils

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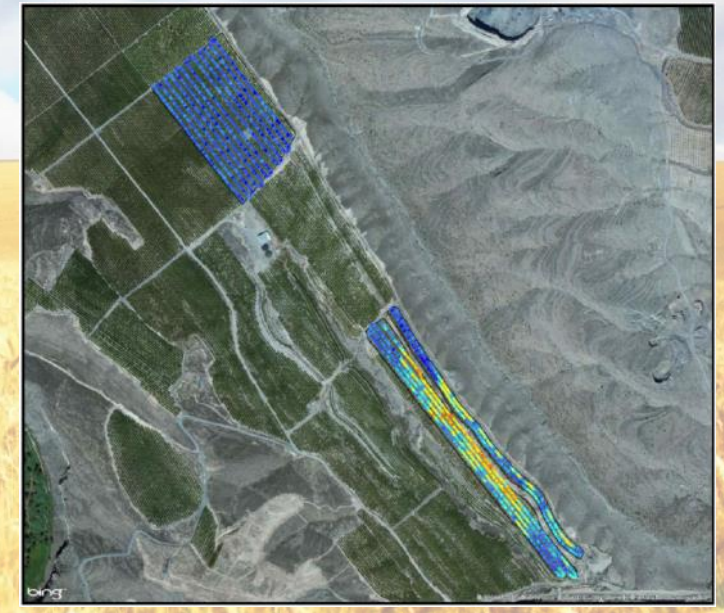
Outlook - Orchards



- Variety allocation
- Crop growth

European Commission

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Muchas Gracias!

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