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UNIVERSITY

FACULTY OF BIOSCIENCE ENGINEERING

DEPARTMENT OF SOIL MANAGEMENT
PRECISION SOIL AND CROP ENGINEERING GROUP - SITEMAN

FarmFUS
Optimising Production Efficiency

FARMFUSE - MULTI-SENSOR INFORMATION

Abdul M. Mouazen

Odysseus Chair in Site Specific Soil & Crop Management

Conference on ICT and Robotics for a Sustainable Agriculture

24 November 2017 @ The National Museum of Denmark, Copenhagen

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SEVENTH FRAMEWORK PROGRAMME

OUTLINE

- Project information
- Overview of current VR practices
- Project aim & WPs structure
- Main results
- Dissemination & Exploitation
- Personal opinion on funding
- Conclusions

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PROJECT INFO

Sponsor:

ICT-AGRI – National delegates

Budget:

€ 664.562

Partners:

Aristotle University of Thessaloniki (AUTH) – Greece – Prof. Dimitrios Moshou

Cranfield University (CU) – UK – Dr. Abdul M. Mouazen

Rostock University (RU) – Germany – Prof. Ralf Bill

Uludag University (UU) – Turkey – Prof. Yucel Tekin

tec5, AG (tec5) – Germany – Mr. Steffen Piecha

Duck end Farm **UK**

Karacebey Farm **Turkey**

Premslin Farm, **Germany**

Coordinator:

Abdul M. Mouazen - CU

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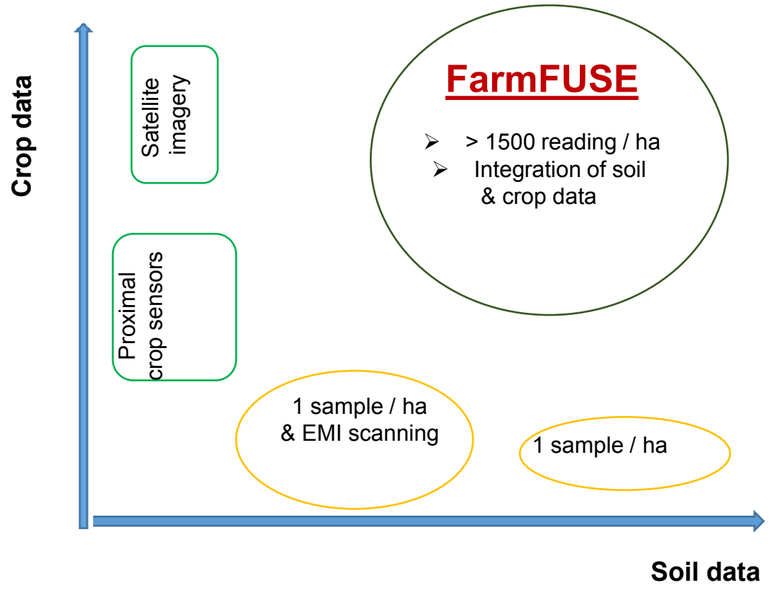
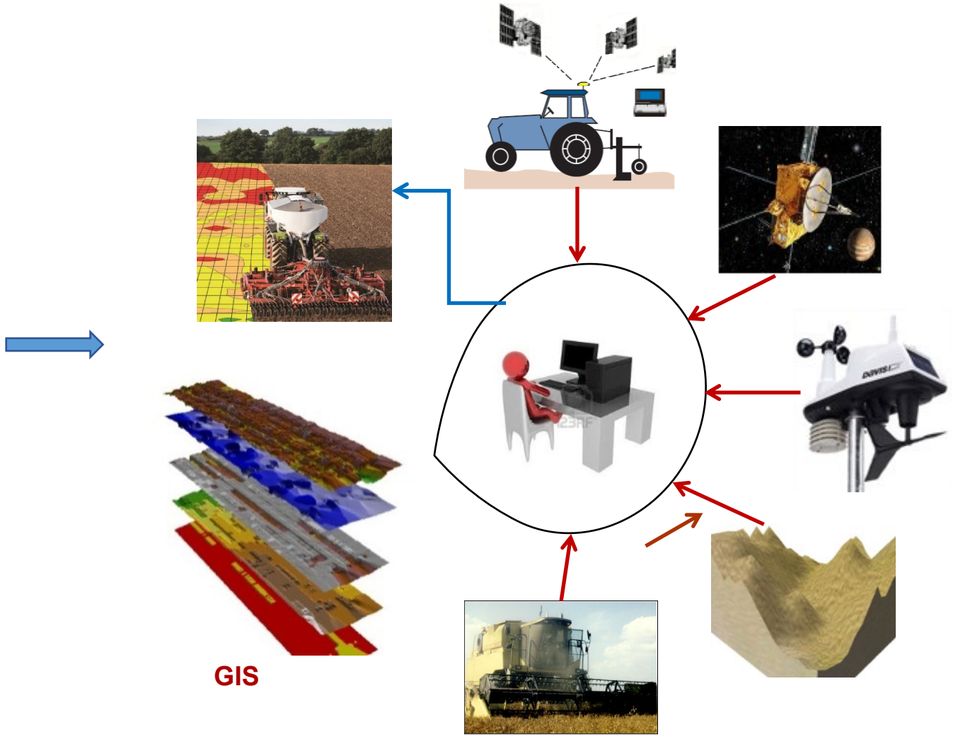
CURRENT VR N PRACTICES

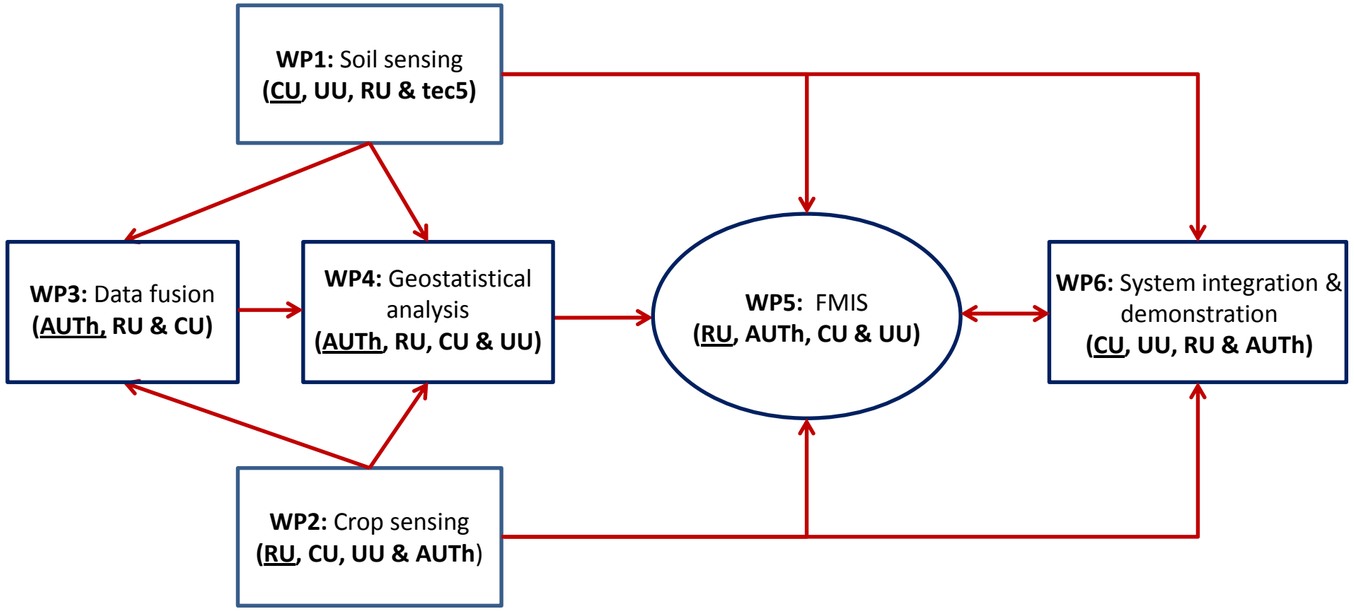




System approach
Multi-sensor & data fusion

AIM & WP STRUCTURE

To fuse a set of data on soil and crop together with auxiliary data on topography, land use and weather to delineate management zones for site specific fertilisation and spraying.



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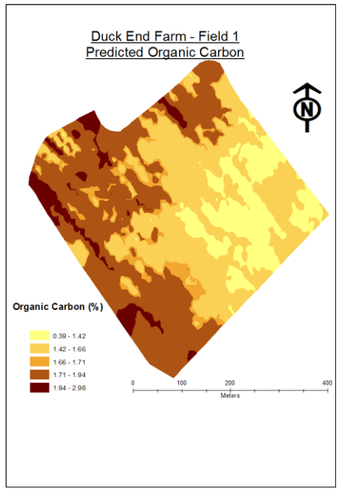
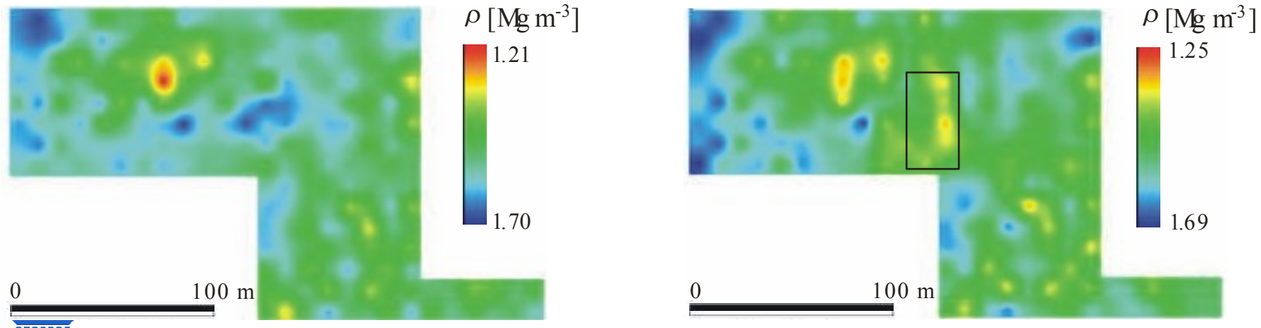
MULTI-SENSOR ‘ON-LINE’ KIT

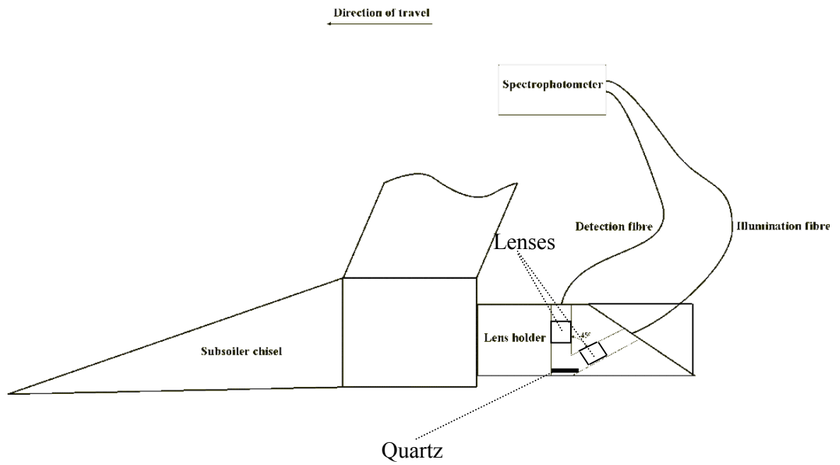
- High resolution data (1500 – 2000 readings per ha).
- Any depth between 5 – 50 cm.
- Can be fit onto different soil equipment e.g., tillage, planters & seeding machine.
- Particularly successful for organic carbon, moisture, total nitrogen, clay and organic matter.
- Less accurate for pH, phosphorous, calcium cation exchange capacity and magnesium.



$$BD = \left(\sqrt[3]{\frac{D + 21.36MC - 73.9313d^2}{1.6734}} \right) \times (1.255 - 0.772MC)$$



Bulk density maps



On-line multi-sensor platform (Mouazen, 2006)

Mouazen, A.M. (2006). Soil Survey Device. International publication published under the patent cooperation treaty (PCT). World Intellectual Property Organization, International Bureau. International Publication Number: WO2006/015463; PCT/BE2005/000129; IPC: G01N21/00; G01N21/00.

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MULTI-SENSOR & DATA FUSION FOR QUANTIFYING YIELD LIMITING FACTORS

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Non-linear parametric modelling

Calculated individual contribution to NDVI				
	2013		2015	
Input	May	June	April	May
TC (%)	10.25	16.46	5.86	3.52
K (cmol kg^{-1})	9.82	3.19	5.90	4.12
P (mg kg^{-1})	6.00	12.33	31.31	0.00
pH	2.69	0.91	3.21	0.00
MC (%)	1.71	1.39	2.31	2.83
TN (%)	0.45	1.14	0.23	0.88
Total (SERR)	30.92	35.42	48.59	11.35

Calculated individual contributions to yield		
Input	2013	2015
K (cmol kg^{-1})	7.66	0.23
P (mg kg^{-1})	4.28	1.96
TC (%)	3.99	3.23
pH	3.51	1.45
TN (%)	1.56	4.46
MC (%)	0.00	1.18
Total (SERR)	21.00	12.51

After: Whetton et al. (2017), Computers and Electronics in Agriculture

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MULTI-SENSOR & DATA FUSION FOR YIELD PREDICTION

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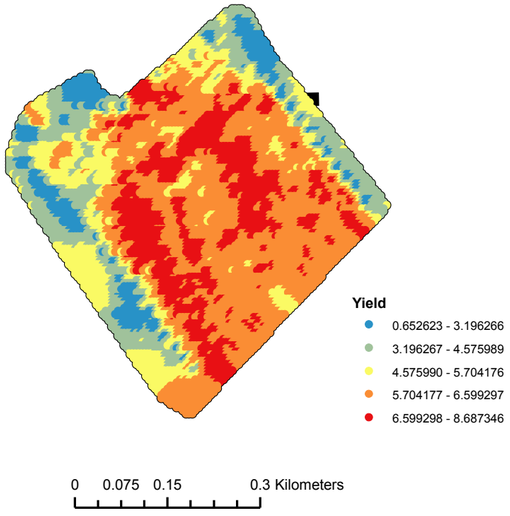
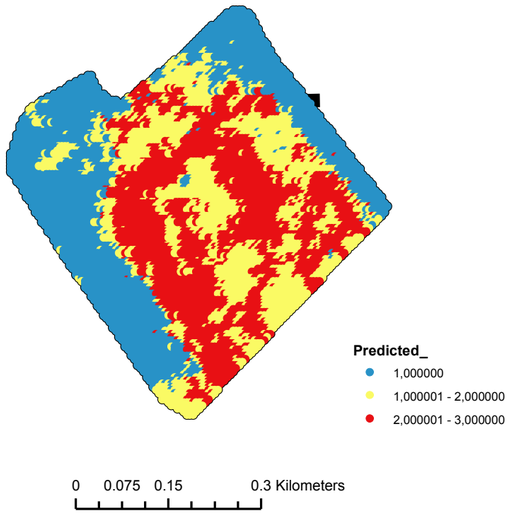


Measured



Predicted

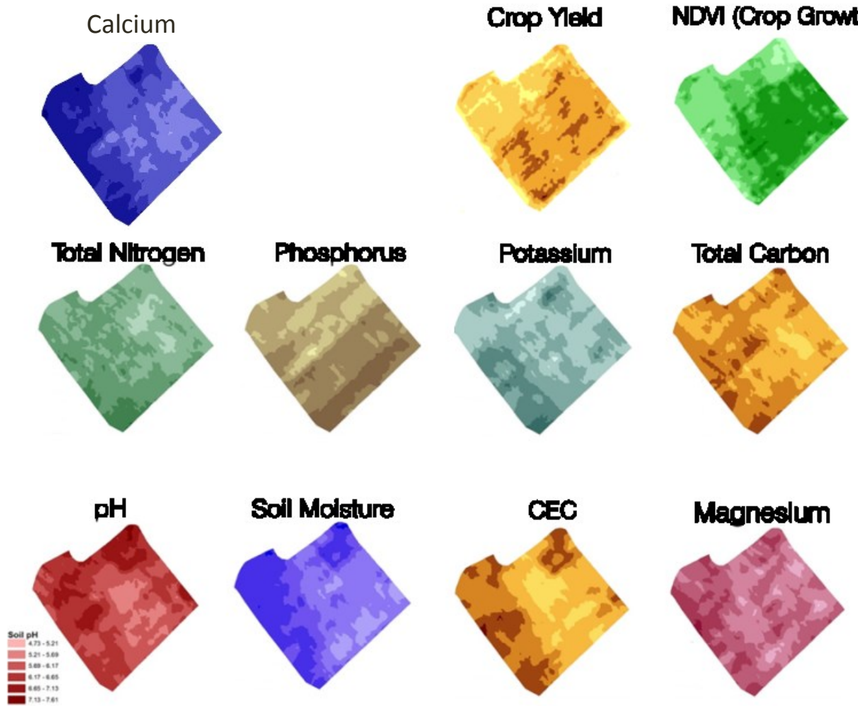
Actual yield Isofrequency Class	Network Prediction (%)		
	Low	Medium	High
SKN			
Low	91.3	6.96	1.74
Medium	10.87	64.35	24.78
High	1.54	16.98	81.48
CP-ANN			
Low	90.09	9.29	0.62
Medium	9.57	69.86	20.58
High	2.11	24.40	73.49
XY-F			
Low	87.91	11.21	0.89
Medium	5.76	85.15	9.09
High	2.11	38.67	59.21

After: Pantazi et al. (2016), Computers and Electronics in Agriculture

MULTI-SENSOR & DATA FUSION FOR VR N FERTILISATION

- Common Raster Grid Creation
- Data Fusion by Clustering
- Mapping



Fertility zone map

N application map

After: Halcro el al. (2013) – 3rd International Workshop on PSS

Nawar et al. (2017) – Advances in Agronomy

DISSEMINATION AND EXPLOITATION

- 17 Peer Reviewed Journal Papers
- 20 Conference Contributions
- A project website run by Rostock Univ.
- Presentations: farmers & policy makers
- 2 PhD theses

- Contribute to new service provider FarmingTruth Ltd.
- Contribute to a new commercial NIR spectrometer
- A sugar factory in Turkey expressed interest

Very positive farmers' feedback

PERSONAL OPINION ON FUNDING

- Projects are focused
- Promote new technology solutions
- Smooth collaboration among partners
- Value for money (total budget 664 K EUR)
- Projects can be of large impact

CONCLUSIONS

- Need for advanced sensing technologies
- Innovative multiple sensors and data fusion approaches
- Integration of all information on soil, crop, weather, topography, etc
- Potential for increase profitability
- Reduce environmental impacts

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BIOSCIENCE ENGINEERING

Abdul M. Mouazen

Professor of Site Specific Soil and Crop management

DEPARTMENT OF SOIL MANAGEMENT

E abdul.mouazen@ugent.be
T +32 9 264 6037
M +32 484 7707 23

www.ugent.be

Ghent University
@ugent
Ghent University

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