"Variable rate irrigation and nitrogen fertilization in Potato; engage the spatial variation"- POTENTIAL

Water JPI
WaterWorks2015 Cofunded Call
6 April 2017, Stockholm

Pieter Janssens
Soil Service of Belgium

POTENTIAL - CONSORTIUM DESCRIPTION

Soil Service of Belgium (SSB) – Pieter Janssens, Sofie Reynaert

Flemish Institute for Technological Research (VITO)– Isabelle Picard

Université de Liège (Ulg) – Sarah Garré, Gaël Dumon

Forschungszentrum Jülich (FZJ) – Jan Van Der Kruk, Christian von Hebel

Aarhus University (AU) – Mathias Neumann Andersen

Fasterholt MaskinfabRik

Wageningen Applied Plant Research (PPO-AGV) – Jan Kamp Johan Booij

National funding agency's

Belgium: Agentschap voor Innoveren en Ondernemen (VLAIO)

Belgium: Fund for Scientific Research – FNRS

Germany: Federal Ministry of Food and Agriculture (BMEL)

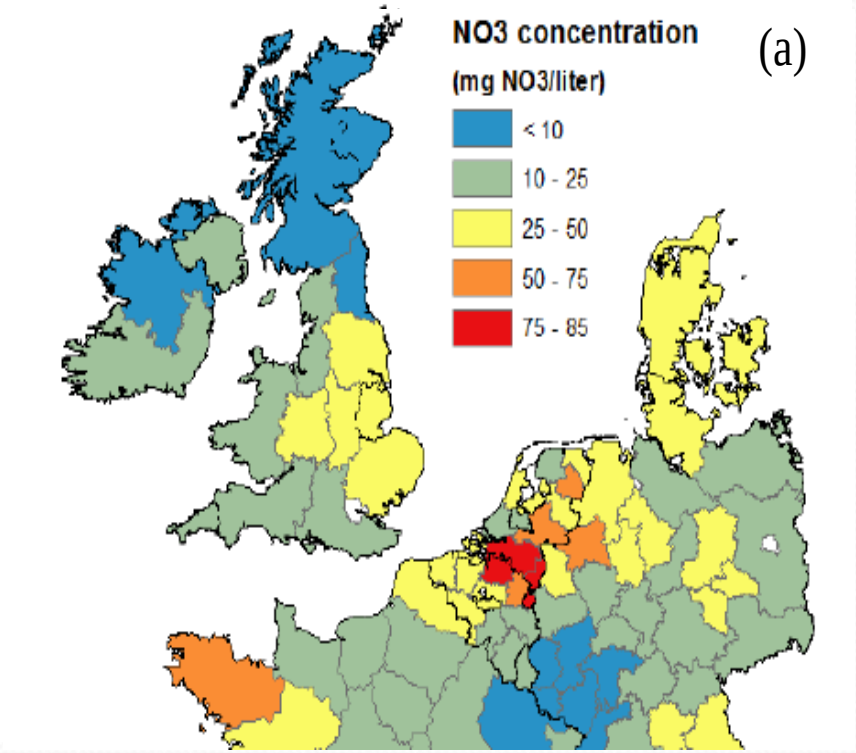
Denmark: Innovation Fund Denmark (IFD)

The Netherlands: Ministerie van Economische Zaken

MOTIVATION

- Agricultural **irrigation consumes huge amounts of fresh water** and even in north Europe often account for more than 50% of withdrawals in dry summers
- Better assessment of crops' uptake and optimal supply of nitrogen to avoid over-fertilization should substantially **reduce losses and subsequent nitrogen pollution of soil and aquifers**

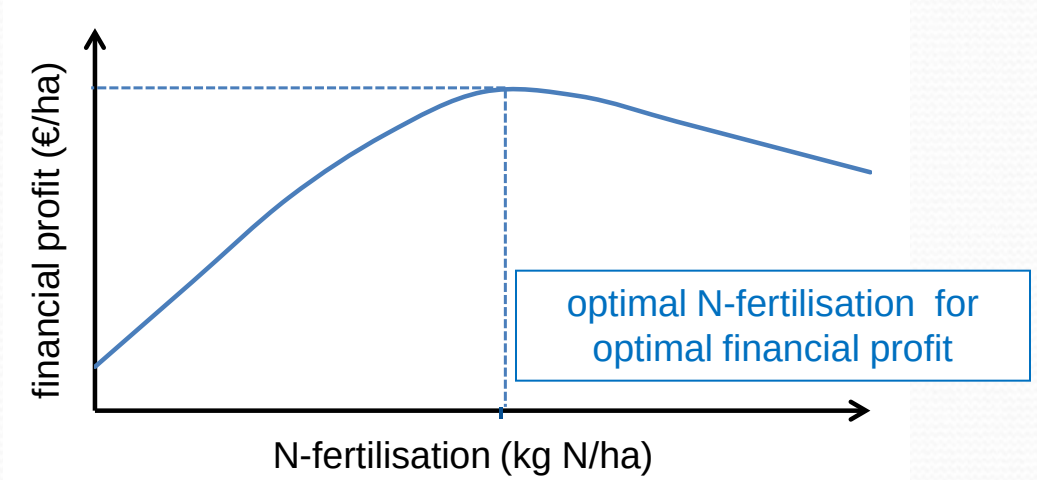
Mean nitrate concentration in leaching water from the rootzone in 2008 in the partnering countries (Van Grinsven et al. 2012)

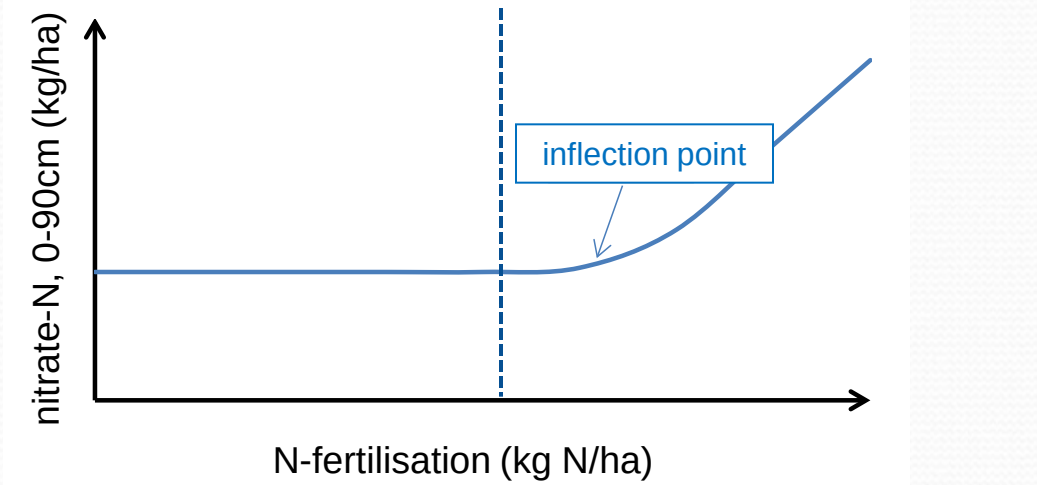


MOTIVATION

By implementing precision farming, the grower is expected to increase his yield while limiting water use and nitrogen leaching

Economical optimum ⟷ **Environmental preconditions**

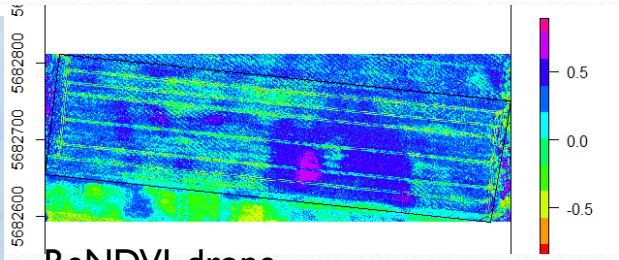




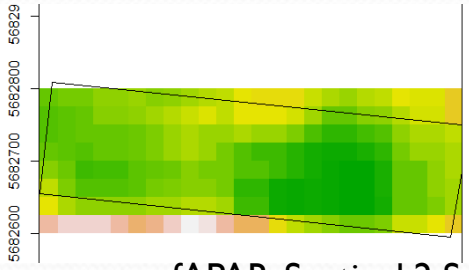
MOTIVATION

With the enlargement of fields and intensive mechanization, it has become increasingly difficult to take account for within-field variability without revolutionary technologies example:

- Remote sensing allows nonintrusive and cost effective monitoring of crop state spatial variability (ReNDVI, fAPAR)

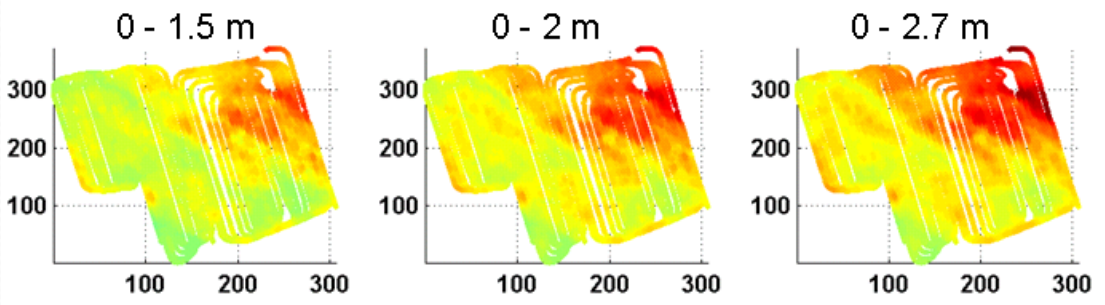


ReNDVI, drone



fAPAR, Sentinel 2 Satellite

- Electromagnetic induction (EMI) (soil scanning) methods allow fast and low-cost surveys of soil apparent electrical conductivity (ECa)



by Chris von Hebel, FZJ, IBG-3

MOTIVATION

Why potato?

- Third food crop in the world
- 65 000 km² in Europe
- High yields in North western Europe (40 tons vs 18 ton world wide average)
- Drought sensitive
- Can take up to 250 kg N/ha
- Shallow root system (risk to nitrate leaching)
- High financial turnover

OBJECTIVES

Improving nitrogen and water use efficiencies in potato by combined irrigation and nitrogen fertilization precision farming

- to obtain more profitable cultivation by increasing potato yield
- to obtain more sustainable cultivation by reducing water percolation and nitrate leaching

Fasterholt FM4400 Irrigation gun which consists of self-propelled irrigators with turbine engine.

OBJECTIVES

Improving nitrogen and water use efficiencies in potato by combined irrigation and nitrogen fertilization precision farming

1. **Assess spatio-temporal variation in water and nitrogen deficit** in potato fields using Remote Sensing (satellite, drone) and Electromagnetic Induction (tractor-mounted sensors)
2. **Distinguish between water stress and nitrogen deficiencies** and quantify these in potato crops through sensor technology
3. Integrate information about the spatial variation **in operational services** for co-scheduling irrigation and nitrogen fertilization
4. Develop, apply and **assess variable rate irrigation and nitrogen fertilization based** on this integrated service

Water JPI

CONSORTIUM DESCRIPTION

Kick off meeting 13/03/2017, Mol, Belgium

CONSORTIUM DESCRIPTION

Soil Service of Belgium (SSB) – Pieter Janssens

Soil laboratory, irrigation and fertilization research and recommendation

Flemish Institute for Technological Research (VITO)– Isabelle Picard

Remote sensing

Université de Liège (Ulg) – Sarah Garré

Geophysical research, electrical resistance tomography

Forschungszentrum Jülich (FZJ) – Christian von Hebel

Geophysical research, electromagnetic induction

Aarhus University (AU) – Mathias Neumann Andersen

Irrigation and fertilization research

Fasterholt MaskinfabRik

Construction irrigation guns

Wageningen Applied Plant Research (PPO-AGV) – Jan Kamp

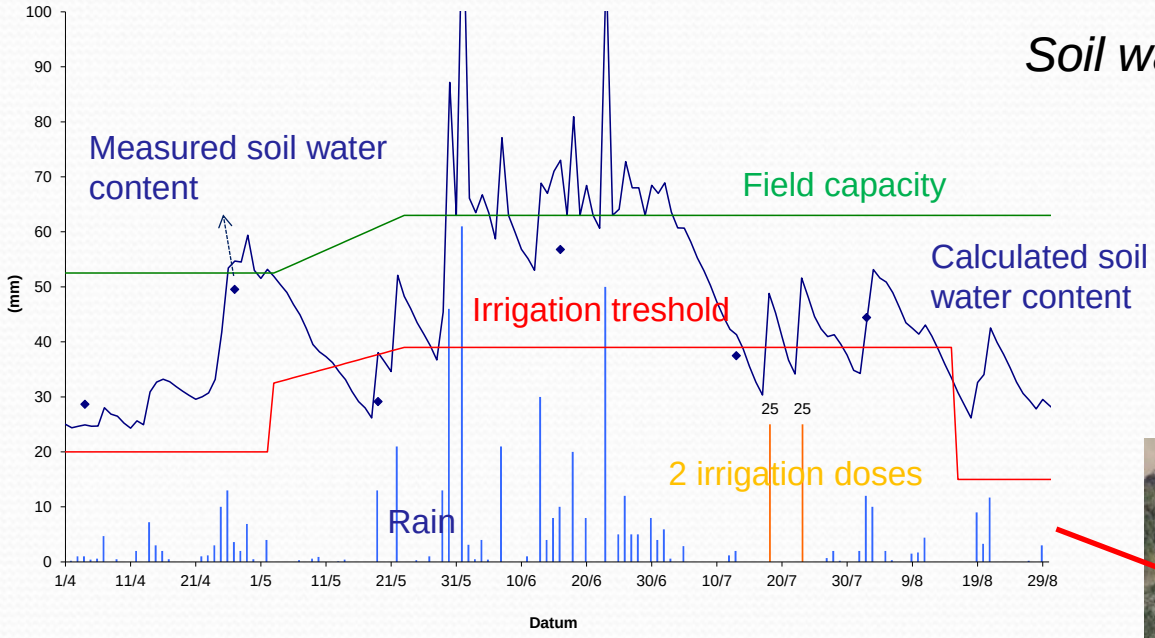
Implementation precision farming in agriculture

WP1: Capture field spatial variation

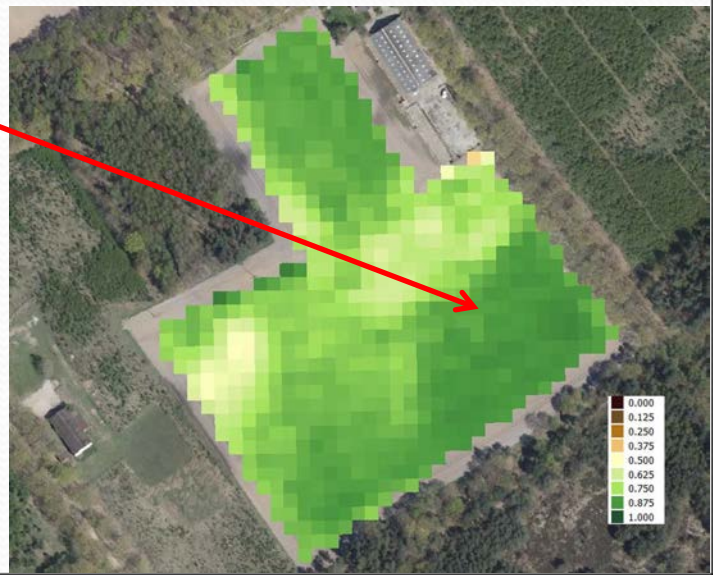
- Field trials are set up in Belgium (3), The Netherlands (1), and Denmark (1) at farmers' fields
- Soil samples and crop monitoring in the experimental fields
- Large-scale ECa multi-configuration maps are obtained with state of the art EMI soil scanners => **ex. soil scanning FZJ trial fields march 2017**
- Spectral information will be gathered from drones, satellites and tractor mounted sensors

WP2: Integration of spatial data sources in classical recommendation services

ex. Irrigation scheduling using a soil water balance at a plot scale can be linked up to the field scale using Sentinel 2 satellite images



Soil water balance on a potato field in Belgium in 2016



fAPAR vegetation-index calculated on a potato field in Belgium on 10/06/2016 based on sentinel 2 data

WP3 Demonstration and evaluation of variable rate application of water and nitrogen in potato

- Field trials in Belgium, The Netherlands, Denmark will be set up following a **split design where one part of the field is fertilized and irrigated homogeneously,** the other part variable rate irrigation and N fertilization is conducted following the manual setup in WP2

van den borne aardappelen

FASTERHOLT

Expected Impact of the Project

- **Reducing water percolation and nitrate leaching** will reduce water pollution
- Applying spatio-temporal precision irrigation will allow the farmer **to save up to 20% (?) of irrigation water**
- Increasing the crop yield will **increase the financial viability** for potato growing in Western Europe
- Implementing variable rate irrigation will make potato cultivation **more resilient and resistant to droughts**
- The manual will serve as a **catalyst for SME to develop new precision farming machinery**, such as for example Fasterholt
- By **linking the project results to existing platforms**, the results will stay to the attention of European participants even after the end of the project

How will your project target to following aims of the call:

- to promote multi-disciplinary work
- to encourage proposals with fundamental and/or applied approaches
- to stimulate mobility of researchers within the Consortium
- to enhance collaborative research and innovation during the project life and beyond

Data collection

Variable rate applications in N fertilization and irrigation

Interpretation

FIELD TRIALS (BE, NL, DK)

STAKEHOLDERS (BE, DK, NL, DE)
- Farmers (potato but also others!)
- Agricultural consultants
- Processing Industry
- Policy makers
- Precision farming enterprises

POTENTIAL

Publications (guidelines for precision farming national, international scientific), Website

Connection to existing apps, expert systems
- BE: Watch it grow
- NE: Akkerweb
- DK/EU: Figaro (AU)

Demonstrations by field visits in BE, NL, DK

Workshop for farmers, agricultural consultants BE, NL, DK

New business opportunities (Fasterholt)

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