iPot: An innovative platform for the Belgian potato sector

BEODay
8 December 2016, Saintes

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With contributions from Romain Cools, Nele Cattoor, Goffart Jean-Pierre, Amaury Leclef, Viviane Planchon, Joost Wellens, Isabelle Piccard, Anne Gobin, Jeroen Dries, Jürgen Decloedt
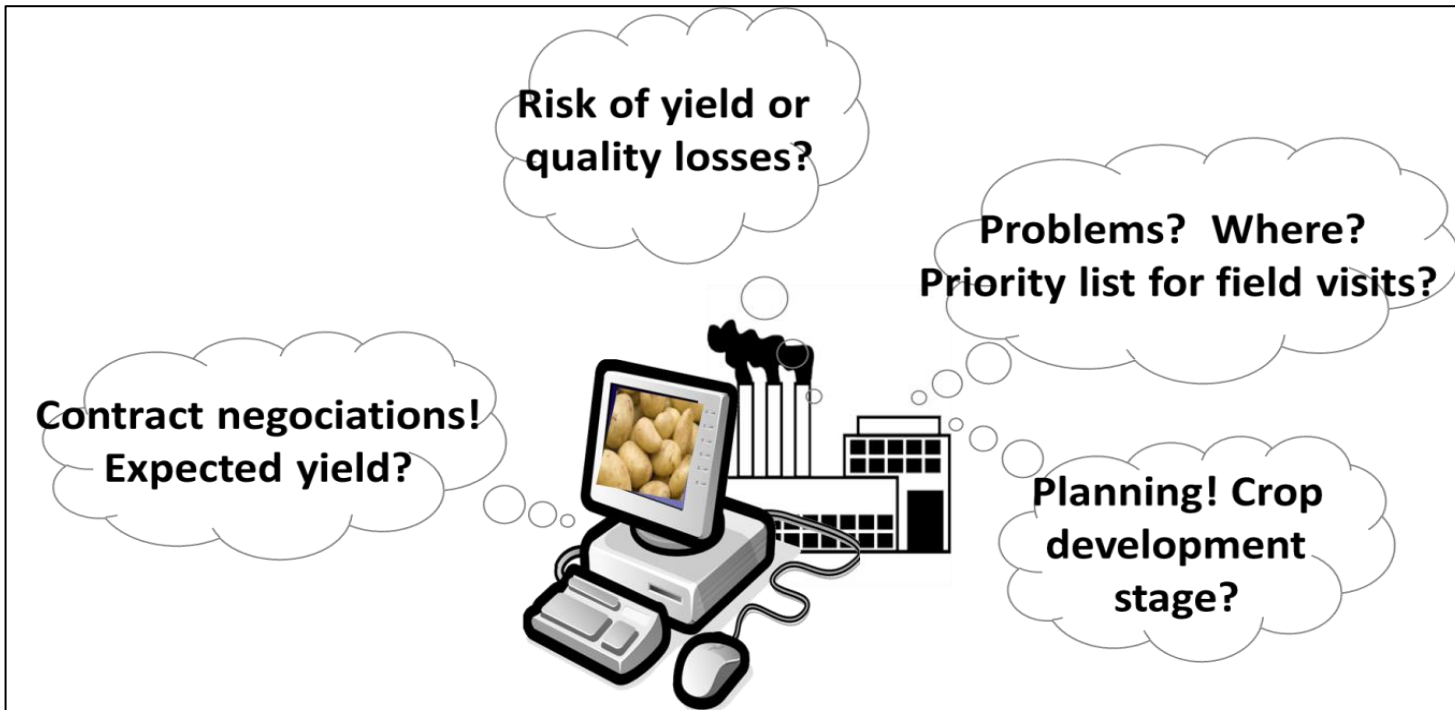
Context of the potato crop in Belgium

- **Current situation**:

  Fast developing sector, world leader for frozen potato products, high-tech processing industry

- **Request for new development**

Global objectives

- To provide the Belgian processing and fresh potato sectors with **near real time information at field or district level,** regarding growing conditions (soil, weather), crop development status and early yield estimation/prediction based on use of **satellite images time series** and **crop growth simulation models.**

- To develop a **web-platform with geolocalized data** allowing growers and industry (fresh and processed potato), together with research and technical centers, to analyse and combine those data with fields observations, aiming to improve management decision during growing season and at harvest and storage of the tubers for several months.

- **Finally, to improve potato fields monitoring over the whole production area, leading to higher volume and quality**

- DMC Deimos (2015)/Sentinel-2 (2015, 2016)

- At country scale

- Atmospheric correction (OPERA)

- Cloud & shadow detection
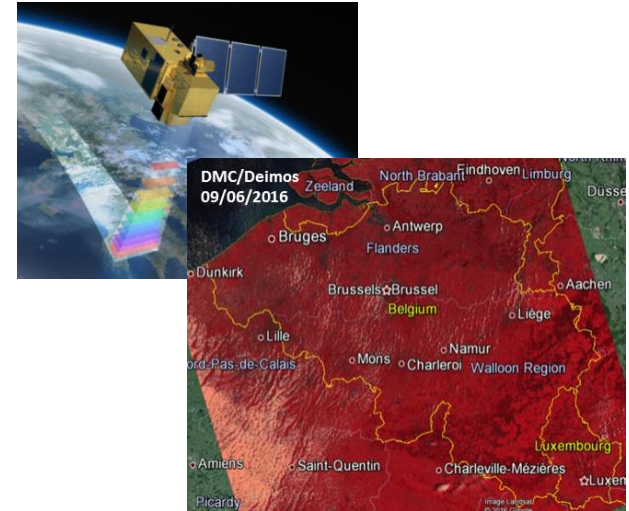
-> Derivation of **Vegetation Indices** (VIs) expressing the productivity of the crop (INRA-EMMAH algorithms)

❖ *f*APAR   Fraction of Absorbed Photosynthetically Active Radiation
❖ *f*COVER   Fraction of Green Vegetation Cover
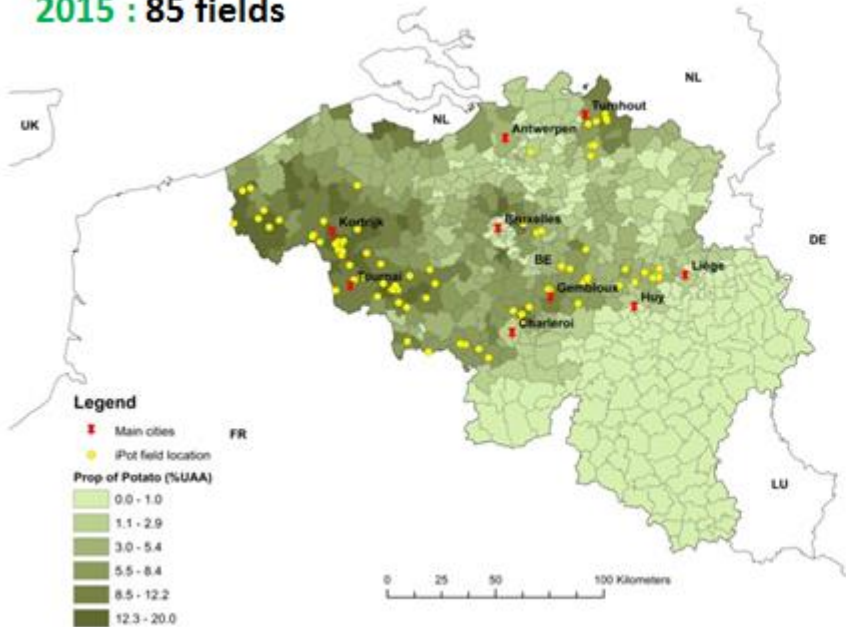
Yield estimation / prediction at field scale

- Crop growth models tested: AQUACROP, WOFOST (PCSE), LINTUL-POTATO-DSS
- Aims at harvest and storage planification **+ benchmarking**

Needs for re-calibration / validation data set
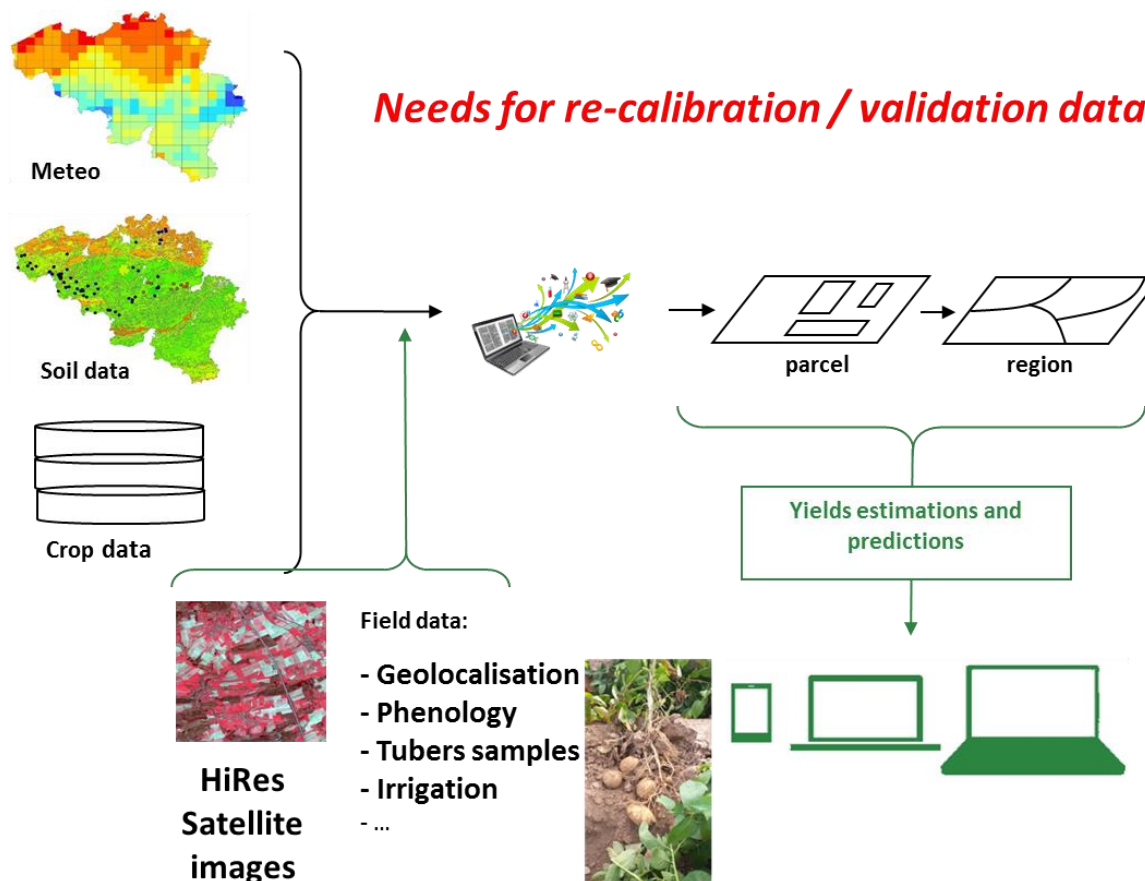
2 field campaigns (2015-2016)
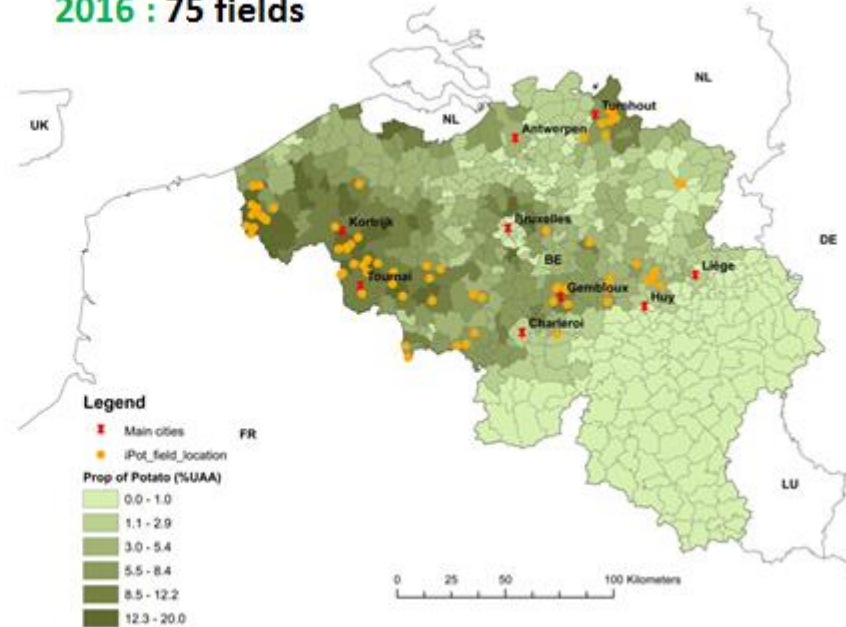
Varieties: Bintje, Fontane (processing) and Nicola (fresh market)

- **Field observations**

    - Geographic coordinates

    - Field area

    - Management data (planting, fertilisation…)

    - Tubers sampling *(every two weeks*
        for yield assessment starting July)

- **Phenological stages follow up**

    - BBCH scale (2-digits)

    - Every 2 weeks

- **Specific events detection :**

    - Waterlogging / flooding

    - Drought

    - Pest and diseases

    - …

MSA-12
(08/06/2016)

- Temperature
- Precipitation

Somme des précipitations [mm]
- 151 - 200
- 201 - 250
- 251 - 300
- 301 - 350
- 351 - 400
- 401 - 450
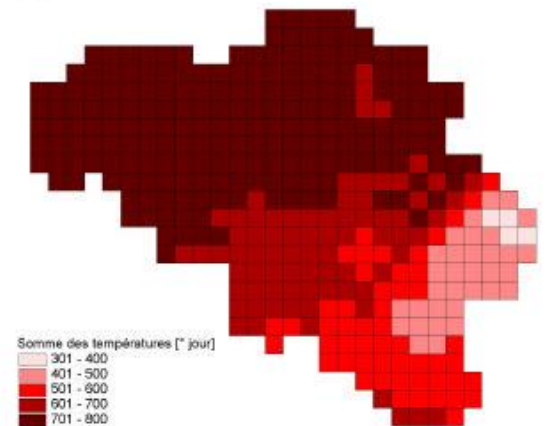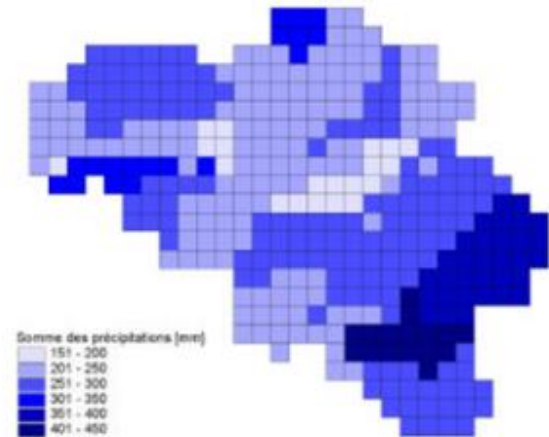
- Useful
  - To monitor field conditions
  - To interpret crop behavior
  - To run crop growth simulation models

- Available on the WEB TOOL

Somme des températures [° jour]
- 301 - 400
- 401 - 500
- 501 - 600
- 601 - 700
- 701 - 800

Validation of satellite VI

- 3 UAV monitoring campaigns (2014-15-16) in 3 fields (1 per variety)

- In Gembloux area – eBee with a RGB/MSpec Camera

- Comparison of indices derived from satellite vs. UAV and ground measurements (DHP)

- **Comparison with UAV derived fCover estimates**

Classification: veg/no veg

fCover: % veg in 10m pixels

S2

Example: Bintje, 22/8/2015

First S2 results

5 Aug 2015
22 Aug 2015

DMC results (2014-15)

R2	RMSE	MAE	MEAN DMC	MEAN UAV	STDEV DMC	STDEV UAV	OBS
0,97	0,06	0,04	**0,55**	**0,54**	0,29	0,30	494
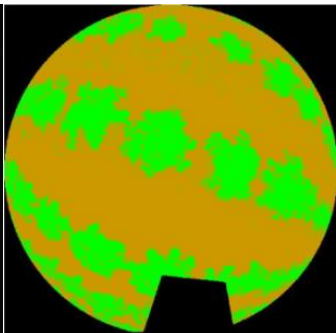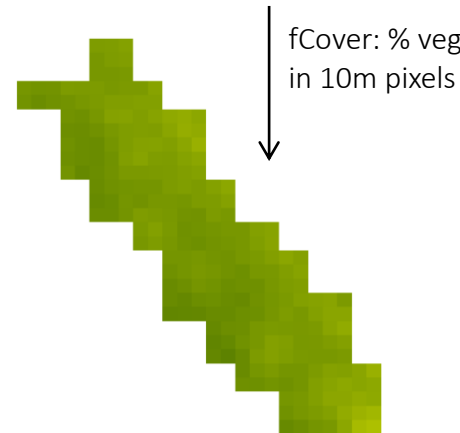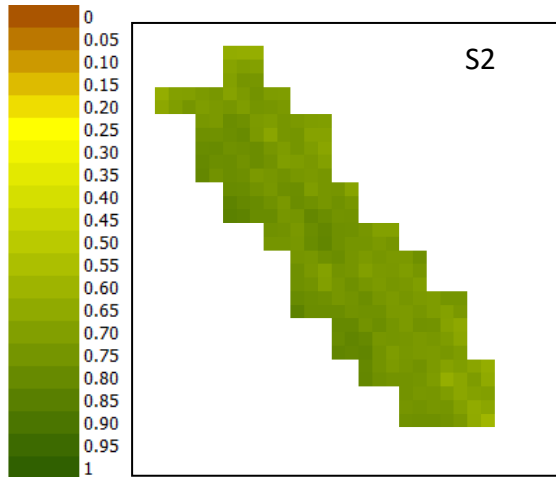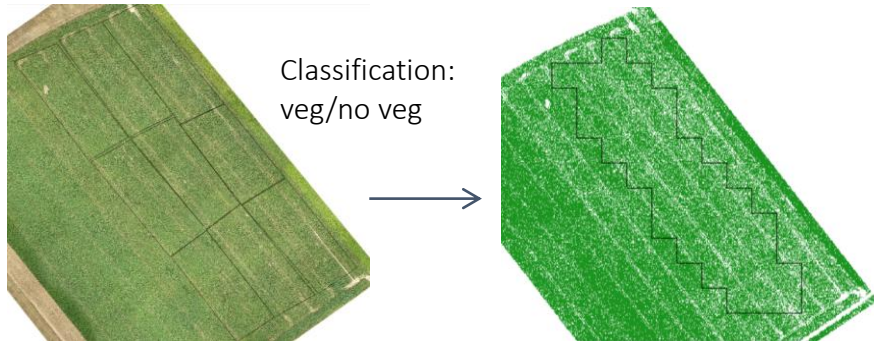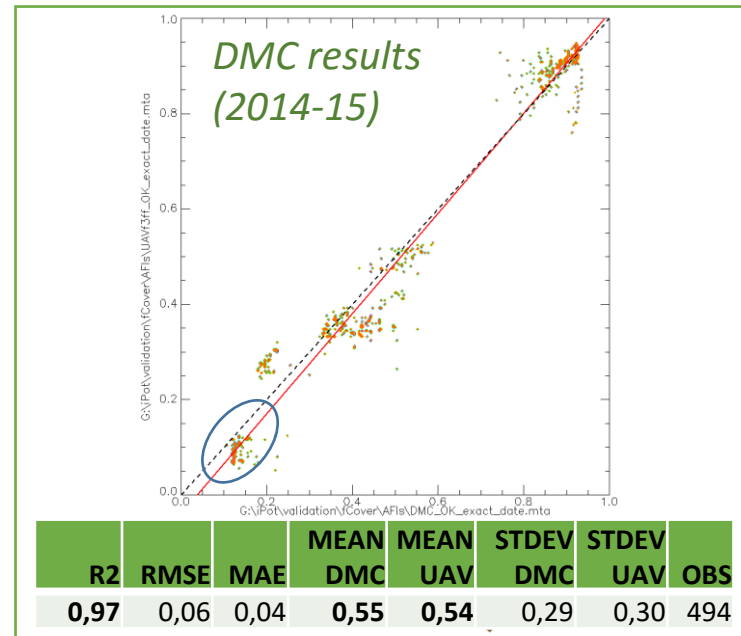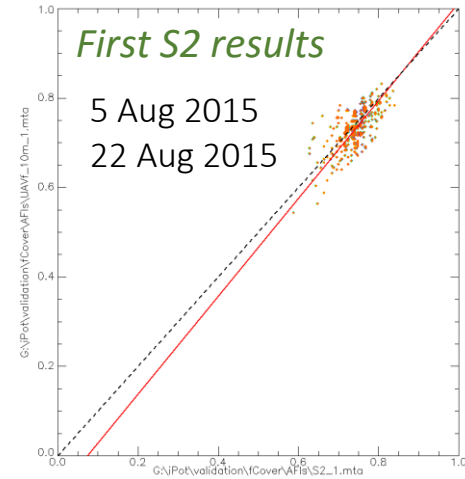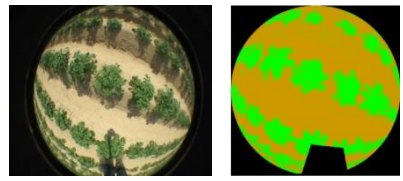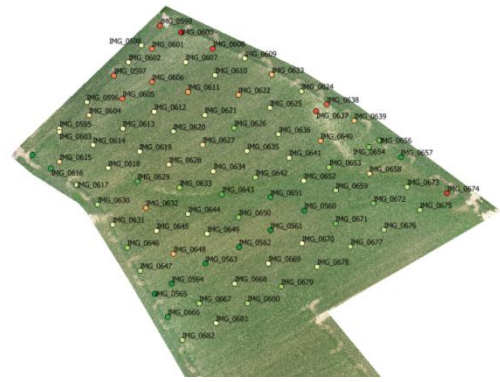
Validation fCover

- Comparison with DHP derived fCover estimates
    - Per field *(see examples)*
    - Per block

Legend: ◆ DHP ■ DMC ▲ S2 ▲ UAV
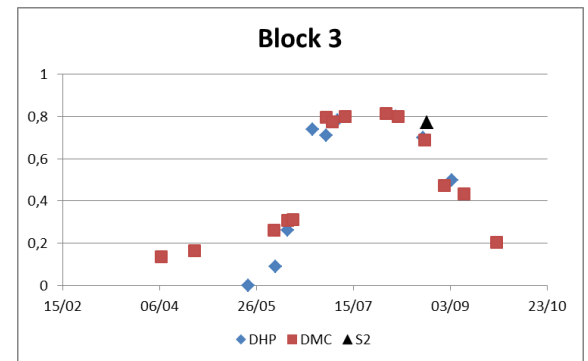

Charts:
- GM - Bintje, 2014
- PL - Fontane, 2014
- SV - Bintje, 2014
- Bintje, 2015
- Fontane, 2015
- Nicola, 2015
- Bintje, 2016
- Fontane, 2016
- Nicola, 2016
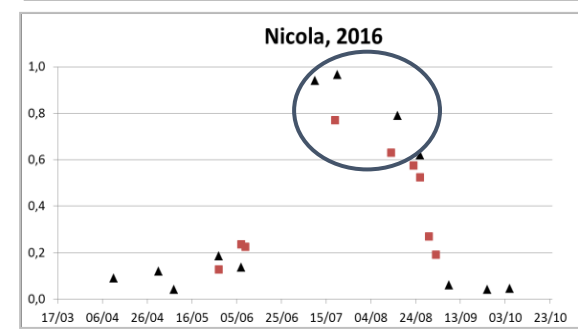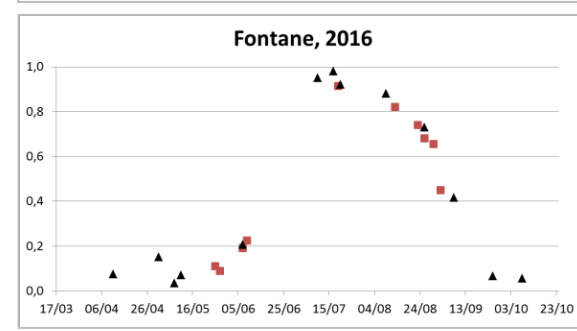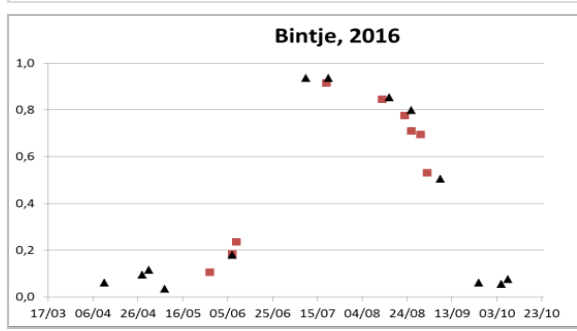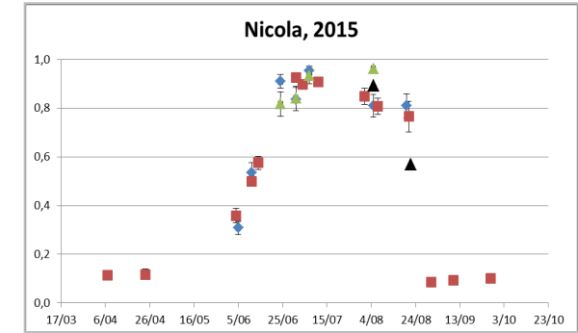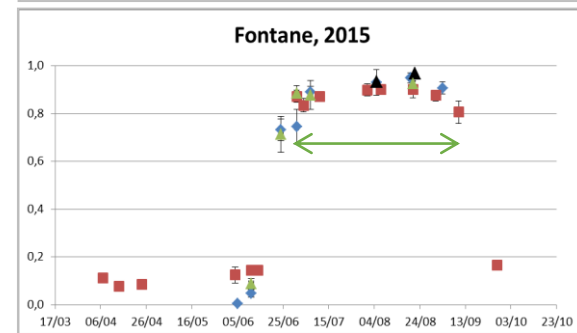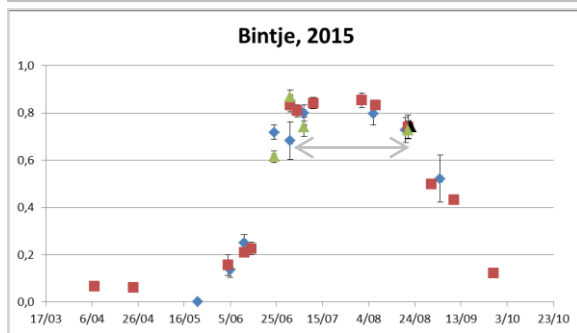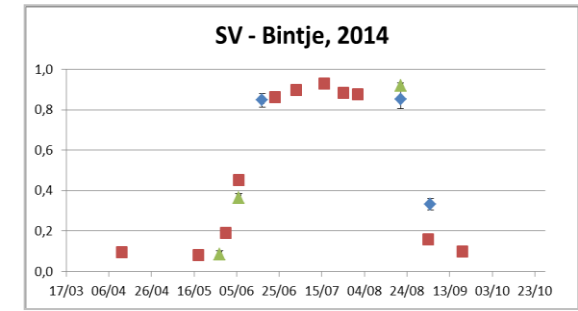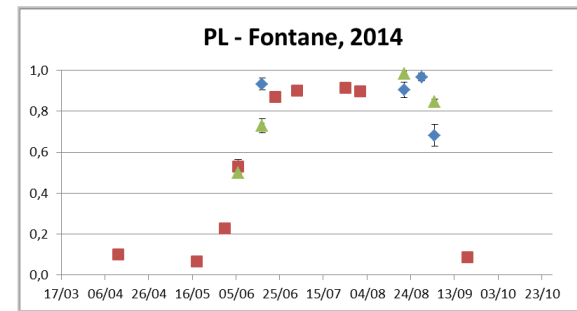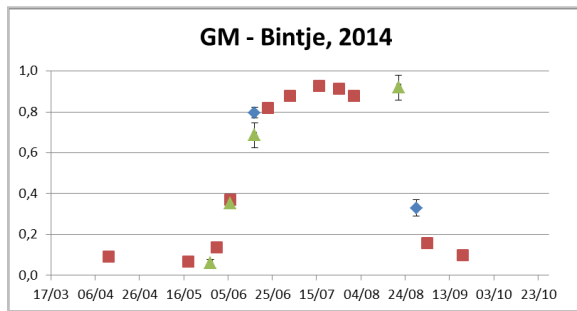
- Comparison with DHP derived fAPAR estimates: per field & per block *(see examples)*

8/3   7/4   14/4   24/4   4/6   11/6   14/6   1/7

4/7   11/7   1/8   7/8   21/8   31/8   10/9   27/9   HK: 15+18/9

Bintje, 2015
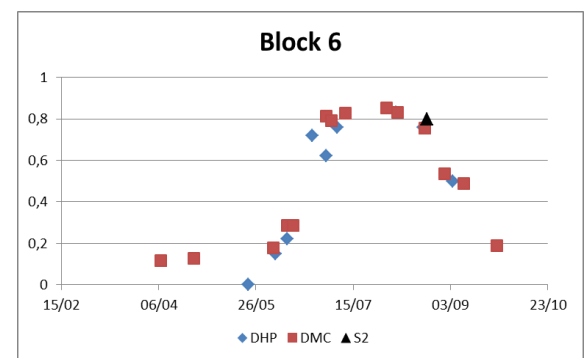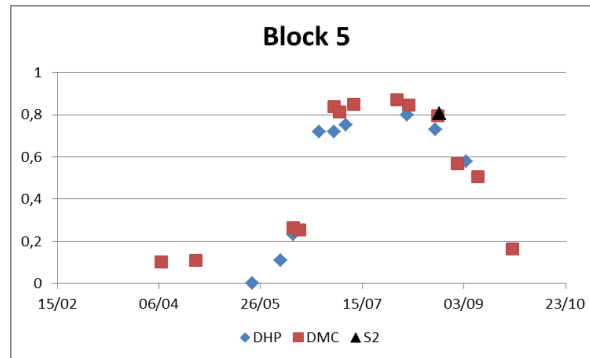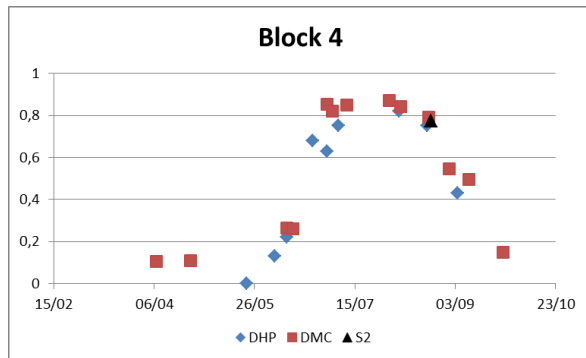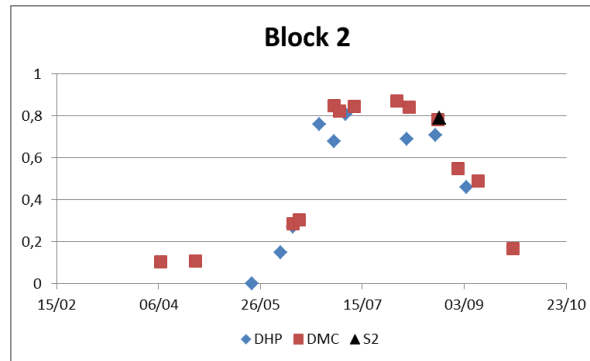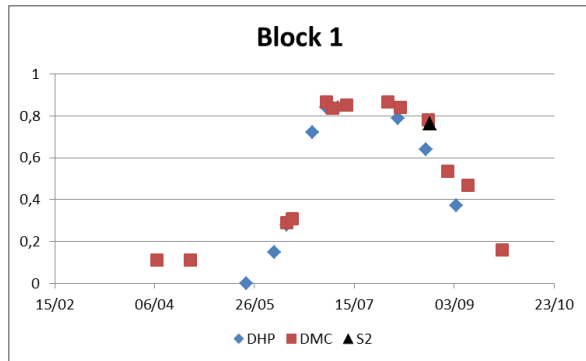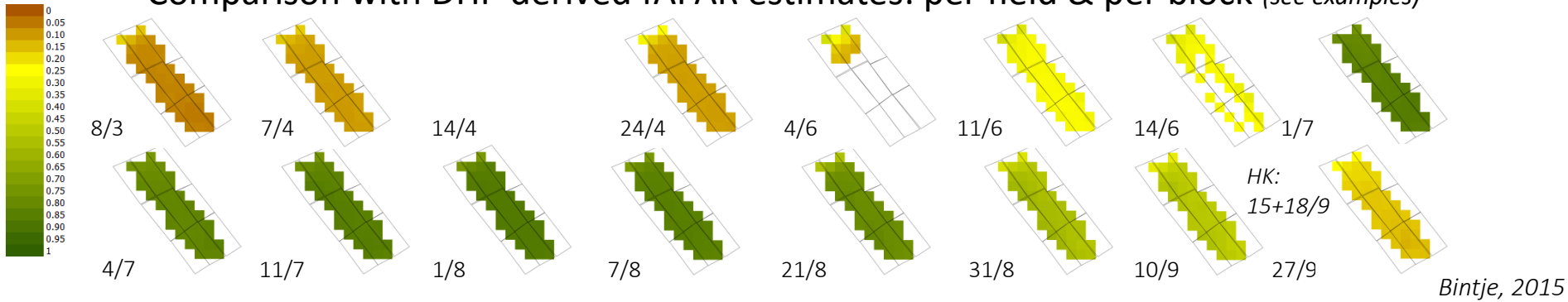
Crop growth monitoring

based on "greenness index" (fAPAR)
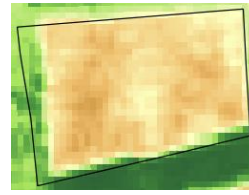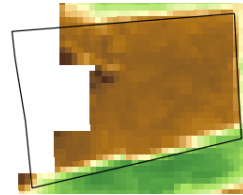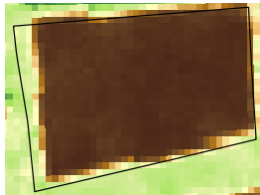
Emergence →

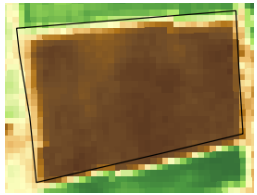| 1 May 2016 | 8 May 2016 | 28 May 2016 | 6 June 2016 | 10 July 2016 | 20 July 2016 | 9 Aug 2016 |
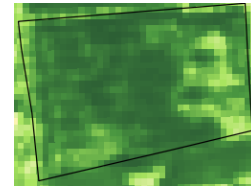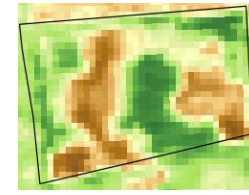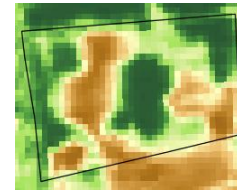
Senescence →

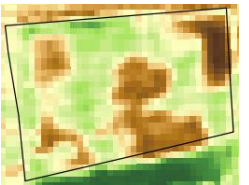| 5 Sept 2016 | 8 Sept 2016 | 15 Sept 2016 | 25 Sept 2016 | 28 Sept 2016 | 5 Oct 2016 |

Legend:
- 0
- 12.5
- 25
- 37.5
- 50
- 62.5
- 75
- 87.5
- 100
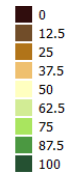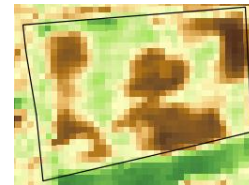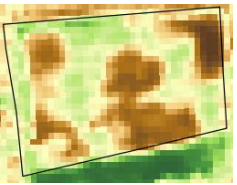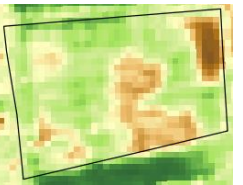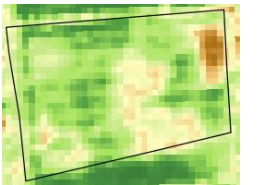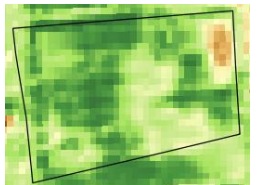
- **Variability within a field**:
  - Allows **V**ariable **R**ate **A**pplications (fertilizers, irrigation,…) -> **M**anagement **Z**ones
  - Definition of tubers sampling strategy (ground truth)

iPot
industrial potato monitoring
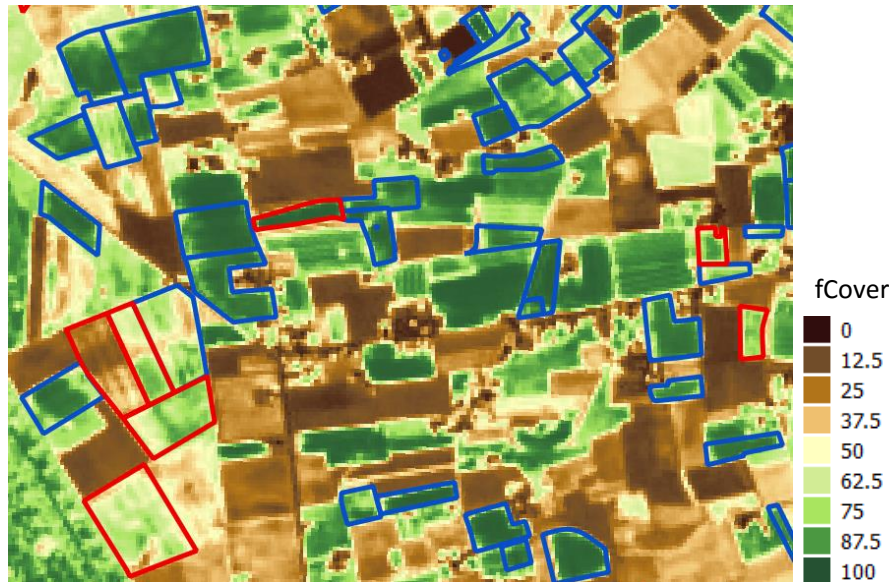
- **Variability between fields:**

    Due to early varieties (in blue) vs. late varieties (in red)

    or to different planting dates or events

Sentinel-2 of 23 June 2016

fCover
- 0
- 12.5
- 25
- 37.5
- 50
- 62.5
- 75
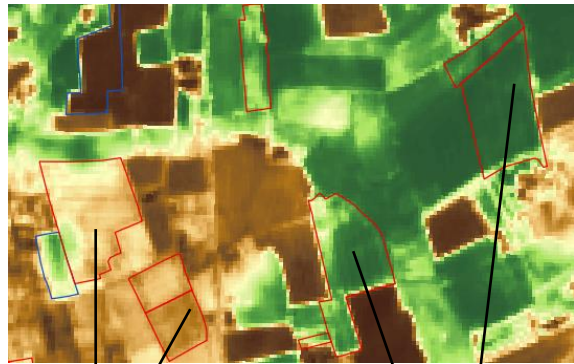- 87.5
- 100

late

mid-late

early

Variability (end of season)

- **Variability between fields**:

  Senescence started? Haulm killing applied? -> harvest planning

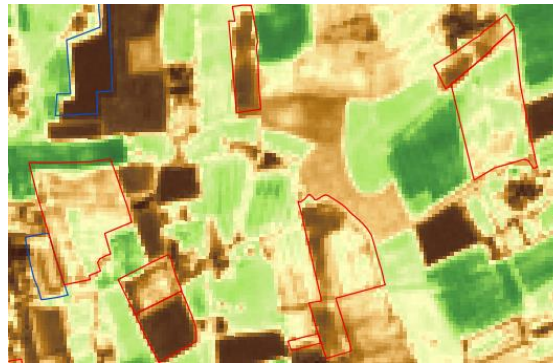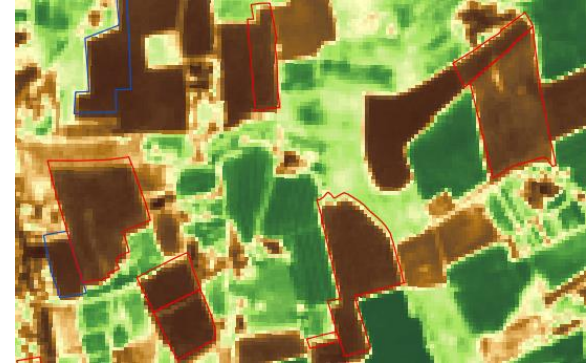**Sentinel-2 of 22 Aug 2016**

8 Sept 2016

1 Oct 2016

fCover

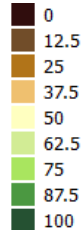|	
■	0
■	12.5
■	25
■	37.5
■	50
■	62.5
■	75
■	87.5
■	100

More advanced senescence

Still green

Haulm killing applied or harvested

- **Variability within a field**:
 - haulm killing: variable rate application
  - where to take yield samples?
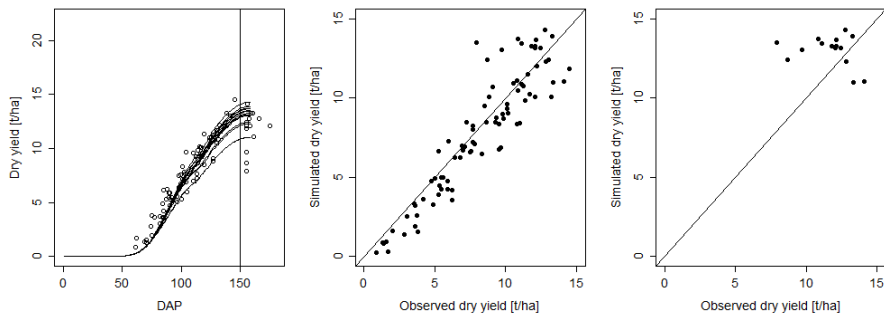
Yields estimation & prediction

Aquacrop (2015)

		fields	samples	
Fontane	Lutosa	5	5	RMSE : 1,2 t/ha
	Mydibel	8	7	RMSE : 1,3 t/ha
	Farm Frites	10	3-4	RMSE : 1,6 t/ha
	Agristo	7	3	RMSE : 2,1 t/ha
Nicola	Pomuni	5	4	RMSE : 0,9 t/ha
Bintje	Lutosa	9	5	RMSE : 1,4 t/ha
	Mydibel	6	7	RMSE : 1,5 t/ha
	MSAV	5	3-4	RMSE : 2,7 t/ha

Wofost (Bintje, 2015)
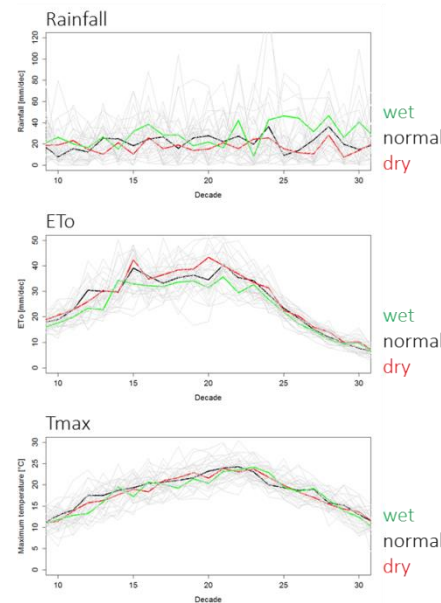

R^2: 0.86, RMSE=1.30 T MS/ ha
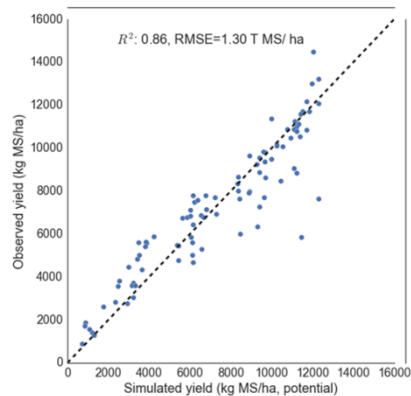
Aquacrop (Bintje, 2015)

- Good in-season trends:
  $R^2 = 0,85$
  RMSE = 1,4 t/ha

- Problematic final yields:
  $R^2 = 0,08$
  RMSE = 2,5 t/ha

Historical weather daily data 1980-2015

For ease of computing:
- for each grid cell
- for each year

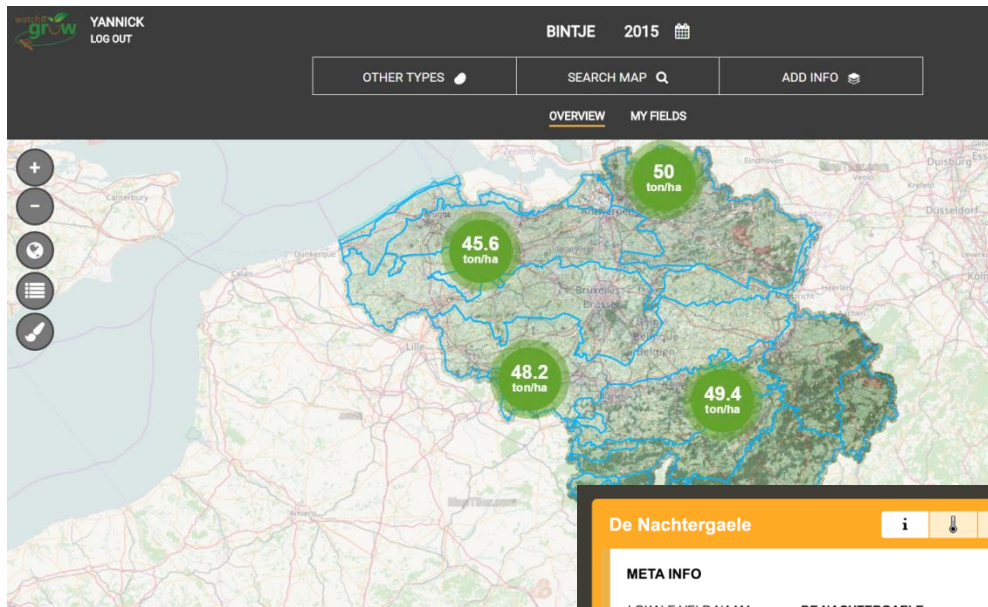$$\sum_{i=\text{day 1}}^{\text{crop season}} (\text{Rainfall}_i - \text{ETo}_i)$$

- quintiles:
  > 80%   wet
  40-60%   normal
  < 20%   dry

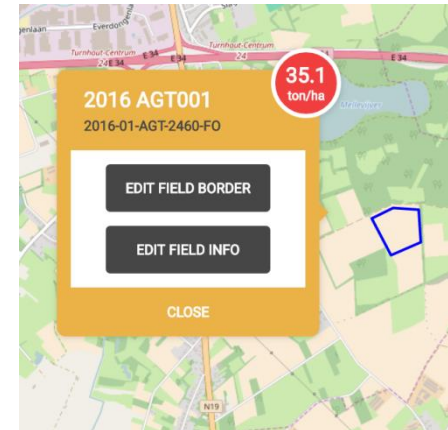Simulate 3 scenarios.

Development of web application, *in progress*

Target users:
- Industry
- Farmers
- Advisors
- Research centres

Webtool

- Start of **Promotional campaign** at Interpom Primeurs (27-29 Nov 2016 in Courtrai/Kortrijk, B)

- Official **launch of the iPot service**: March 2017

Live demo during the Lunch break !

Thank you!