



Industrial potato monitoring

*The Bright Side of Remote Sensing Workshop
25 October 2016, Brussels*



Jean-Pierre Goffart, CRA-w
Isabelle Piccard, VITO

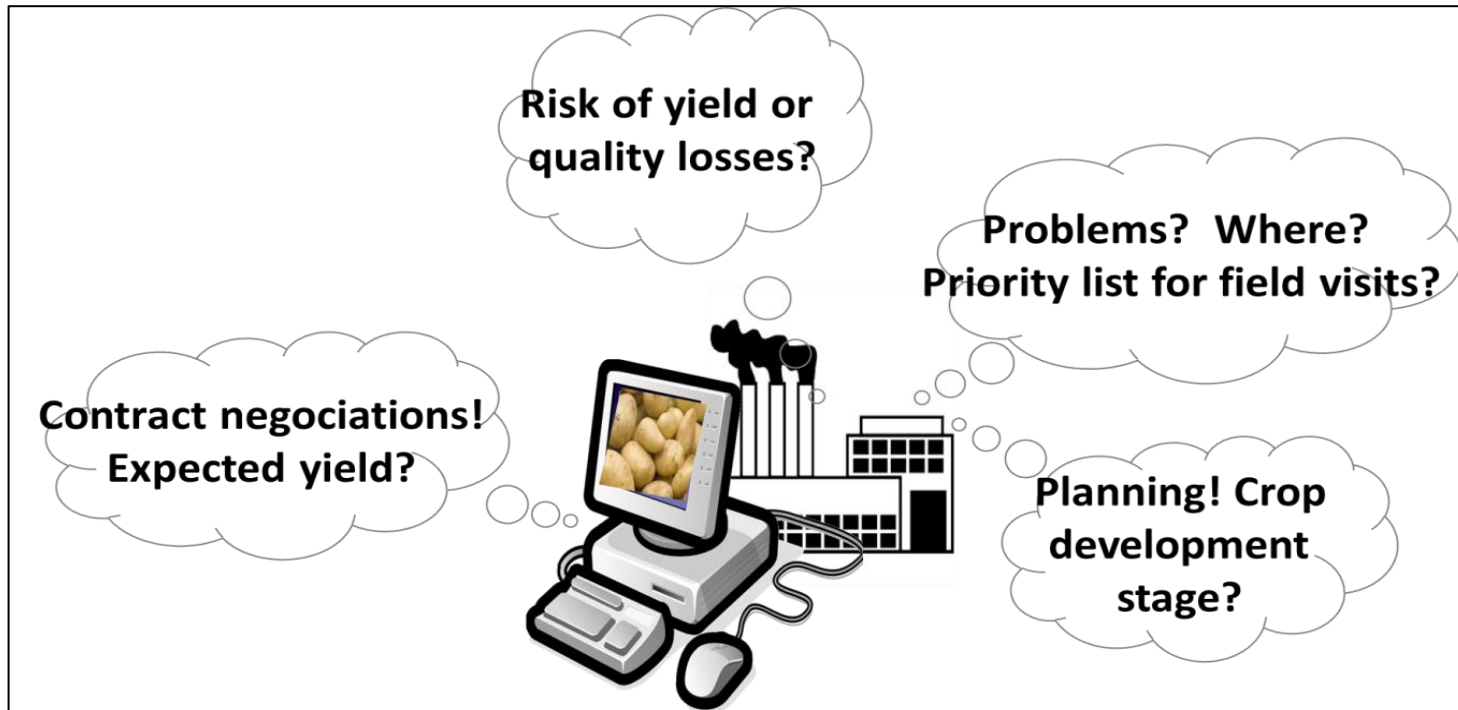
With contributions from Romain Cools, Nele Cattoor, Yannick Curnel, Amaury Leclef, Viviane Planchon, Joost Wellens, Bernard Tychon, Anne Gobin, Jeroen Dries, Jürgen Decloedt

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

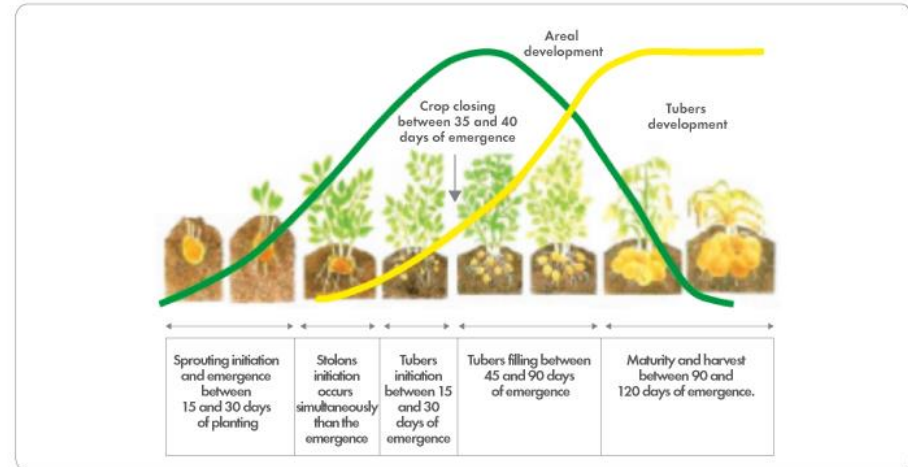
- To provide the Belgian processing and fresh potato sectors with **near real time information at field or district level**, regarding growing conditions (soil, weather), crop development status and early yield estimation/prediction based on use of **satellite images time series** and **crop growth simulation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



Crop monitoring at field scale aims at...

- **Crop phenology monitoring ...**

Key stages are:



- **Emergence** to improve crop growth simulation models

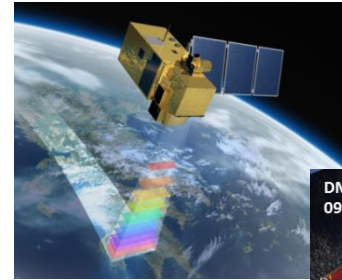
- **Senescence** to help decision on haulm killing and harvest planification

...and aerial biomass status monitoring

- To compare crop growth and development between fields during the growing season (*Normal? Faster? Slower ?*)
- To analyse intra-field variability (*helpful for invasive tuber sampling and modulation of fertilizer-N application*)
- To detect field anomalies linked to drought, water logging/flooding, pest or diseases (*hampered or delayed growth*)

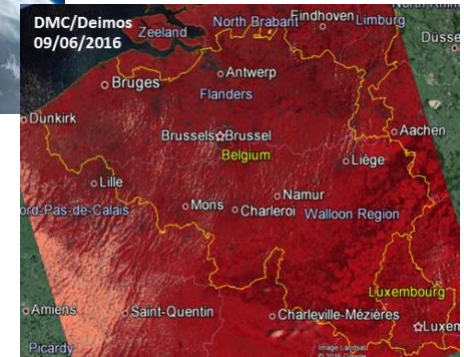


Methodology for crop monitoring at field scale



- **Satellite images (high resolution)**

- DMC Deimos/ Sentinel-2
- At country scale
- 10 m (Sentinel) - 25 m (DMC) spatial resolution
- +/- weekly acquisitions



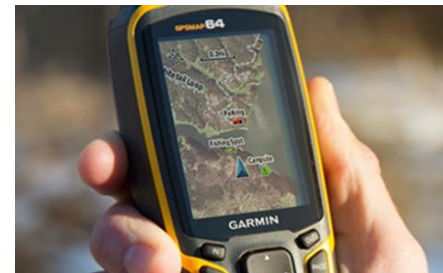
-> Derivation of **Vegetation Indices** (VIs) expressing the productivity of the crop (“greenness indices”):

- ❖ *f*APAR Fraction of Absorbed Photosynthetically Active Radiation
- ❖ *f*COVER Fraction of Green Vegetation Cover



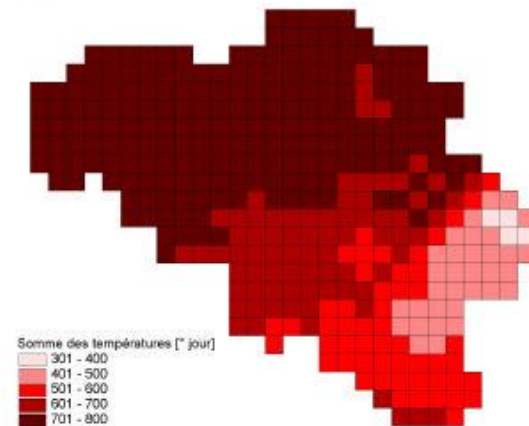
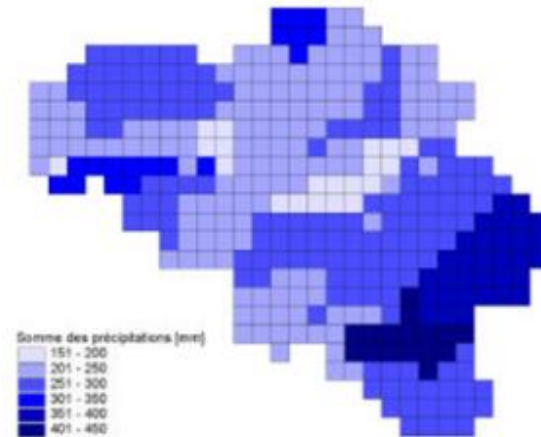
Field observations

- **Field observations**
 - Geographic coordinates
 - Field area
 - 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
 - ...



Weather data

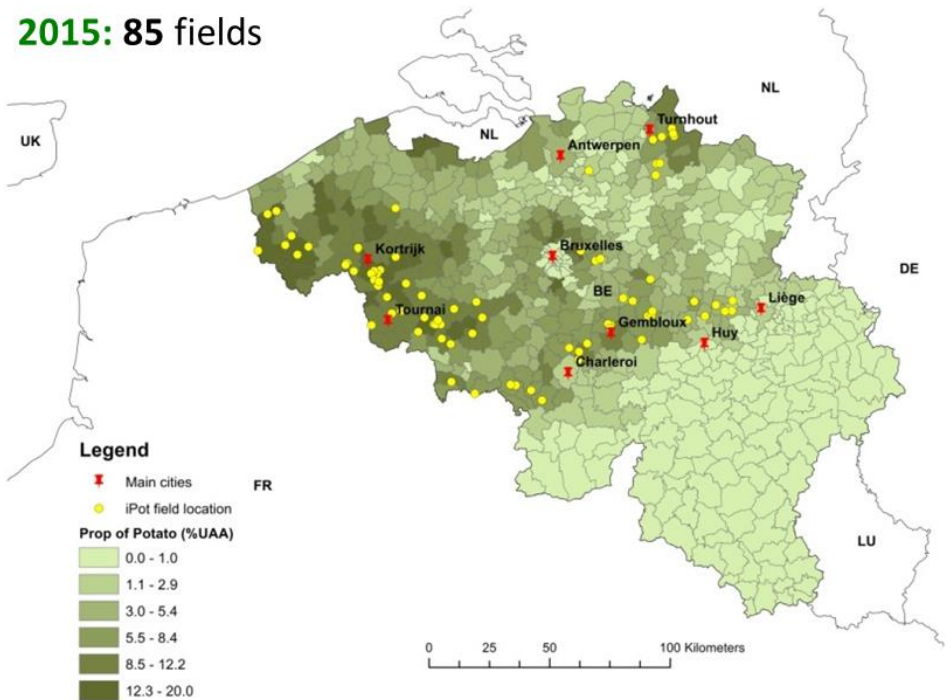
- Temperature
- Precipitation



- Useful
 - To monitor field conditions
 - To interpret crop behavior
 - To run crop growth simulation models
- Available on the iPot WEB TOOL

2 field campaigns (2015-2016)

2015: 85 fields

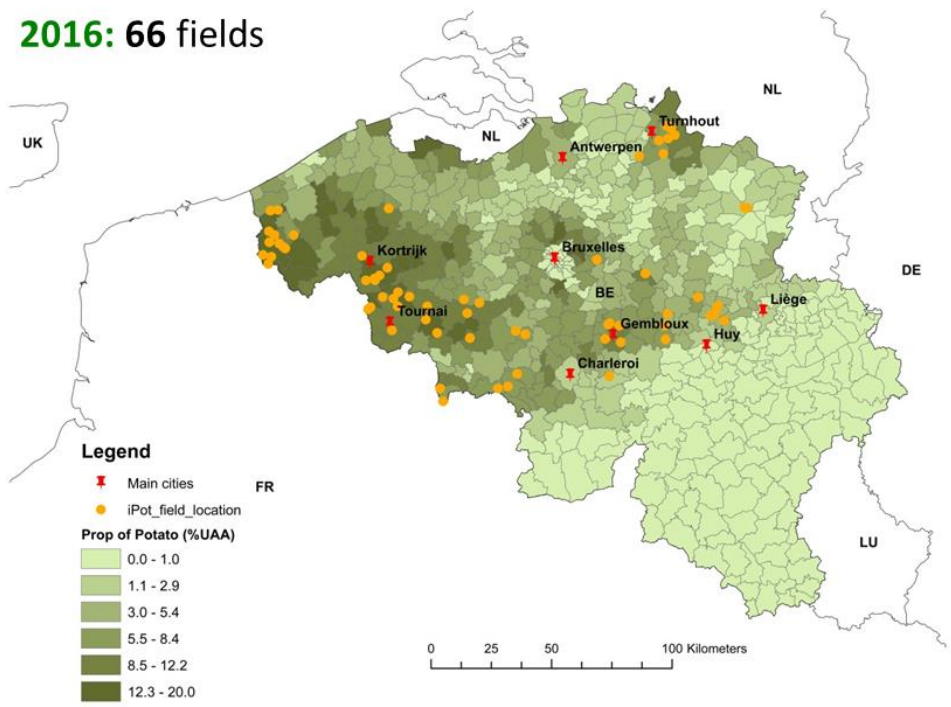


Varieties: Bintje, Fontane (processing) and Nicola (fresh market)



2 field campaigns (2015-2016)

2016: 66 fields

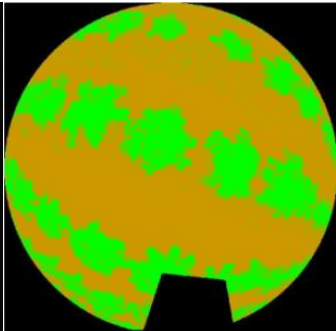


Varieties: Bintje, Fontane (processing) and Nicola (fresh market)



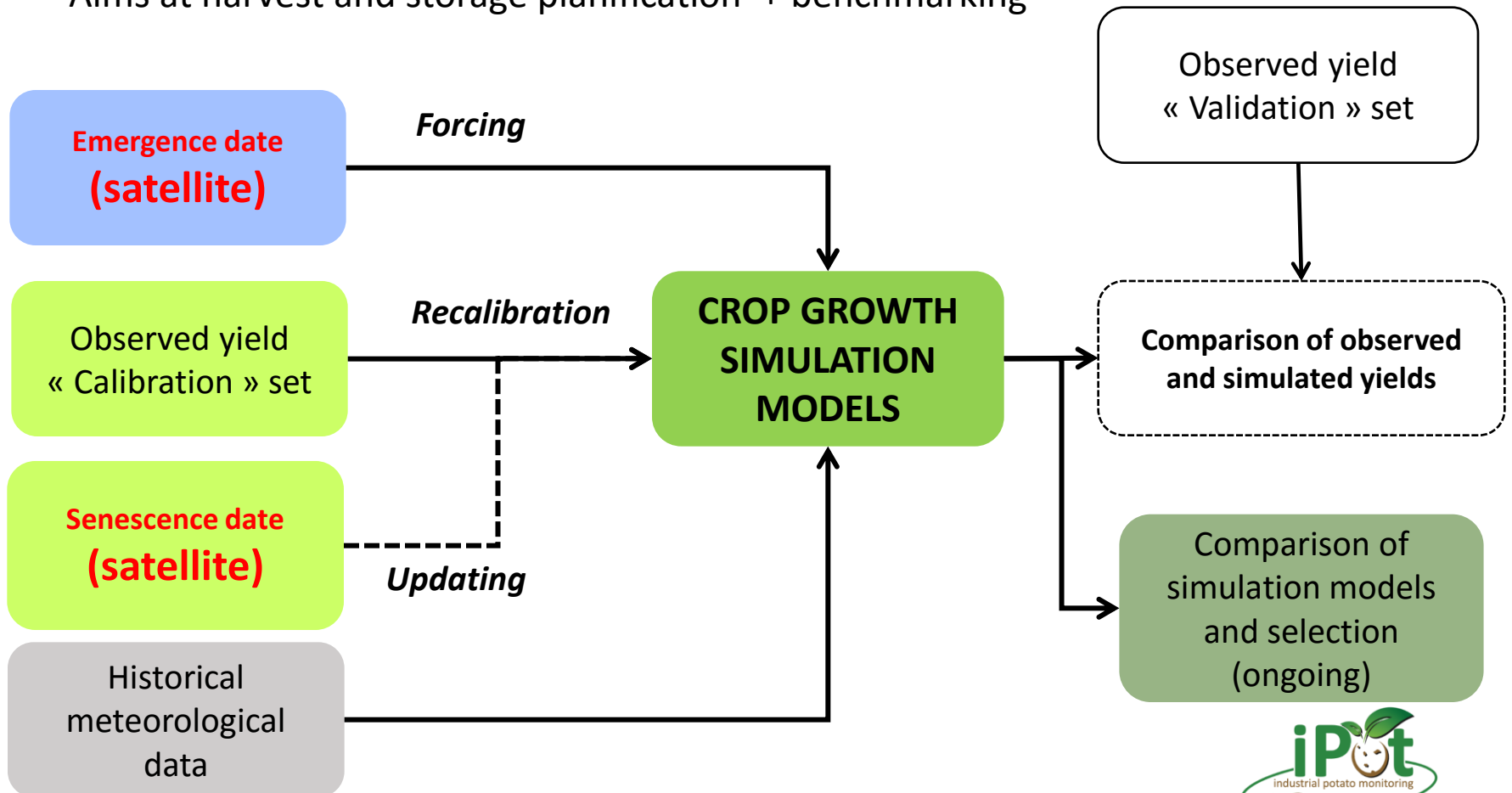
Validation of satellite info

- 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)



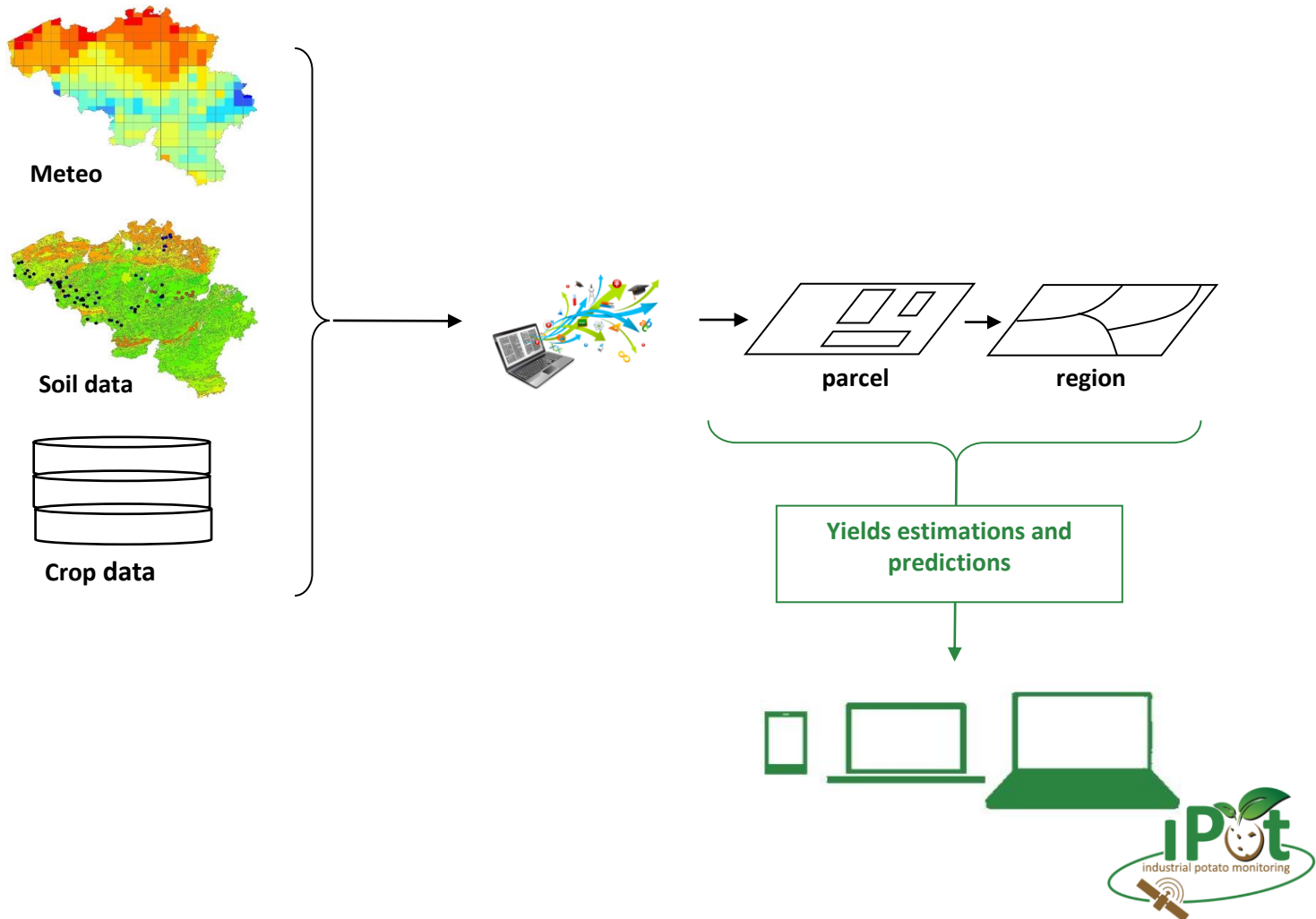
Yield estimation / prediction at field scale

- Yield estimation/prediction are expected to be improved with the assimilation of satellite derived-data into the models
- Aims at harvest and storage planification + benchmarking



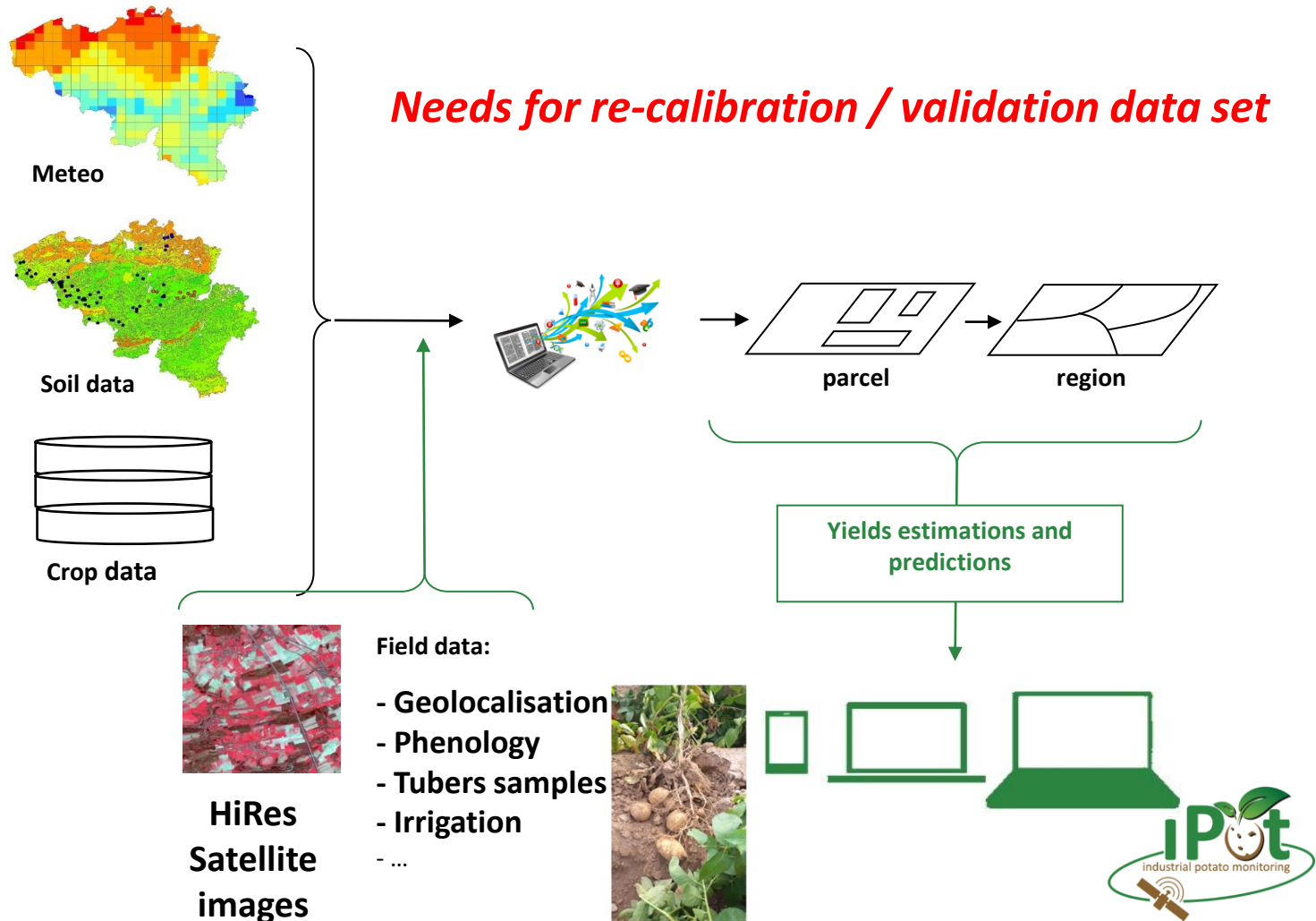
Yield estimation / prediction

- Crop growth models tested: AQUACROP, WOFOST, LINTUL-POTATO-DSS



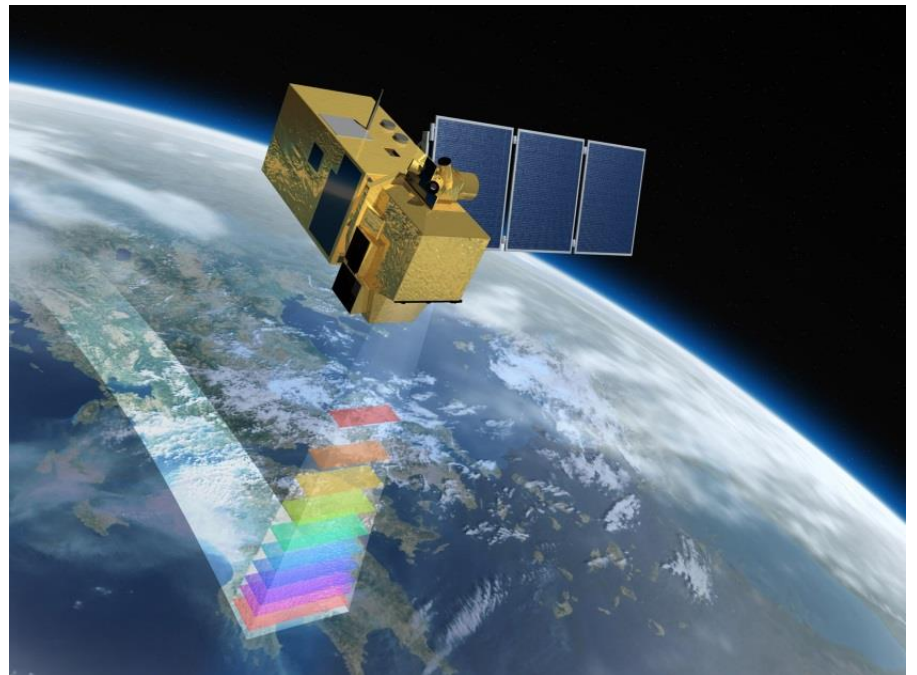
Yield estimation / prediction

- Crop growth models tested: AQUACROP, WOFOST, LINTUL-POTATO-DSS

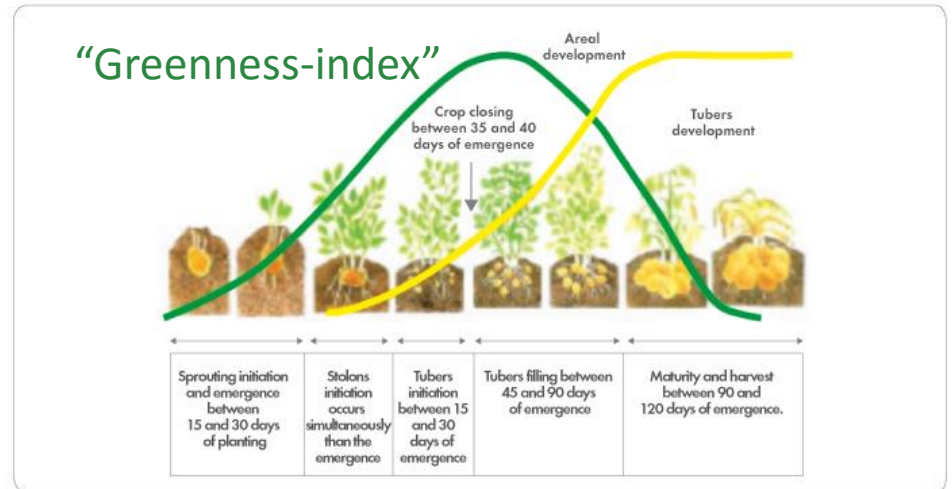




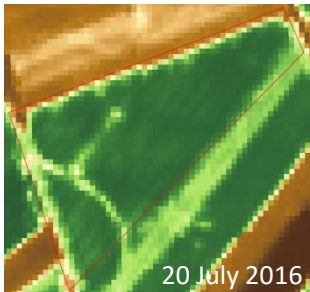
and Sentinel-2!



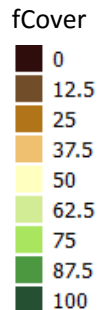
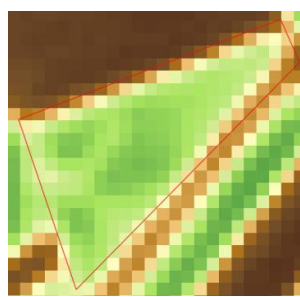
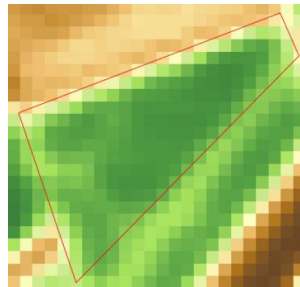
- Time series of satellite images:
 - DMC/Deimos (22m, since 2009)
 - Sentinel-2 (10m, since Aug 2015)
- Indices:
 - fAPAR
 - fCover



Sentinel-2



DMC



Processing by VITO:

- Atmospheric correction (OPERA)
- Cloud & shadow detection
- Calculation of biopar's (INRA-EMMAH algorithms)

Crop growth monitoring

Emergence →

based on “greenness index” (fAPAR)

1 May 2016

8 May 2016

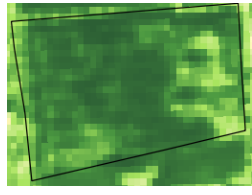
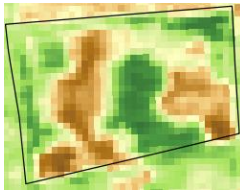
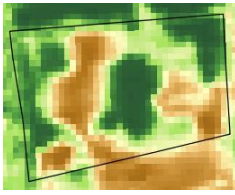
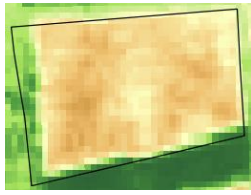
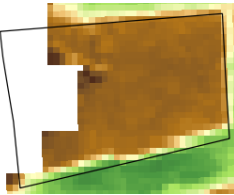
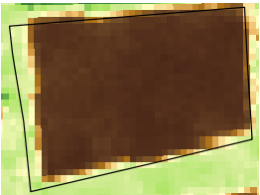
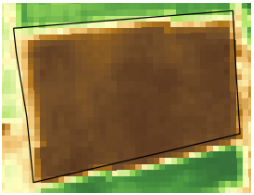
28 May 2016

6 June 2016

10 July 2016

20 July 2016

9 Aug 2016



Senescence →

5 Sept 2016

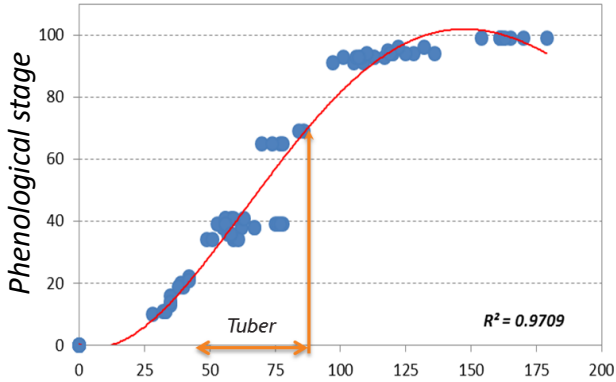
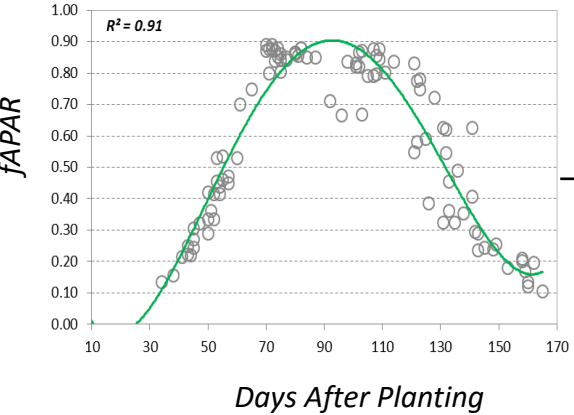
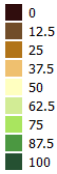
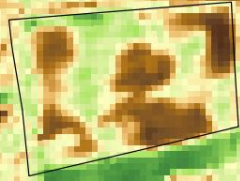
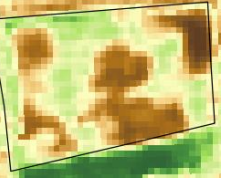
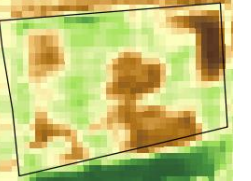
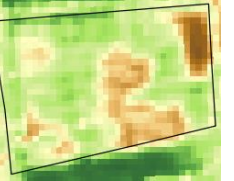
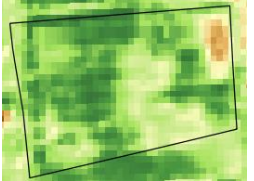
8 Sept 2016

15 Sept 2016

25 Sept 2016

28 Sept 2016

5 Oct 2016



Use of this info:

- Field management
- Planning / logistics
- Input for yield models



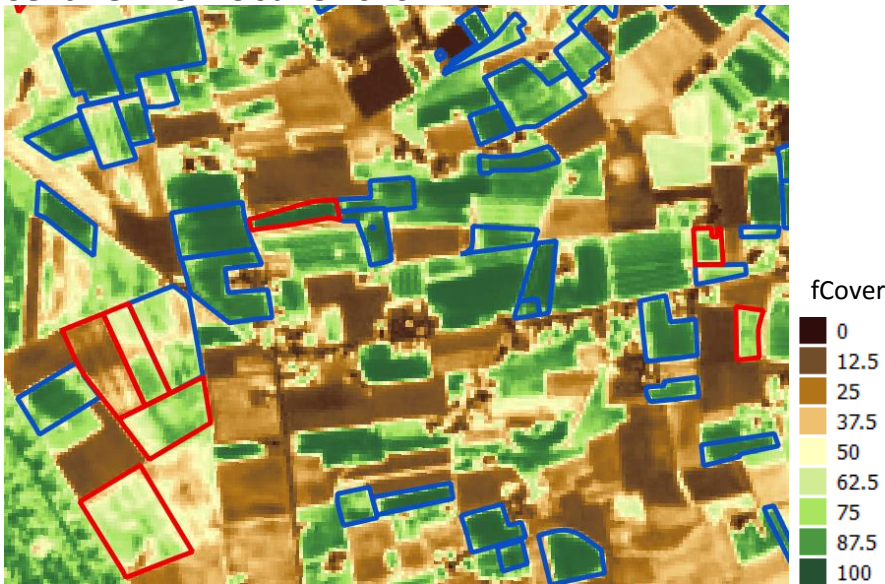
Variability (in season)

- **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



- **Variability within a field:**

- Allows **Variable Rate Applications** (fertilizers, irrigation,...) -> **Management Zones**
- Definition of tubers sampling strategy (ground truth)



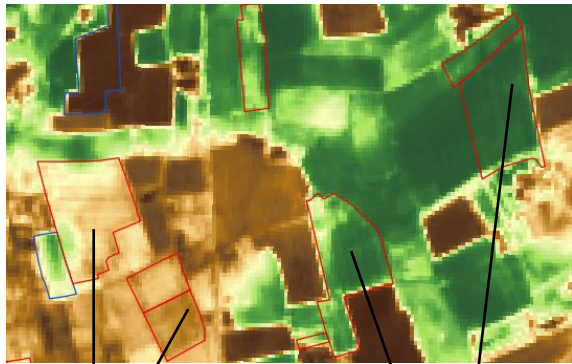
Variability (end of season)

- **Variability between fields:**



Senescence started? Haulm killing applied? -> harvest planning

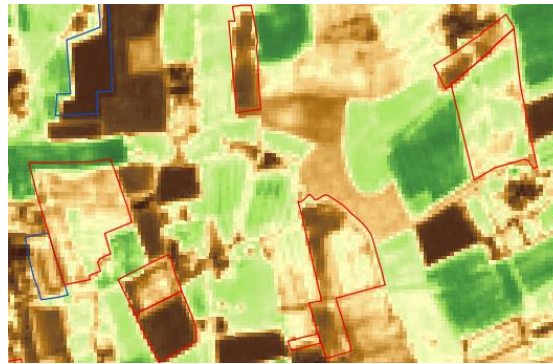
Sentinel-2 of 22 Aug 2016



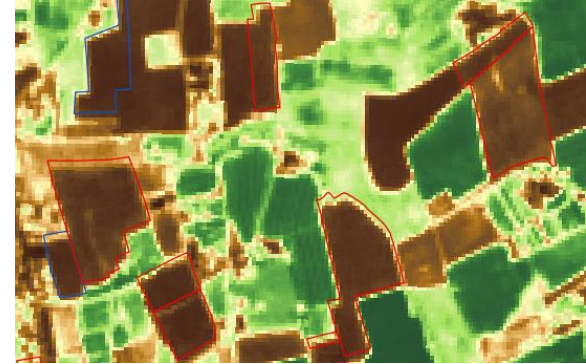
More advanced senescence

Still green

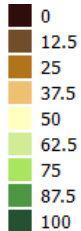
8 Sept 2016



1 Oct 2016



fCover



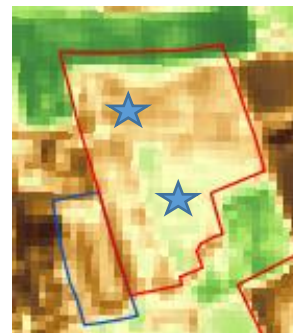
Haulm killing applied or harvested

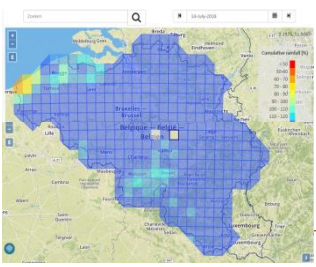
- **Variability within a field:**

- haulm killing: variable rate application



- where to take yield samples?

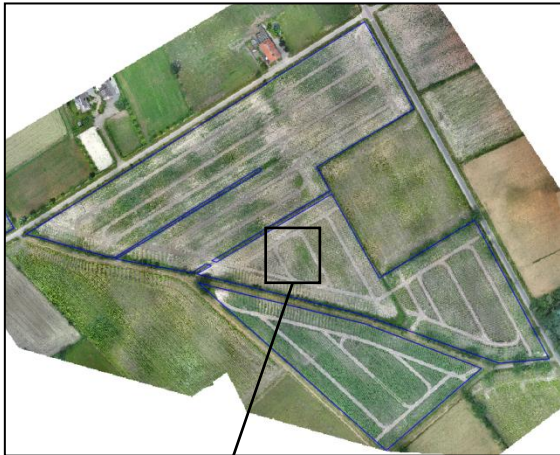




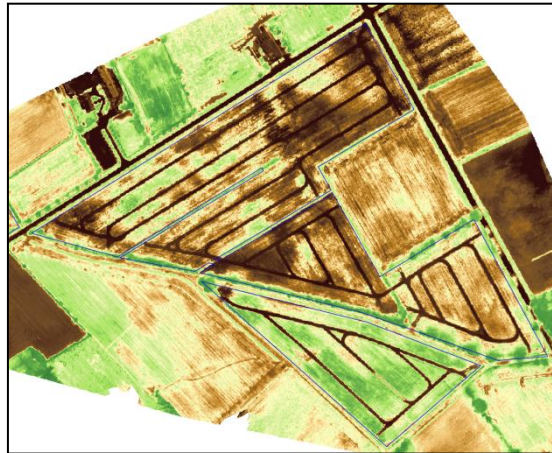
Anomaly detection

- Heavy rainfall in June 2016: water logging, flooding...

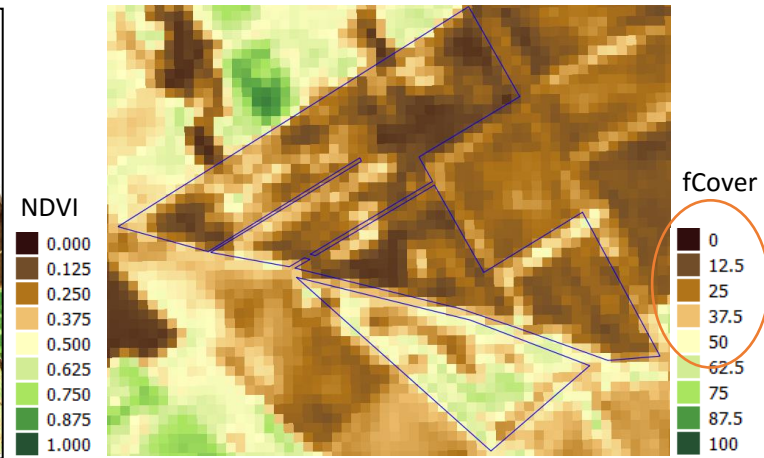
UAV image of 18 July 2016 (RGB, 3 cm)



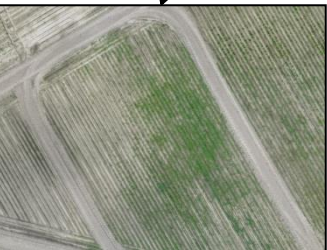
UAV image of 18 July 2016 (NDVI, 8 cm)



Sentinel-2 of 20 July 2016 (10m)



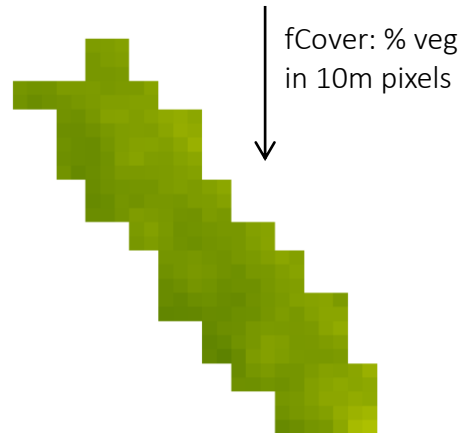
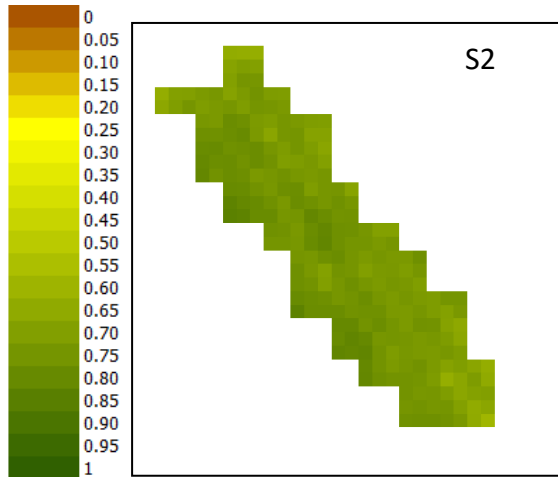
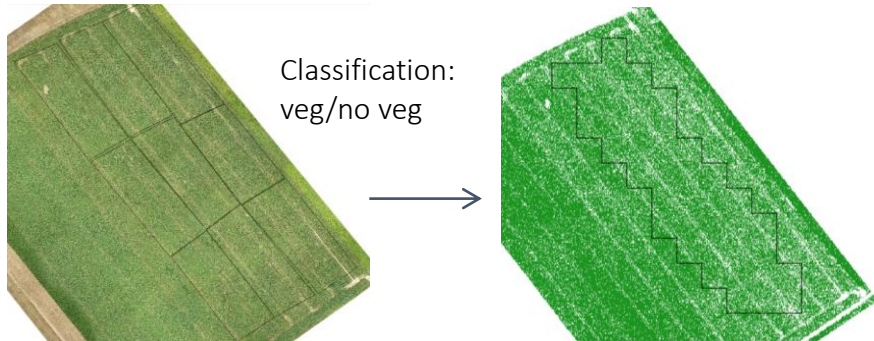
fCover < 50%: crop lost or severely damaged



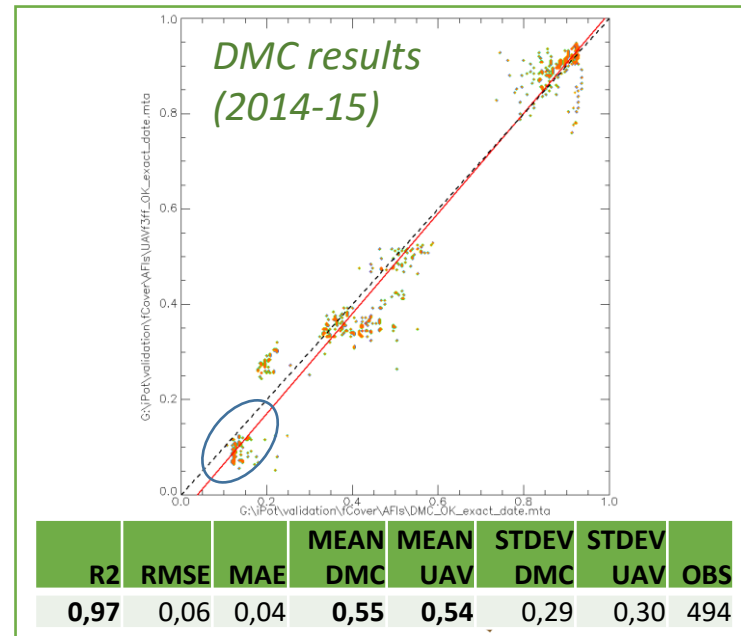
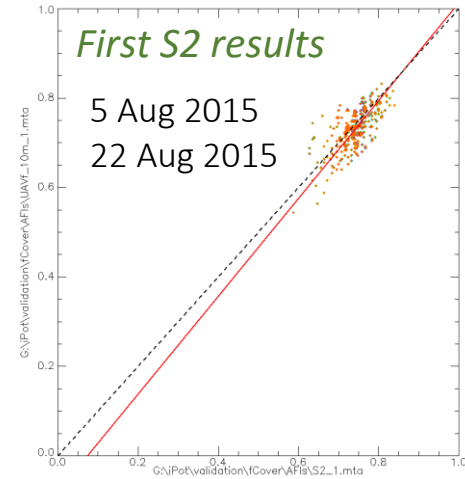


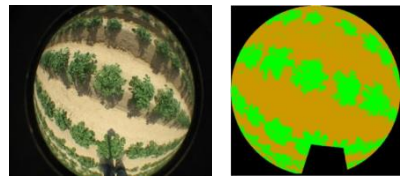
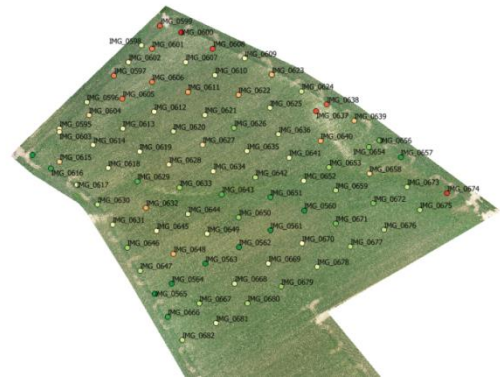
Validation fCover

- Comparison with UAV derived fCover estimates



Example: Bintje, 22/8/2015



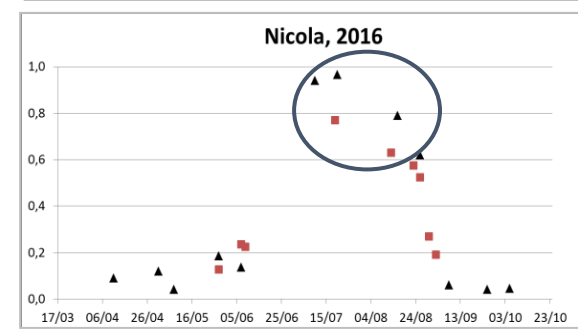
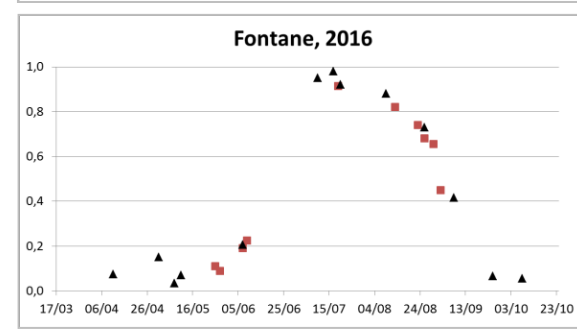
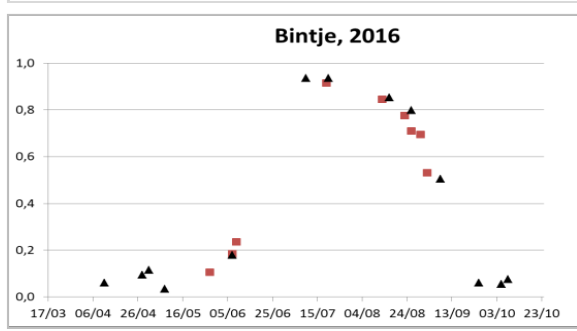
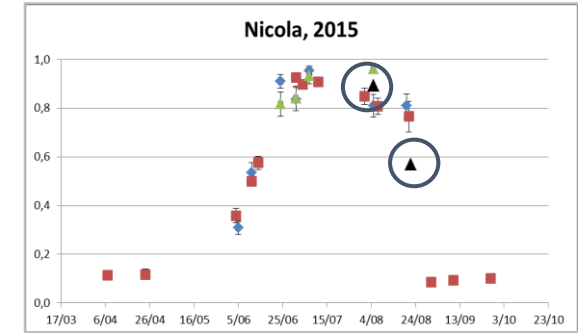
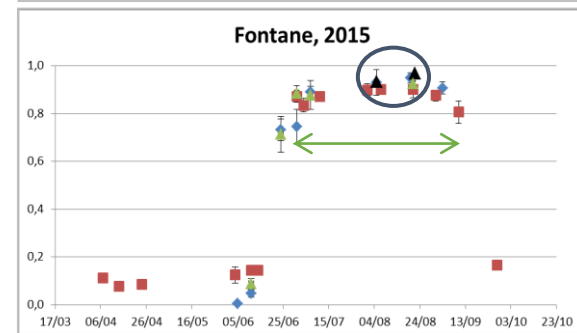
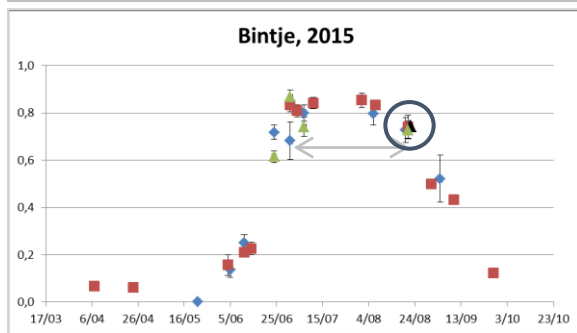
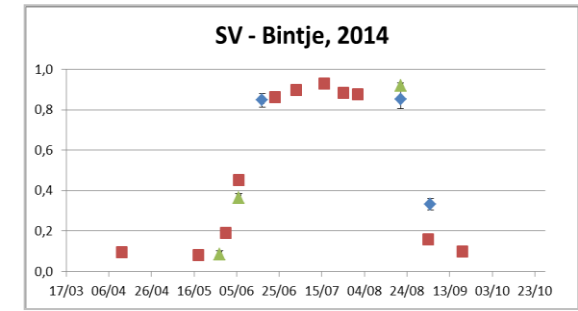
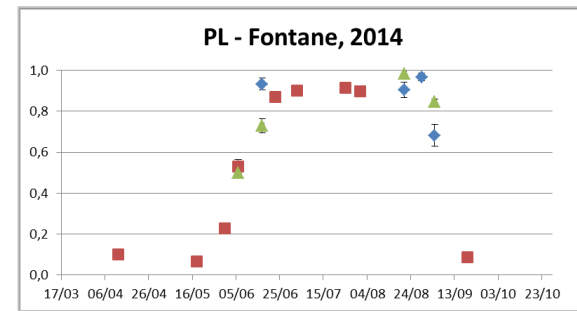
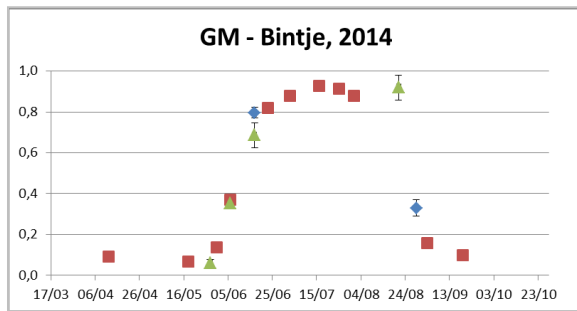


Validation fCover



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

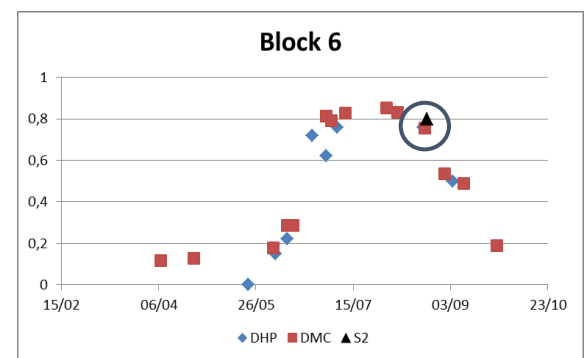
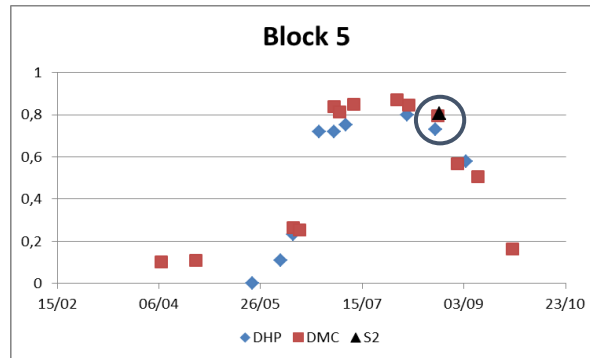
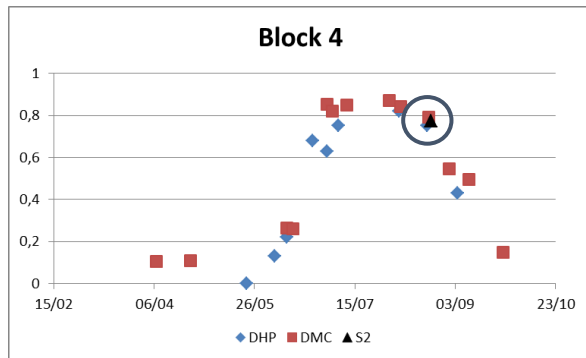
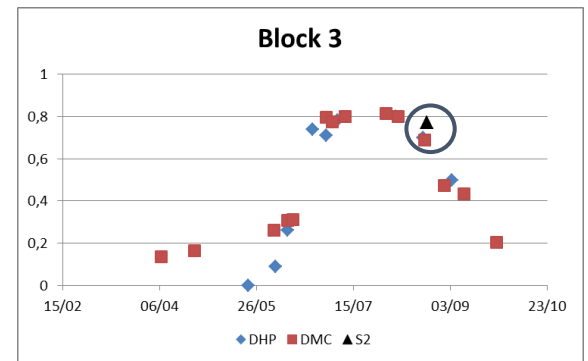
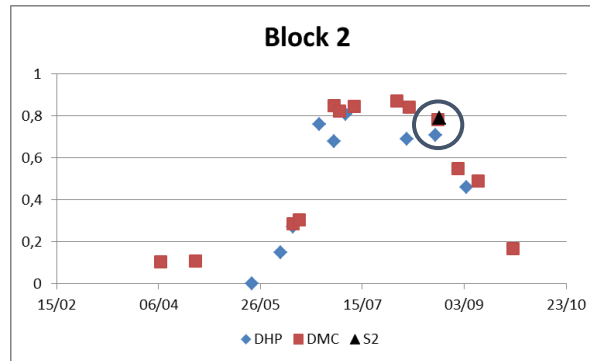
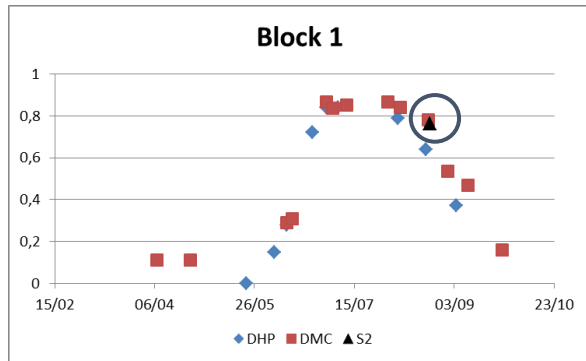
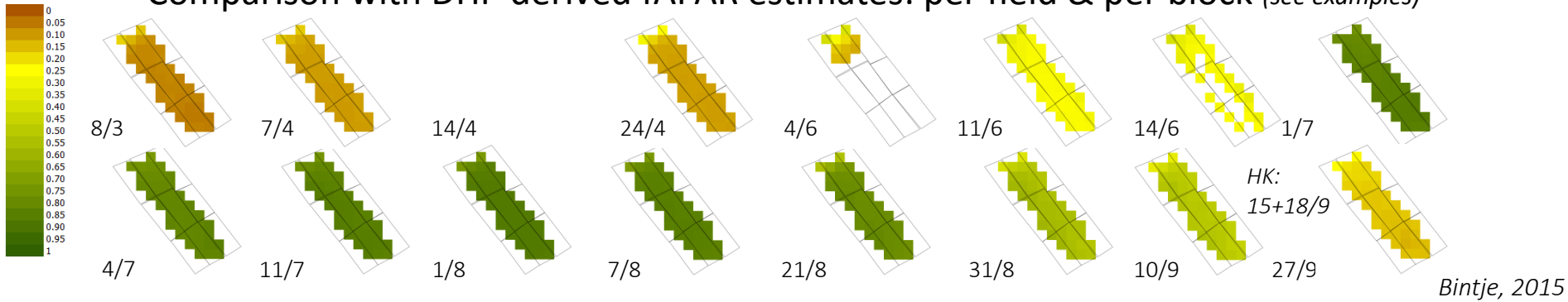
◆ DHP ■ DMC ▲ S2 ▲ UAV



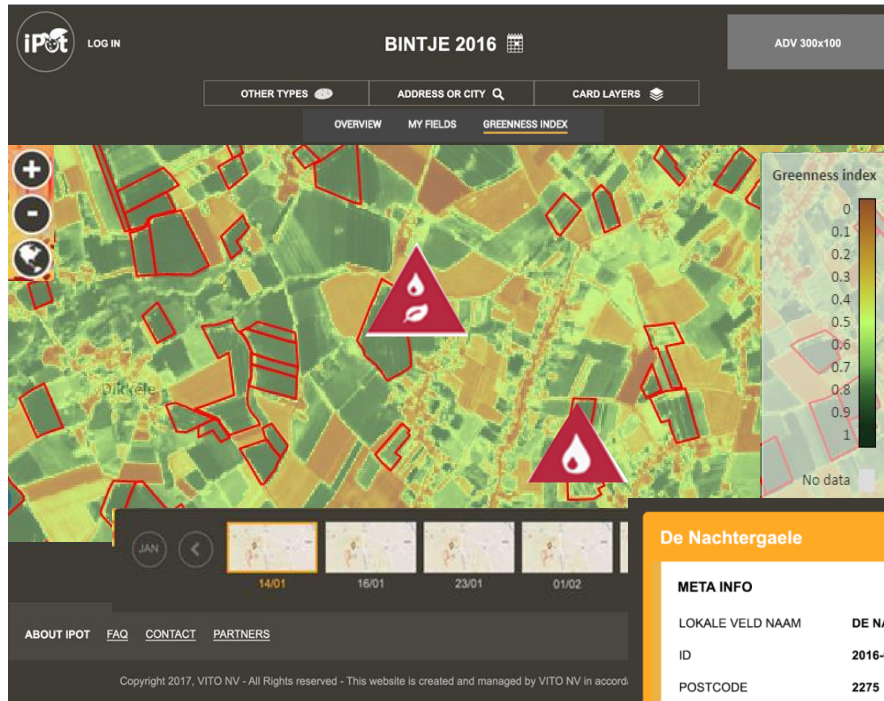


Validation fAPAR

- Comparison with DHP derived fAPAR estimates: per field & per block (see examples)



Development of web application, *in progress*



LOG IN BINTJE 2016 ADV 300x100

OTHER TYPES ADDRESS OR CITY CARD LAYERS

OVERVIEW MY FIELDS GREENNESS INDEX

Greenness index

0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

No data

JAN 14/01 16/01 23/01 01/02

ABOUT IPOT FAQ CONTACT PARTNERS

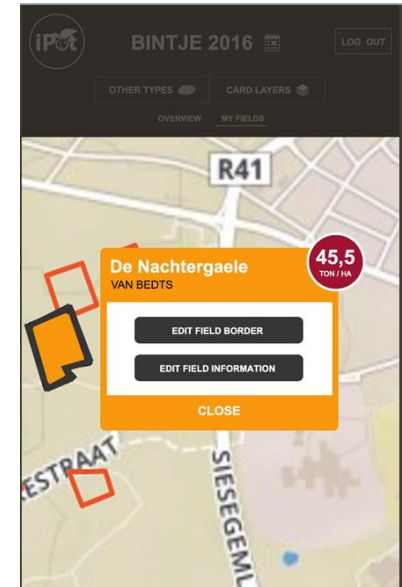
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ADD LAYERS

- Cumulative precipitation**
Monitor the amount of rain that has accumulated on your field throughout the season.
- Cumulative temperature**
Monitor the temperature of your fields throughout the season to catch signs of drought or disease.
- Greenness index**
Monitor the emergence of your crops by means of the greenness of your field.

CONFIRM

CLOSE



BINTJE 2016 LOG OUT

OTHER TYPES CARD LAYERS

OVERVIEW MY FIELDS

R41

De Nachtergaele 45,5 TON/HA

VAN BEDTS

EDIT FIELD BORDER

EDIT FIELD INFORMATION

CLOSE

ESTRAAT SIESEGEMUL

De Nachtergaele

META INFO

LOKALE VELD NAAM	DE NACHTERGAELE	BOER	VAN BEDTS
ID	2016-01-FAF-2275-FO	OPPERVLAKTE (HA)	6,1
POSTCODE	2275	BEDRIJF	FARM FRITES
GEMEENTE	LILLE	LAT	51,23094
		LON	4,85501
			51° 13' 51" N 4° 51' 18" E

GEWAS KENMERKEN

BEHANDELINGEN

BESCHADIGINGEN

FENOLOGIE

CLOSE

Target users:

- Industry
- Farmers
- Advisors
- Research centres



Outlook

- **Updates:**
 - Validation of S2 & DMC fAPAR & fCover for 2016
 - Intercalibration S2 & DMC
 - Finetuning yield models
- **Webtool** improvement & further testing
- Start of **Promotional campaign** at Interpom Primeurs (27-29 Nov 2016 in Courtrai/Kortrijk, B)
- Official **launch of the iPot service**: March 2017



Thank you!



***Eat Belgian
fries !***

