

# WHEN SPACE MEETS AGRICULTURE

14-15 November 2016 | Matera, Italy

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## Spatial information gives new ideas to manage fields in Wallonia

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**Walloon Agricultural Research Centre**

Agriculture and Natural Environment Department

*Farming systems, Territory and Information Technologies Unit*



REGIONE BASILICATA



in collaboration with



and the support of



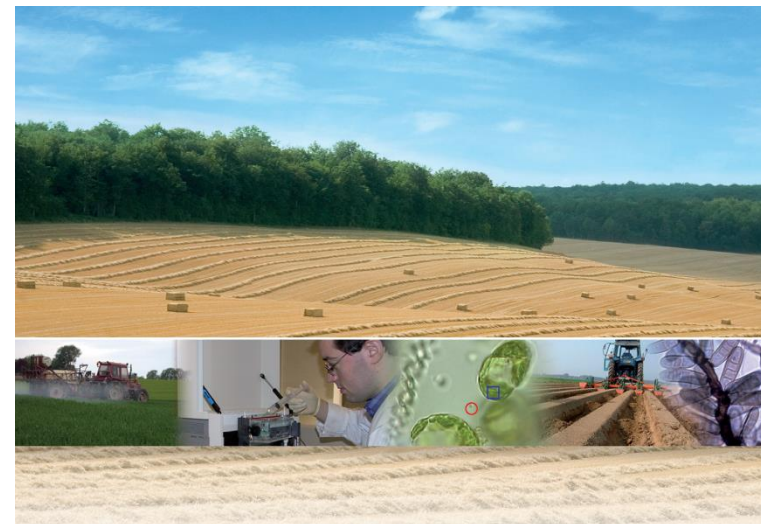




# Walloon agricultural Research Centre



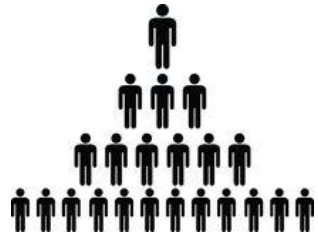
Regional public body



- To carry out fundamental and applied agricultural researches
- To provide services using expertise and equipment related to research results
- To offer a multidisciplinary scientific expertise in the fields of the agriculture and the agro-food industry



# Walloon agricultural Research Centre



**420** including  
**150** scientists



**300** ha  
experimental  
fields, orchards,  
greenhouses,  
laboratories...



**3** sites  
Gembloux,  
Libramont,  
Mussy-la-ville



**150** research  
projects at  
regional,  
national and  
european level

**29** automatic  
agricultural weather  
station  
**'PAMESEB network'**





## Walloon agricultural Research Centre



Aerospace cluster 'Skywin Wallonia'  
= group of companies, training centers and research units engaged in public and private partnership and building synergies around common and innovative projects



Agri-food cluster dedicated to the walloon food industry

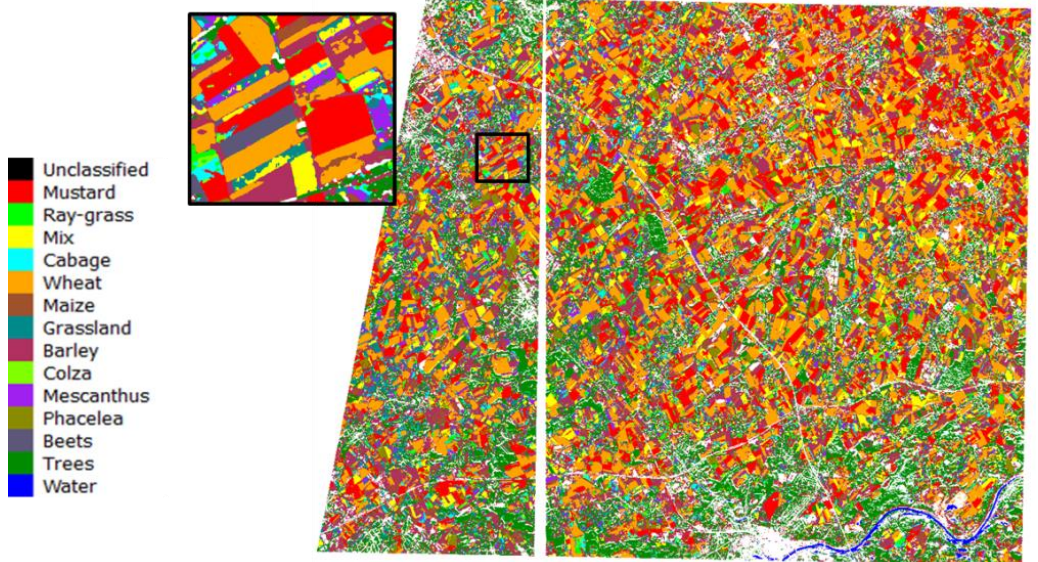
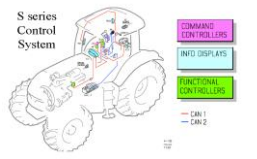




# In the frame of Smart Farming

‘Agriculture and Natural Environment’ and the ‘Production and Sectors’ Departments of CRA-W cover various activities related to space activities :

Technico-economic research on **GNSS-based systems and ICT** (busCAN, ISOBUS) for **agricultural machinery** (navigation aids, auto-guidance, field operations) to reduce inputs (pesticides, fertilizers, energy) while increasing worker’s comfort



- Precision 5 to 10 cm
- Automatic steering

Preparation of the seeds bed  
Cereals harvesting  
Seeding  
Grass mowing



Plantation / seeding  
Mechanical weeding  
Repeatability between two swath



Source: Valtra

Size of a farm in Wallonia : 30-50 ha

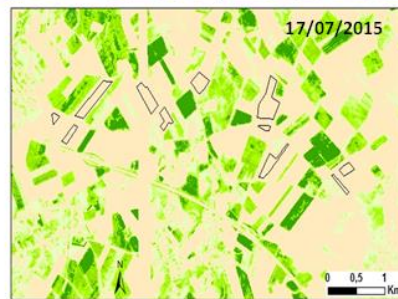
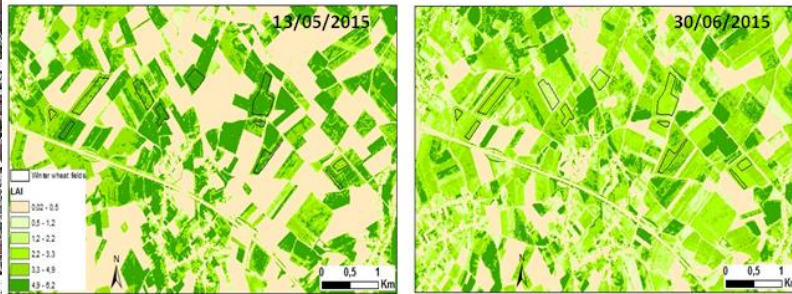


# In the frame of Smart Farming

Development of applications based on Earth Observation to the

**crop management at field and regional levels** using

- models and Decision Support Systems (e.g. crop nitrogen status)
- temporal, multi-sensors information and assimilation techniques



Evolution of biomass (LAI) in winter wheat crops (S2 images) near Gembloux (BE)

Greenseeker



Yara ALS (active light source) system



Source: Agrometius

Veris (pH)

Embedded sensors on agricultural machinery

Manual technologies for in-situ measurements  
SPAD, Cropscan, dualox, multiplex

Fluorimeter **Dualox**



Estimation of leaf [flavonoids]



# In the frame of Smart Farming

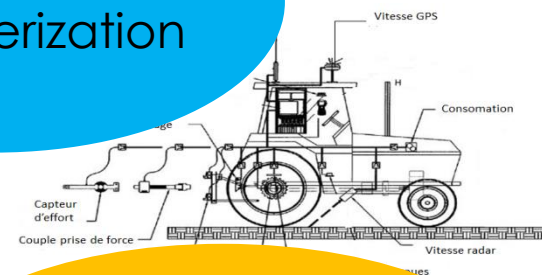
## VISA

project



Harvest  
characterization

Vegetation  
characterization



Soil  
characterization



Use of geolocalised generic data at the field level  
in order to develop precision agricultural strategies



# In the frame of Smart Farming



**Concept = compare, correlate and validate the generic data with other pertinent and known agronomical data**

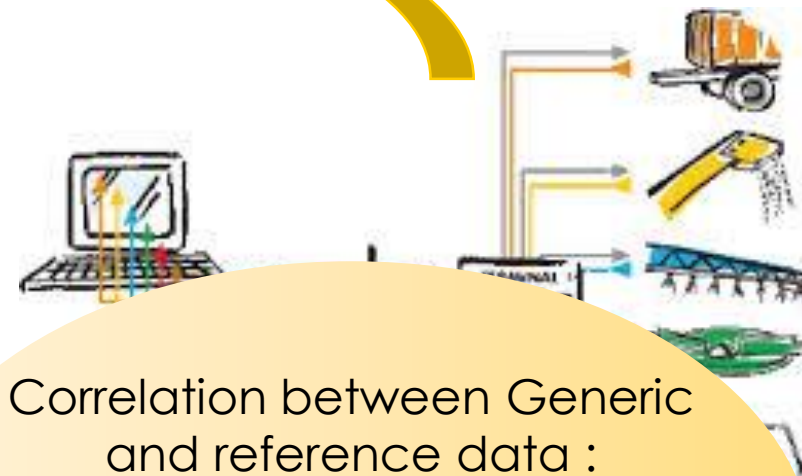
Collection and analysis of the generic data

**META-DATA**  
(Generic and geo-localized)

Agronomical interpretation



Source: Geo-pro



Correlation between Generic and reference data :

**Slippage  $\approx$  Soil humidity**



Seeding density

# VISA

project

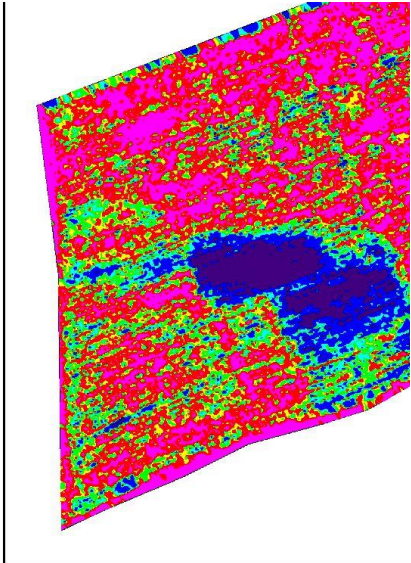


# In the frame of Smart Farming

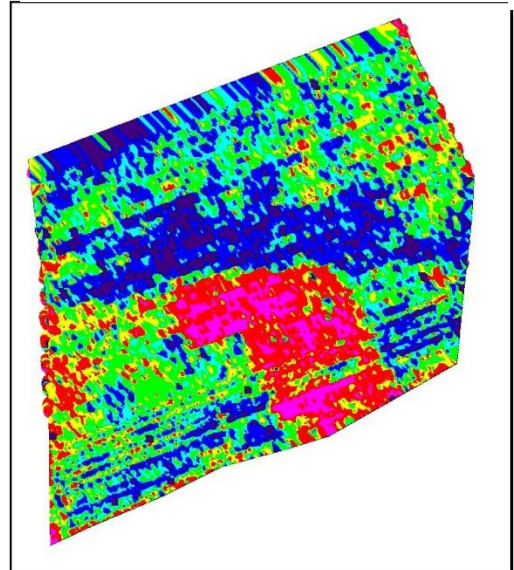


Rèves  
Patinage

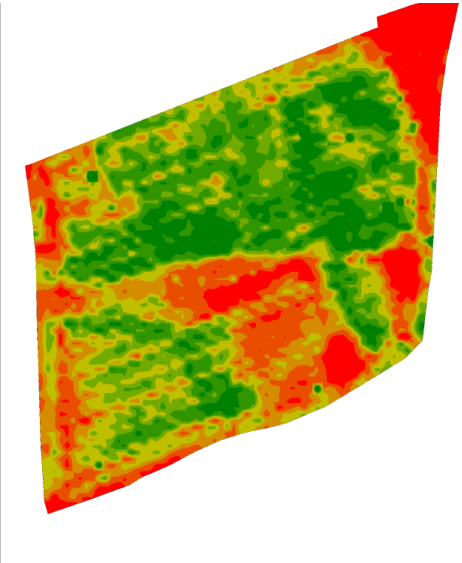
Slipping images



Height of the crop



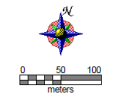
Yield of the crop



11,000 - 45,000  
6,000 - 10,999

4,1 - 103,0 kg/ha  
3,7 - 4,0 kg/ha  
3,4 - 3,6 kg/ha  
3,0 - 3,3 kg/ha  
2,6 - 2,9 kg/ha  
2,1 - 2,5 kg/ha  
0,4 - 2,0 kg/ha

Exploitation: < Exploitation non assign  
Ferme: Domaine  
Champ: Rèves  
Culture: 2016 Wheat  
Nom: rendement reves  
Date: 31/08/2016

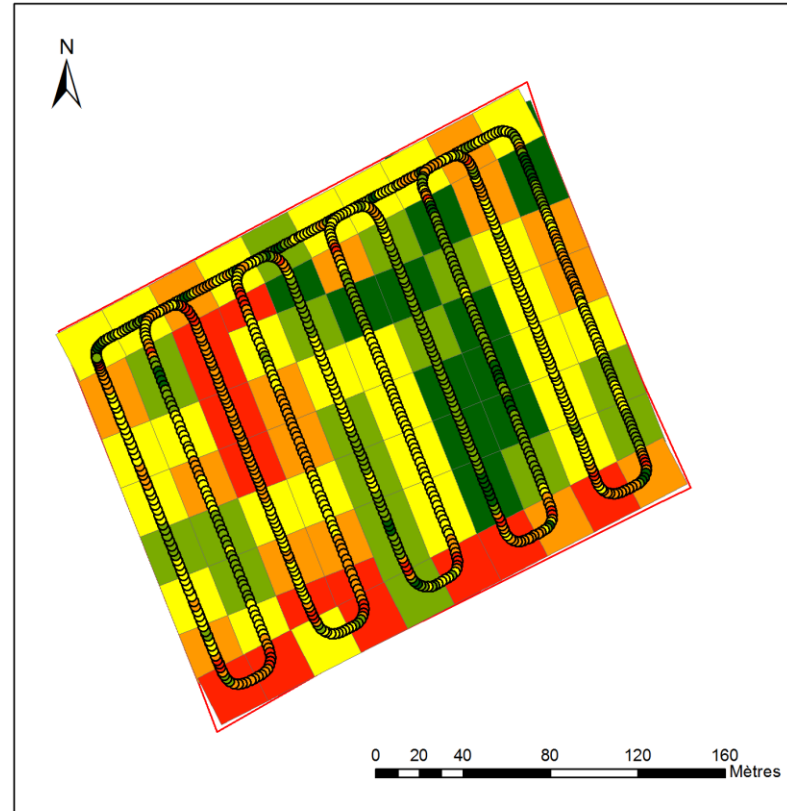


# VISA



# In the frame of Smart Farming

## Variability within a winter wheat field and proposition of nitrogen modulation for 2016



### Légende

#### NS\_h\_14avr16\_N

N

- 39 - 70
- 71 - 77
- 78 - 81
- 82 - 86
- 87 - 97

#### modulationgrid\_h\_bbfddb\_uNSN

Avg\_N

- 70,000000 - 75,230769
- 75,230770 - 78,400000
- 78,400001 - 80,769231
- 80,769232 - 82,909091
- 82,909092 - 86,647059
- Hostellerie\_projected

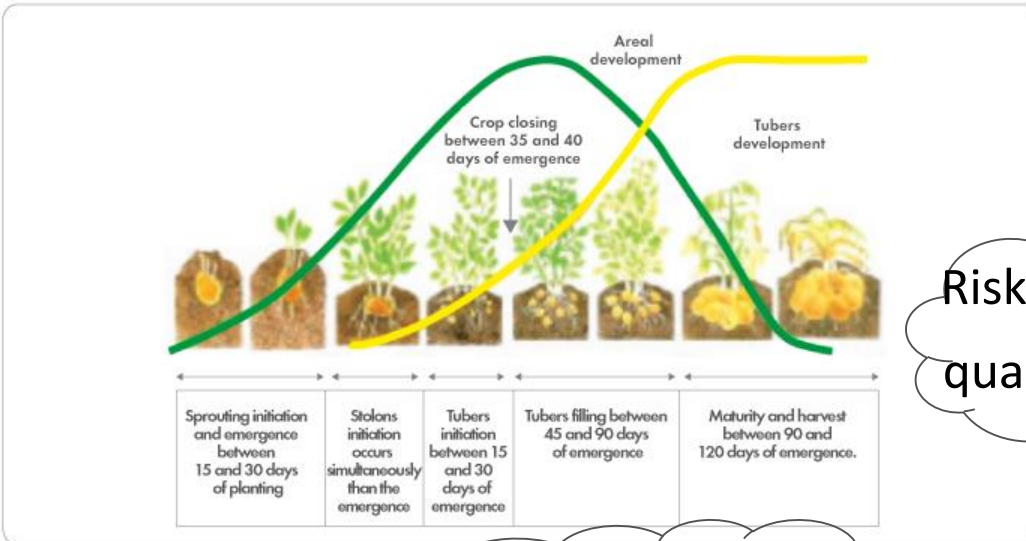
# VISA





# In the frame of Smart Farming

Earth Observation services for **crop growth monitoring and crop damage assessment Systems** (crop yield estimations and natural risk management)



## Industrial potato monitoring



Risk of yield or quality losses?

Problems? Where?  
Priority list for field visits?

Contract negotiations!  
Expected yield?



Planning! Crop development stage?



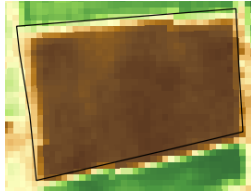


# Industrial potato monitoring

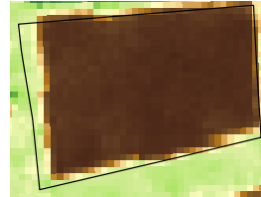
Emergence →

based on “greenness index” (fAPAR) – S2

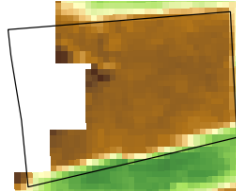
1 May 2016



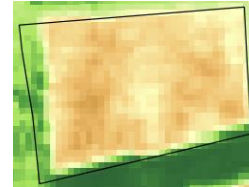
8 May 2016



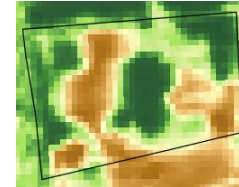
28 May 2016



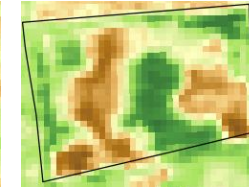
6 June 2016



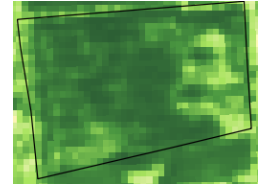
10 July 2016



20 July 2016

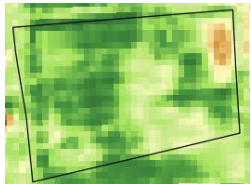


9 Aug 2016

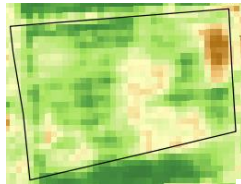


Senescence →

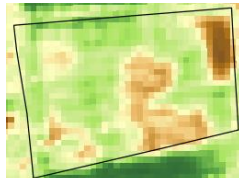
5 Sept 2016



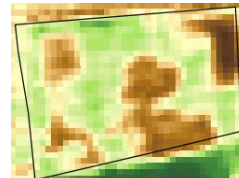
8 Sept 2016



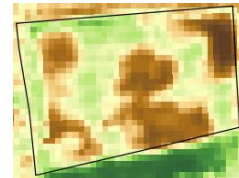
15 Sept 2016



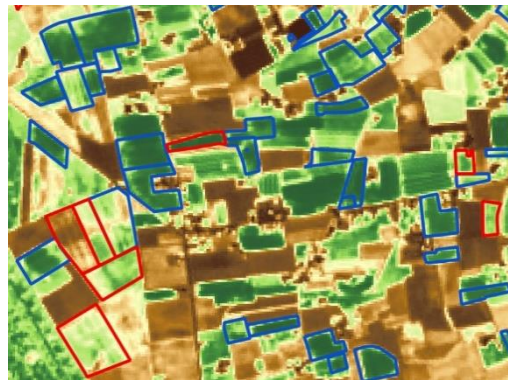
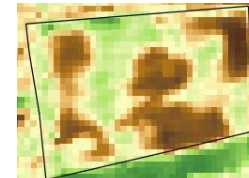
25 Sept 2016



28 Sept 2016



5 Oct 2016



Sentinel-2 of 23 June 2016



- **Variability within a field**

Allows **Variable Rate Applications** (fertilizers, irrigation,...)

-> **Management Zones**

- **Variability between fields (benchmarking)**

Due to early varieties (in blue) vs. late varieties (in red) or to different planting dates or events

Lot of in-situ measurements and validation with UAV







# Industrial potato monitoring

Development of web application, in progress







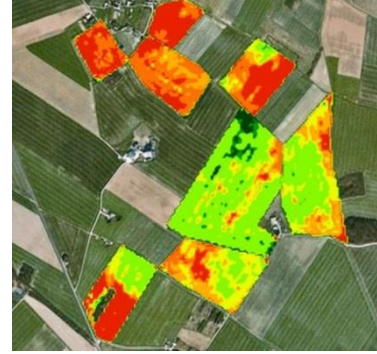
# BELgian Collaborative Agriculture Monitoring at parcel level for sustainable cropping systems







# BELgian Collaborative Agriculture Monitoring at parcel level for sustainable cropping systems



*Farm-sourcing*

By fully exploiting the red-edge capabilities of Sentinel 2 and the wide and frequent coverage of Sentinel 1 and 2 as well of PROBA-V, different information will be delivered along the season to the farmers :

- 1) the provisional annual Nitrogen balance-sheet
- 2) the field zoning
- 3) the crop Nitrogen status before the 3rd application for winter wheat and before a potential second application for potato at the parcel level





# Development of the BELCAM collaborative platform



The screenshot displays the BELCAM web application interface. On the left, a sidebar lists parcels under the heading "Mes parcelles". The main area shows a satellite map with a white outline around a specific parcel. A blue arrow points from the "Travaux au champ (6)" section in the sidebar to a detailed view of field work on the right.

**Mes parcelles**

- Bechet *Joost Wellens*
- Beguín
- Bemestingsproef Zwevegem *Lies Willaert*
- Bintje Comijn rue des aubépines entre Ramelot et Abbée *Daniel Ryckmans*
- Bladziekteproef Koksijde *Lies Willaert*
- Bladziekteproef Zwevegem *Lies Willaert*
- Bouge** *Rasmont helene*
- Champ de Leyde G *Benoit Heens*
- Cloos 30 *Joost Wellens*
- Cloos 31 *Joost Wellens*
- Cloos 32 *Joost Wellens*
- Corroy *Manssens*

**Informations générales**

**Travaux au champ (6)**

- Fertilisation  
Engrais de synthèse Azote  
5790 kg par ha  
14 Apr 2016
- Fertilisation  
Engrais de synthèse Fertiphos  
6 kg par ha  
23 Jul 2015
- Semis d'engrais vert  
Moutarde  
Développement : Elevé  
Entfouï 12 Jan 2016
- Semis  
Dames de terre Fontaine 0

**Informations générales**

- Travaux au champ (6) +
- Evénements (0) +
- Visites de terrain (1) +



# Development of the BELCAM collaborative platform



Page appartenant à Jean-Pierre Goffart

**Mes parcelles**

Bechet	Joost Wellens
Begu	
Bemestingsproef Zwevegem	Lies Willaert
Binlje Comijn rue des aubépines entre Ramelot et Abbée	Daniel Ryckmans
Bladziekteproef Koksijde	Lies Willaert
Bladziekteproef Zwevegem	Lies Willaert
<b>Bouge</b>	<b>Rasmont helene</b>
Champ de Leyde G	Benoit Heens
Cloos 30	Joost Wellens
Cloos 31	Joost Wellens
Cloos 32	Joost Wellens
Corroy	Manssens

**Imagerie satellite**

Visible: Les images satellites sont présentées dans le visible, c'est à dire en couleurs réelles telles qu'on les perçoit sur une photographie.

Proche infra-rouge: Quand on inclut le proche infra-rouge, la végétation sur l'image apparaît rouge. L'intensité du rouge est directement liée au développement de la végétation. Plus le rouge est foncé, plus la végétation est dense. Le sol nu dans les champs apparaît dans les tons jaunes-bruns et les routes en gris.

12 Mars 10 Juili

Visible

Near infrared

4.9541, 50.4900

belcam



# New ideas to manage fields in Wallonia



In organic crops, tests to assess **mechanical weeding** on wheat, corn peas, quinoa, soy crops

Trials involve a comparison of weed control techniques (different tools, settings and routes) and assess the :

- impact on the number and types of weeds
- impact on culture in place
- cost





# New ideas to manage fields in Wallonia

Assessment of **Grassland Use Intensity** by Remote Sensing :  
SAR-based Detection of Mowings

Increasing pressure on grassland ecosystems currently observed and results in an **intensification of grassland management**

Grassland management practices (mowing or grazing) and the intensification level of these practices (number of mowings per year, livestock density, level of N fertilization) have an **impact on the different services associated to this agro-ecosystem** (e.g carbon sequestration, erosion prevention or pollination support)

Grassland use intensity can be assessed in mowed grasslands based on several features such as the **biomass**, the **floristic composition** or the **mowing calendar**



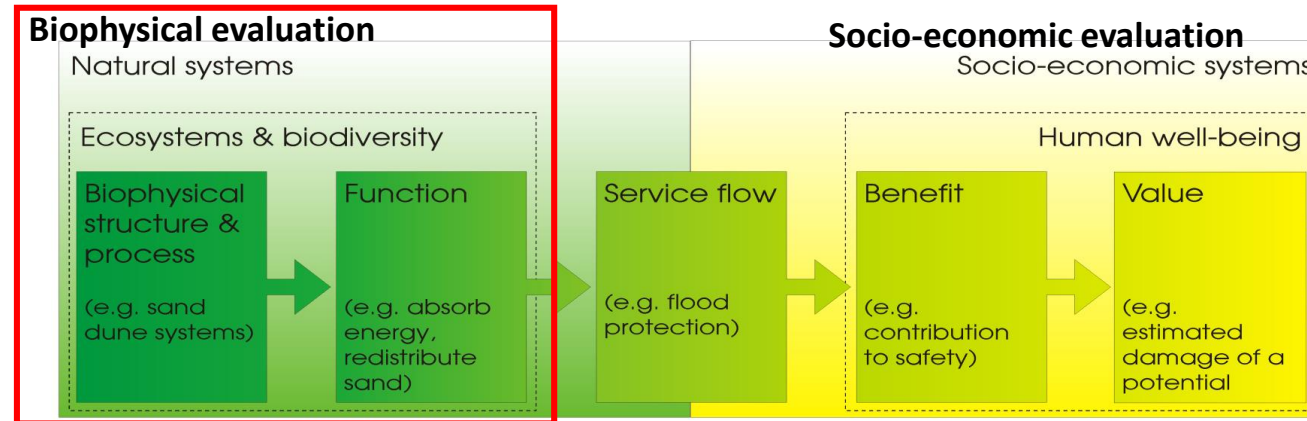
**grassland growth  
OBSERVATORY for  
livestock Precision  
Farming**

*PhD Thesis of Y. Curnel, 2015, CRA-W*



# New ideas to manage fields in Wallonia

## Assessment of **ECOSYSTEM** services of grassland



## Qualitative and quantitative assessment

of ecosystem services provided by the agro-ecosystem grassland according to its management and its territorial context

*CAP : Agri-environment measures (AEM)*

To evaluate these services, **in situ measurements** are performed as part of the taking into account both the **type of grassland** (permanent vs. temporary) but also its **management** : vs. mowing grazing, mineral fertilizer vs. organic, AEM 2 or AEM 8

These measures will serve to evaluate the impact of different grassland management modes on functions to the basic ecosystem services and this in different soil and climatic regions (Ardennes Fagne-Famenne, Herve) to have a good representation of the context Walloon especially at the various management modes (M. Campion PhD thesis)



**BIOECOSYS project**



## Conclusion

Lot of possibilities to manage fields and grassland based on new space technologies, new sensors, smart farming concept, research creativity, ...

BUT

- Lot of work on the ground (reference observations)
- Meteo different from one year to another :  
inter annual heterogeneity
- Need of 3-4 years of observation to get robust information

... need of some PATIENCE to develop space-based services ...



**BIOECOSYS project**





MANY THANKS!







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P. Defourny, C. Delloye, Th. De Maet



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