CISCO – SYMPOSIUM

IOT Field Sensors remote monitoring for agriculture

DATE

May 2019

AUTHOR

Alexis Comar, Jocelyn Gillet, Jérôme Brunet

hiphen-plant.com | contact@hiphen-plant.com | +33.(0)4.28.70.40.01

CONTENT

		Page
1	Presentation of the system	3
2	A use case: wheat fertilization	11
3	Who are we?	25

hi-phen

1

Presentation of the project

1.00

The IoT Field Sensors journey is build on strong relationships

The first application of IoT Field Sensors was on cereals, and it has since then been tested on additional crops.

- Global sales organisation
- Expert in engineering
- Top industrial production

- Agronomists
- Expert in remote sensing
- Top data modelling

- Regional experts
- Crop models
- Top research applications

2016
Ideation & Concept

2017-2019
Experiments & solution development

2020
Production & global deployment

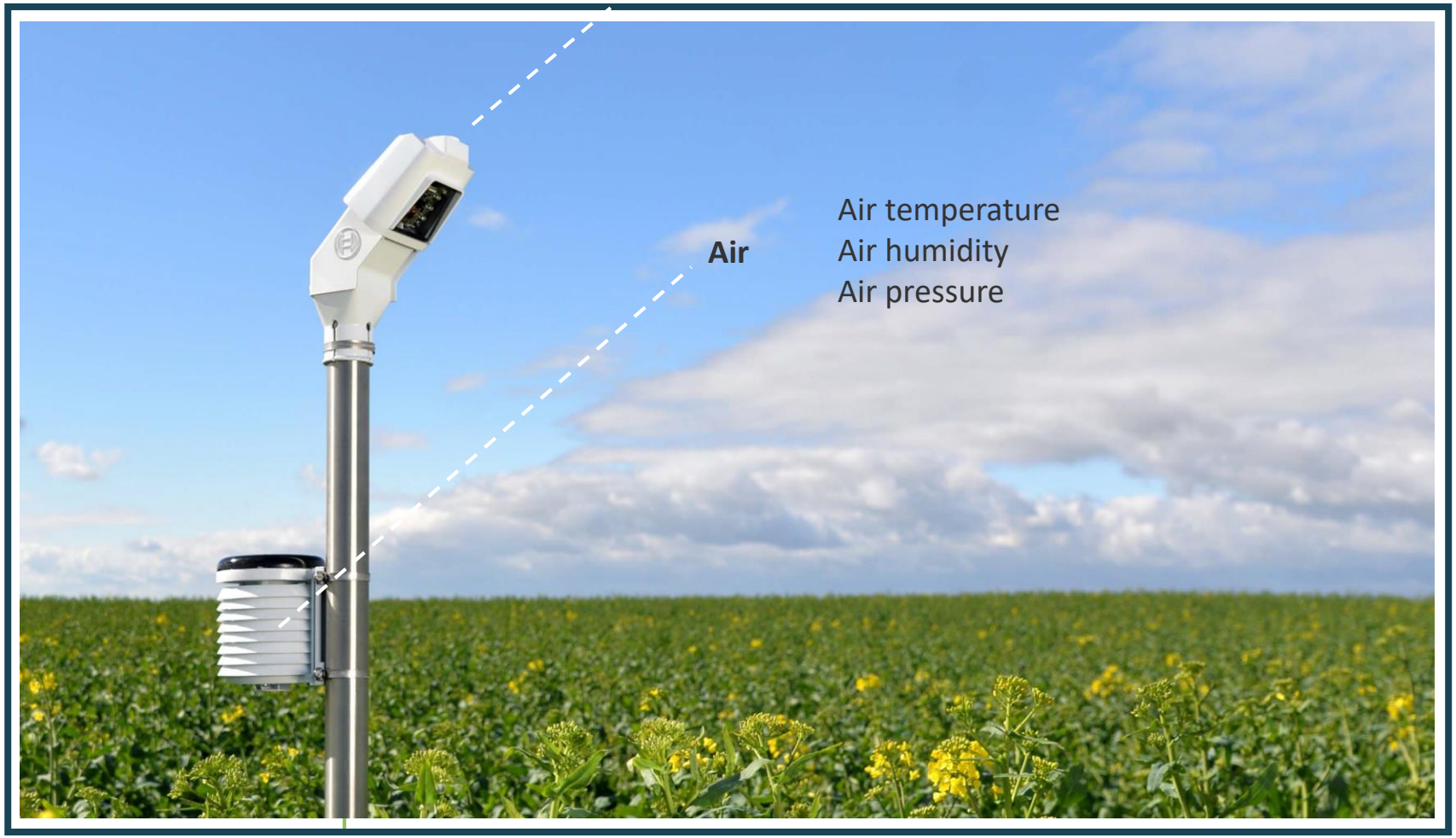
1.05

IoT Field Sensors can monitor your crop's health in real-time

Bosch's Field Sensors can be installed in your field in strategic zones, and transmit data to Bosch's server via cellular networks and other technology (e.g. Lora).

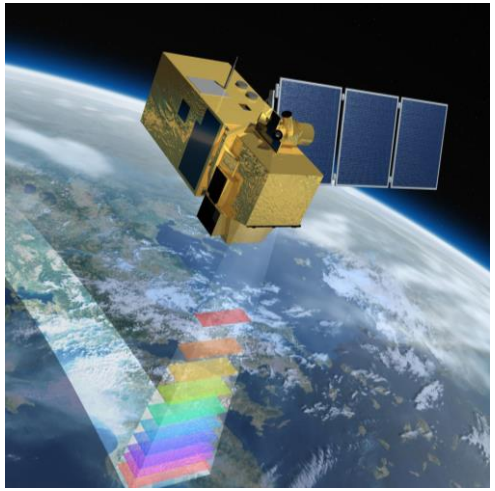
PAR refers to Photosynthetically Active Radiation, i.e. the quantity of light usable for photosynthesis.

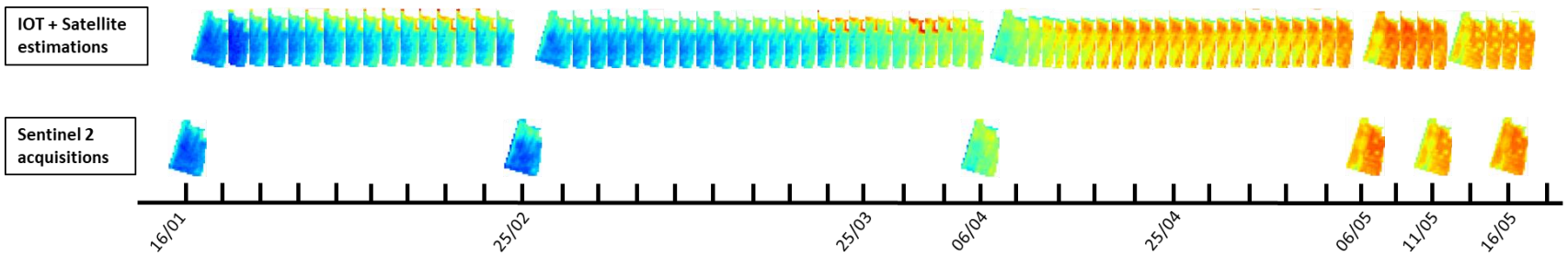
BOSCH



1.05

Not just a standalone IOT



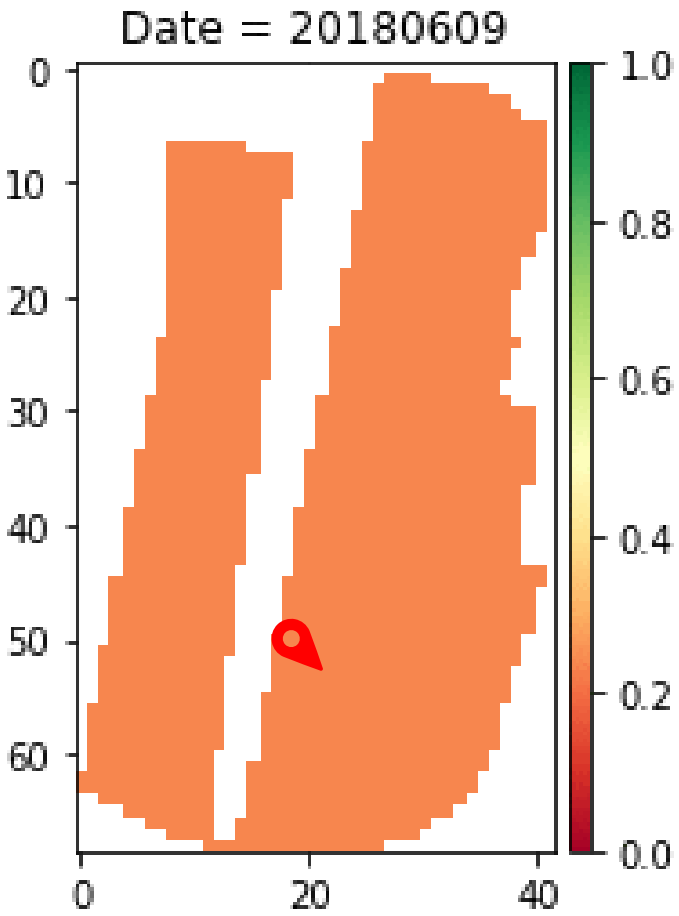


1.15

Spatialization done by blending IoT and Satellite sensors

This spatialization methodology has already been applied to wheat and maize, and is scalable to other crops.

The Sentinel-2 satellite captures images every 5 days, but images cannot be processed if clouds obstruct the area studied.



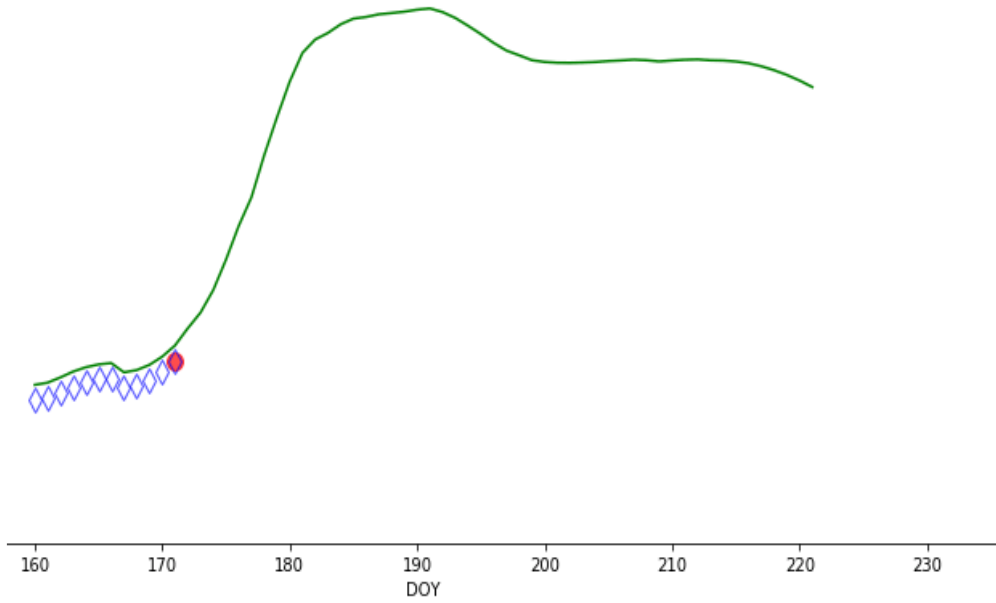
Bosch Field Sensor inputs, captured daily

\+

New **Sentinel 2** inputs, captured every ~5 days

=

Final adjusted pattern



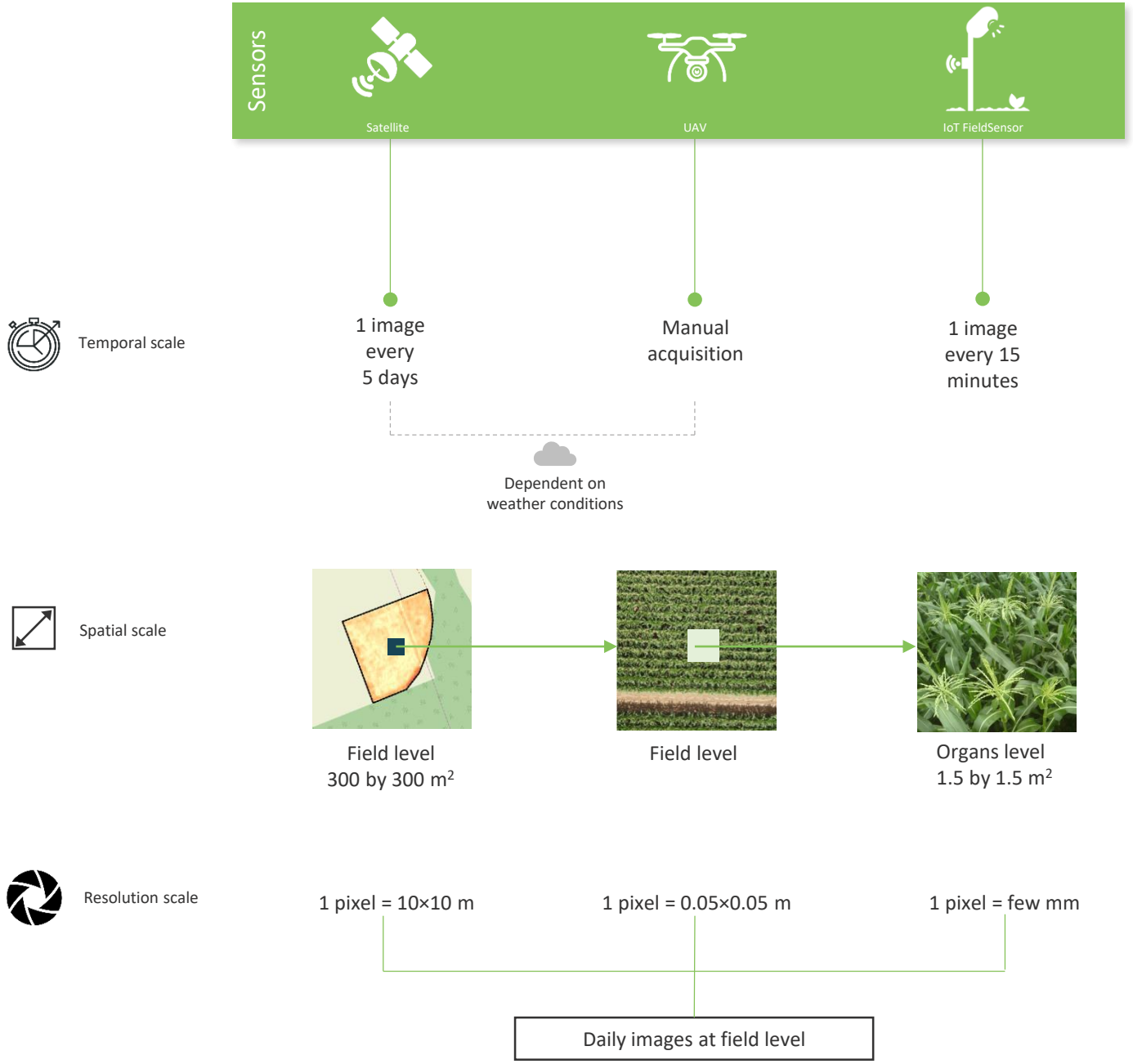
1.10

The fusion of IoT and Satellite sensors creates added-value

The combination of Satellite and IoT Field Sensors allows very rich monitoring and analytics of the crop's health during the season.

Bosch Field Sensors allow us to:

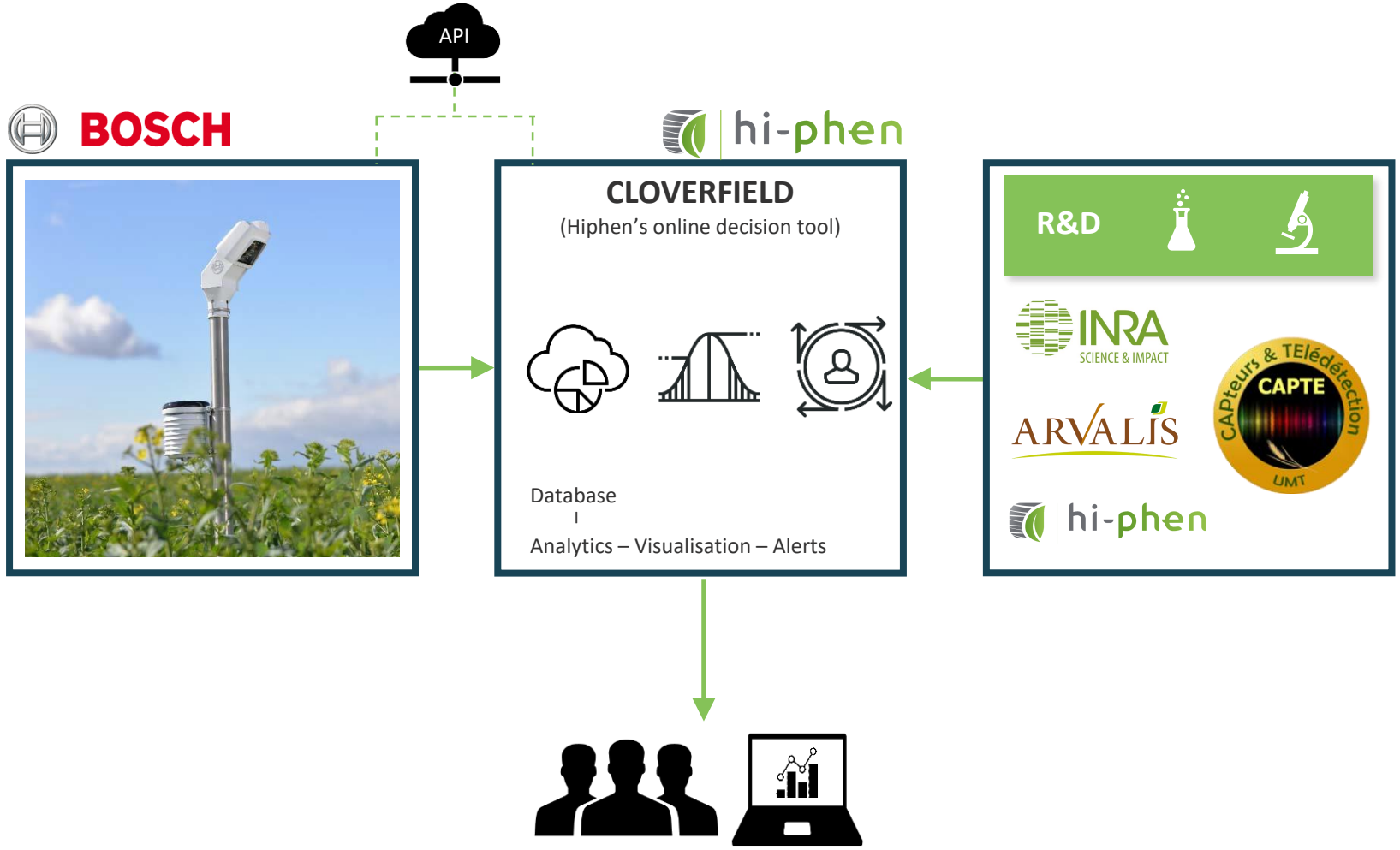
- Analyse what cannot be seen inside your fields with Satellite imagery;
- Fill in the gaps when Satellite images are not available due to cloudy conditions.



1.20

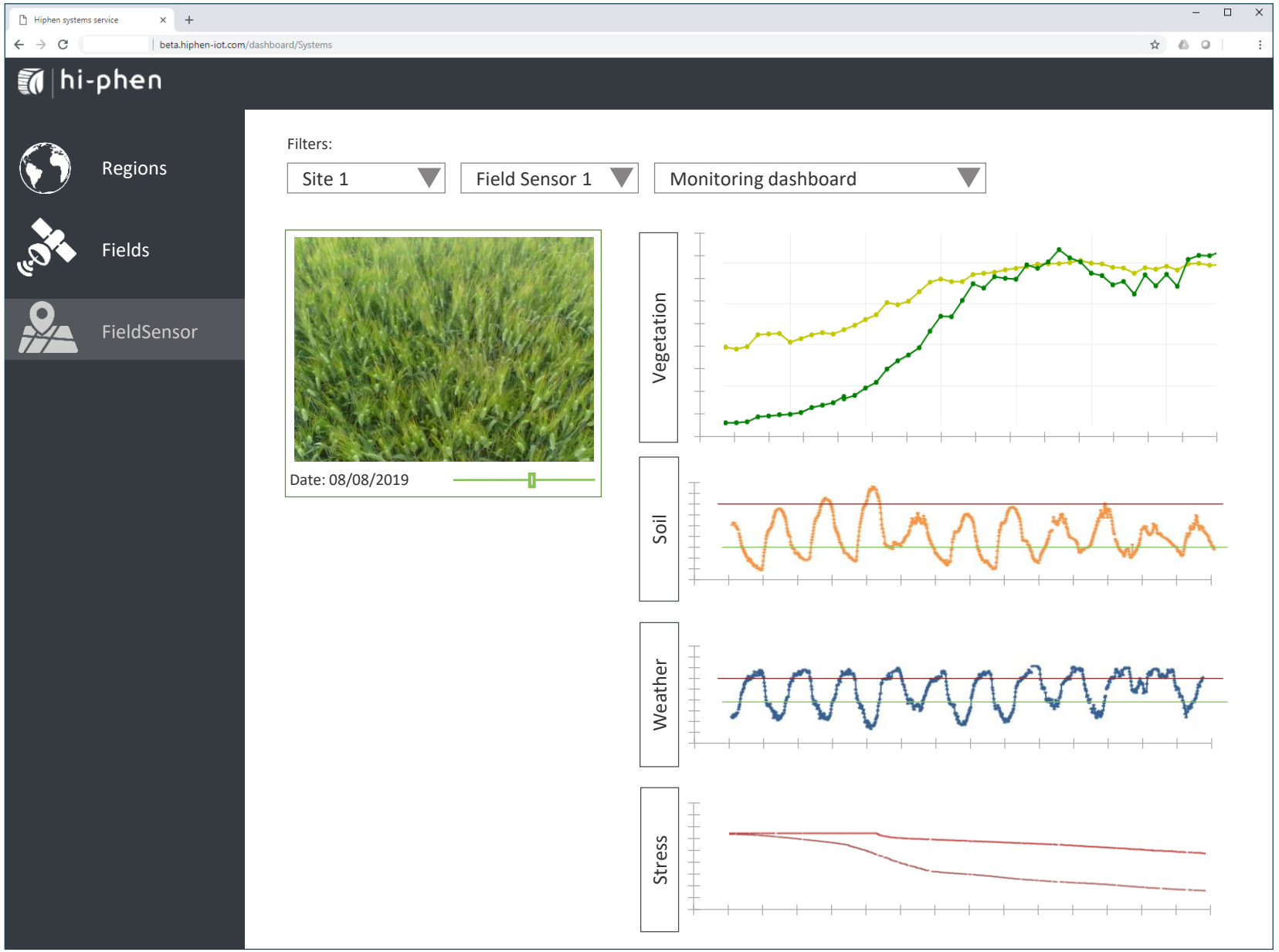
The data analytics ecosystem powering the IoT sensors

Our data platform allows you to access the data and images from the IoT sensors straight from your computer.



1.25

Access all data and insights in real-time via our web interface



2

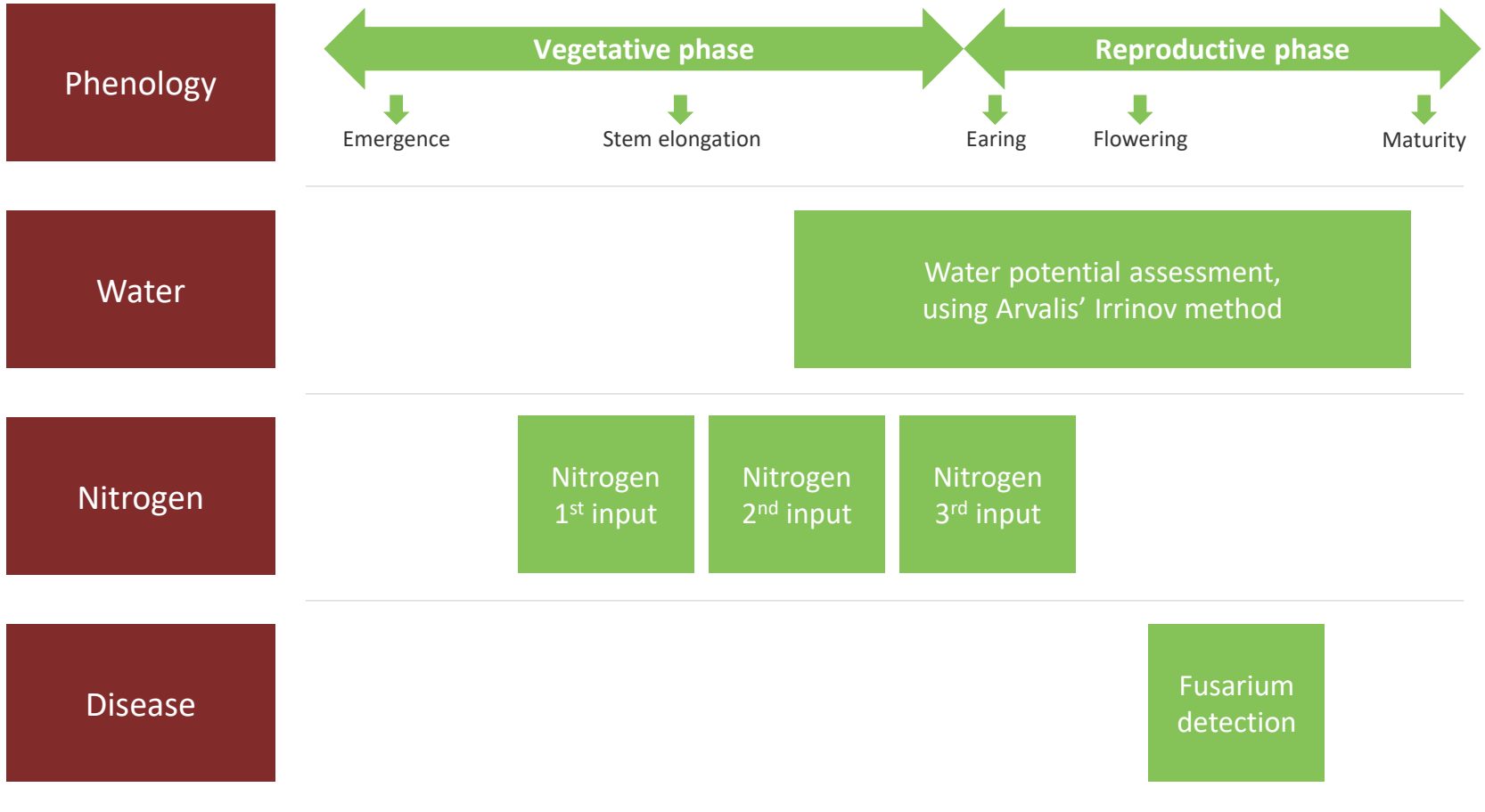
A use case: wheat fertilization

2.00

The different aspects Bosch Field Sensors can monitor

During the life cycle of the crop, we can detect and monitor pheno-risks, yield growth levers and disease presence.

Crop models can be implemented to derive corrective actions particularly during critical phenological stages (e.g. emergence, fertilization during flowering).



2.05

Phenology is the backbone of our analytics framework

Once Bosch FieldSensors are installed and connected, we start by focusing on the detection of phenological stages which represent the backbone of our analytics framework.

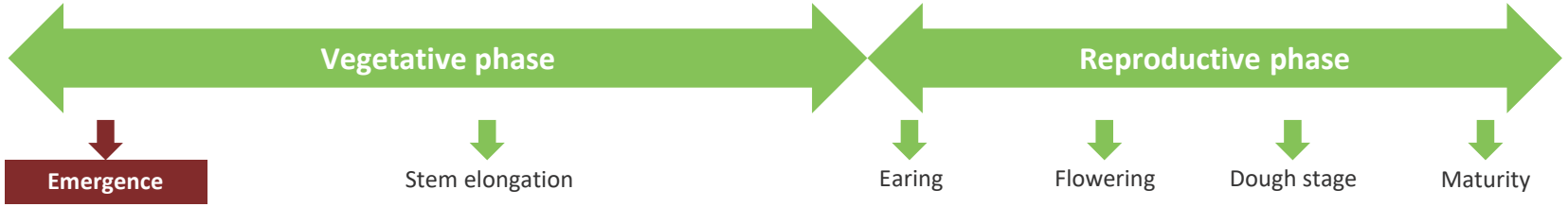
For each key phenological stage,
what can we automatically **describe**, **predict** and **prescribe**?

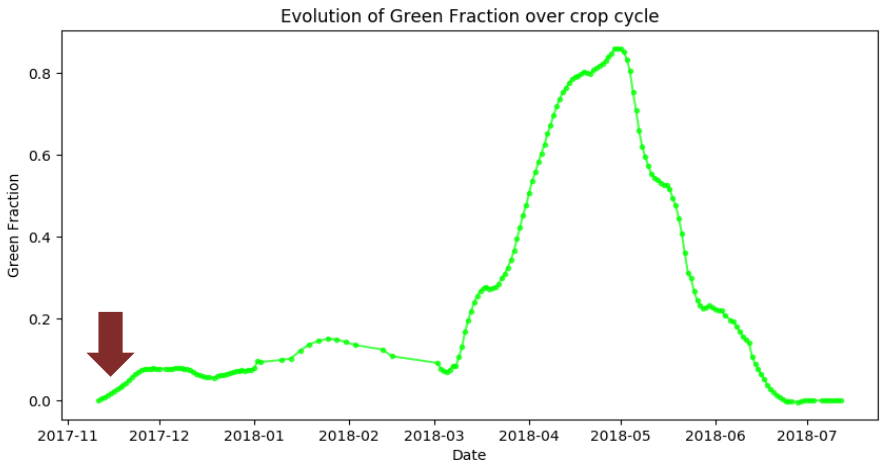
Vegetative phase | **Reproductive phase**

Emergence | **Stem elongation** | **Earing** | **Flowering** | **Maturity**

2.15

Emergence detection





Automatic detection of stems from the daily image

Example of data

Phenology

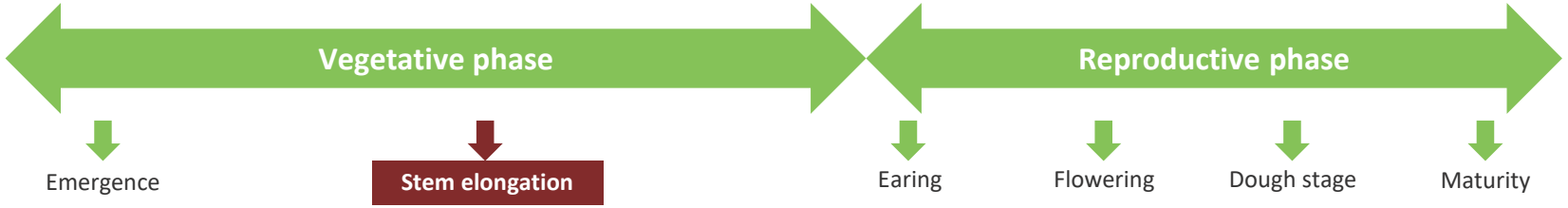
Water

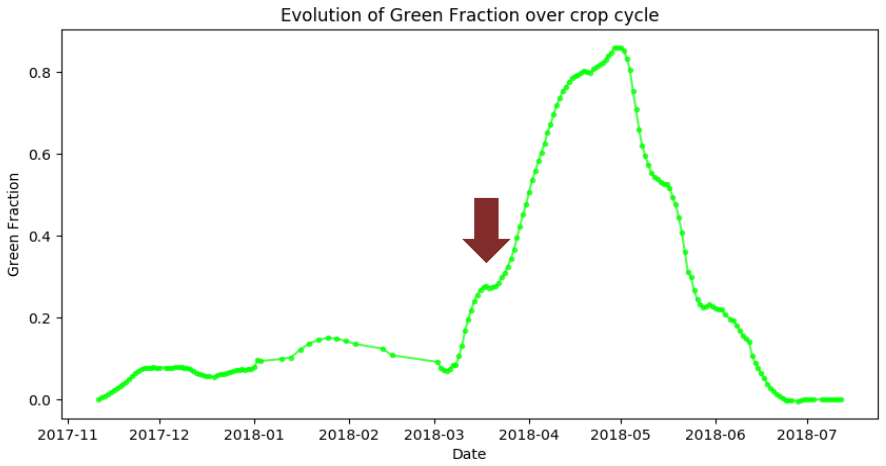
Nitrogen

Disease

2.20

Stem elongation detection





Automatic detection of architectural changes between the tillering and stem elongation stages.

Example of data

Phenology

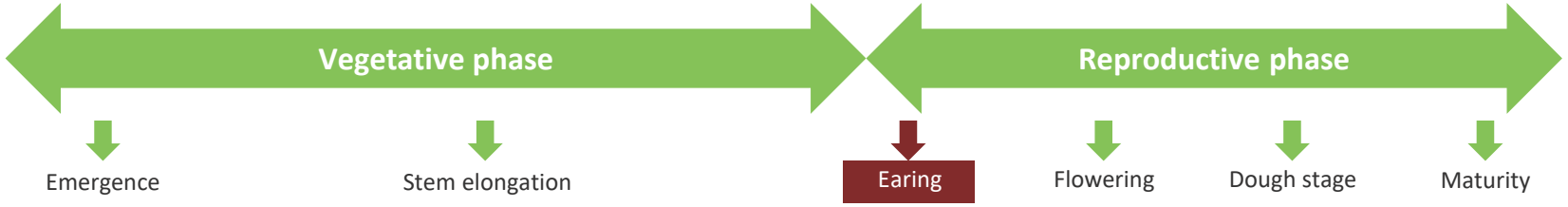
Water

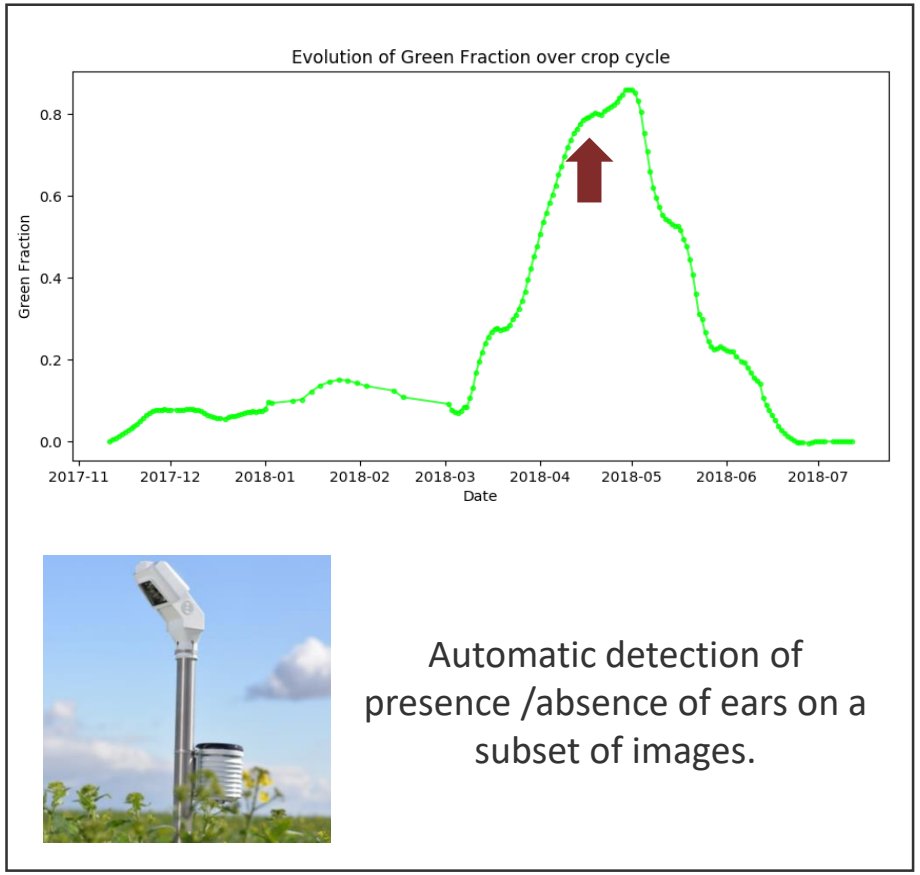
Nitrogen

Disease

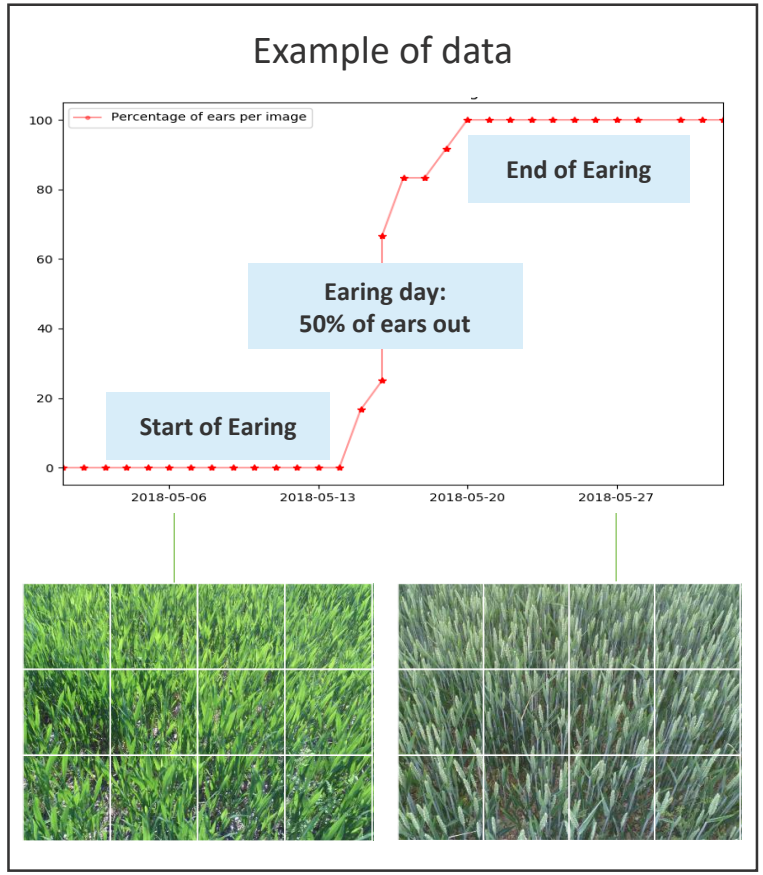
2.25

Earing detection





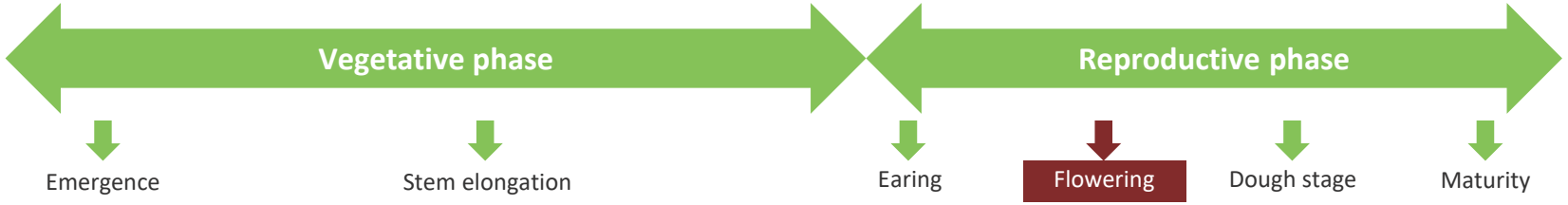
Automatic detection of presence /absence of ears on a subset of images.

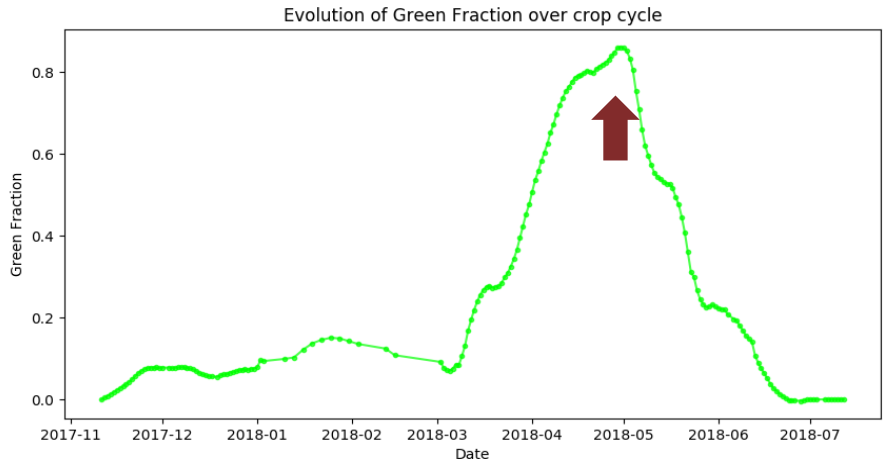


- **Phenology**
- Water
- Nitrogen
- Disease

2.30

Flowering detection





Automatic detection of presence /absence of flowers on each ear detected.

Example of data

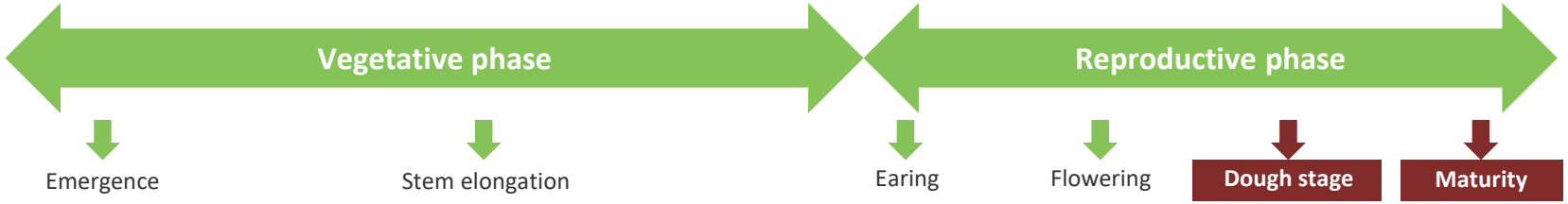
Flowering

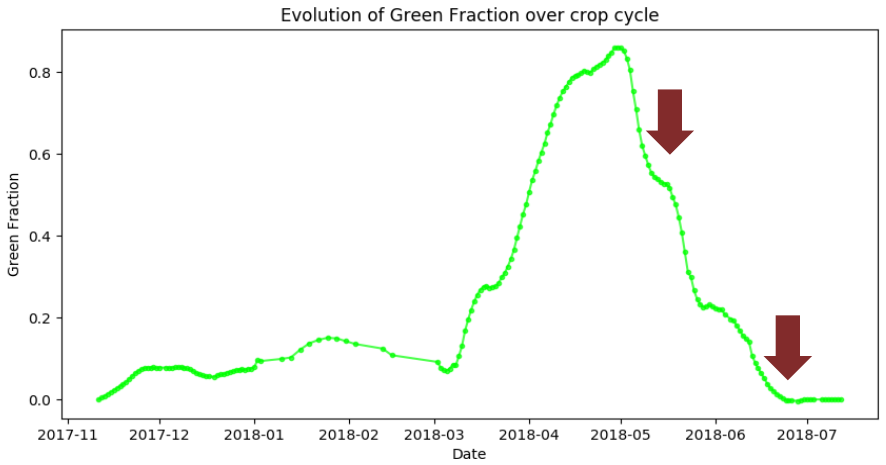
No flowering

- **Phenology**
- Water
- Nitrogen
- Disease

2.35

Senescence detection





Green area disappearance through the RGB image and LEDs (NDVI) monitoring.

Example of data

Phenology

Water

Nitrogen

Disease

2.40

Modelling for plant management

Mechanistical approach

- *Requires prior knowledge*
- *Simplification of reality (through hypothesis)*
- *Everything should be understood and described*

Artificial intelligence

- *No prior knowledge*
- *Requires a lot of data (training dataset)*
- *Stability issues depending on learning dataset*

Solutions are often based on a mix of both approaches

Phenology

Water

Nitrogen

Disease

Modelling for management

Phenology

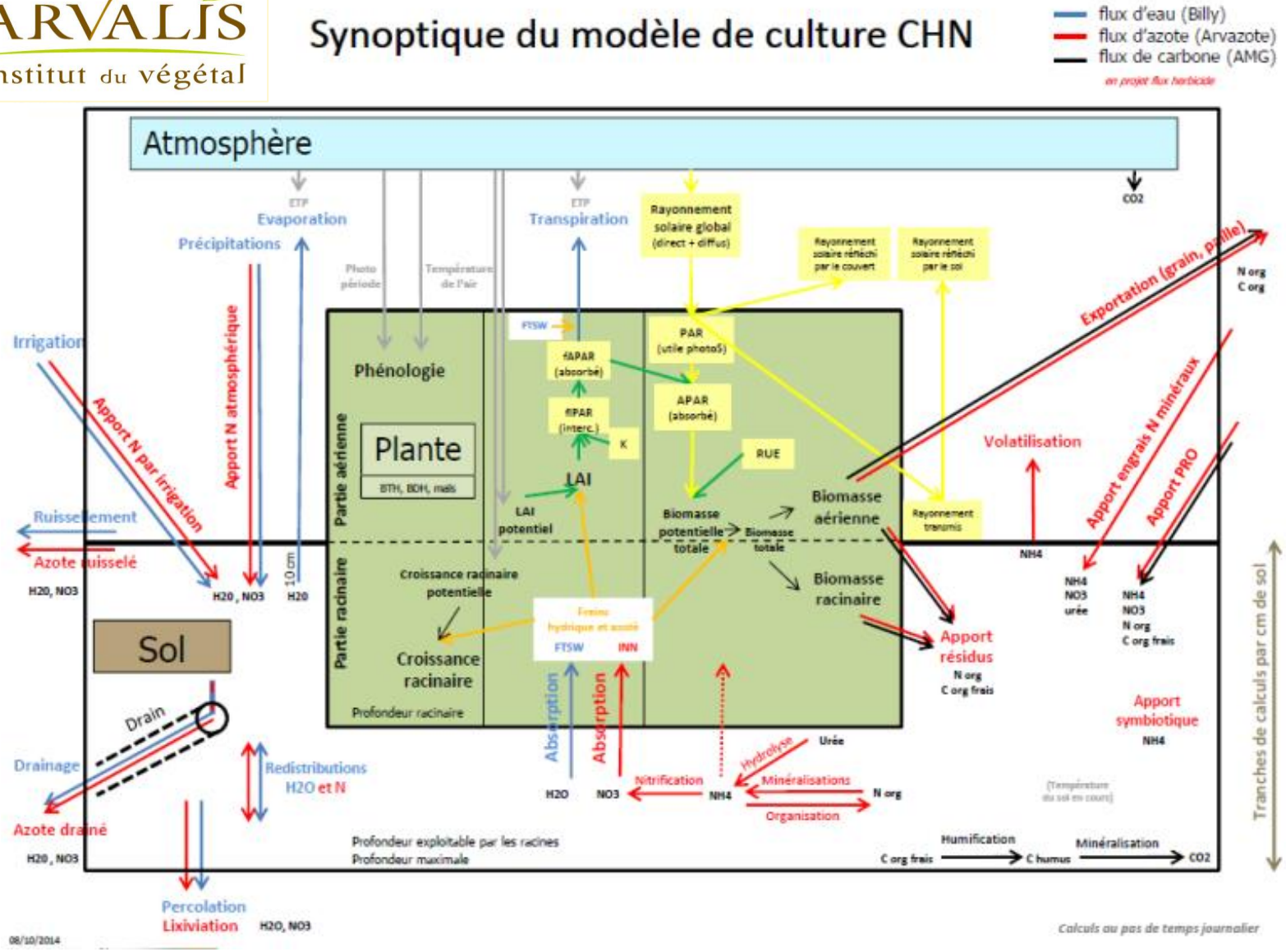
Water

Nitrogen

Disease

ARVALIS Institut du végétal

Synoptique du modèle de culture CHN



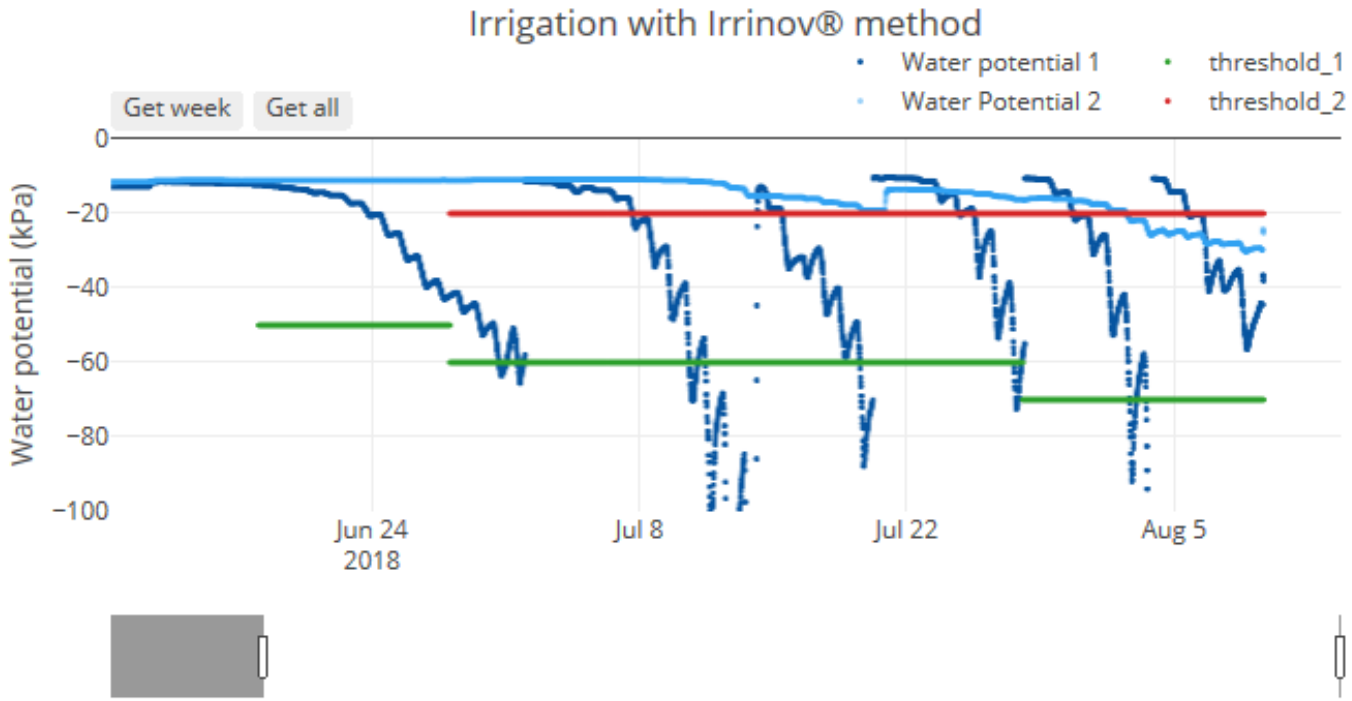
2.45

Water management

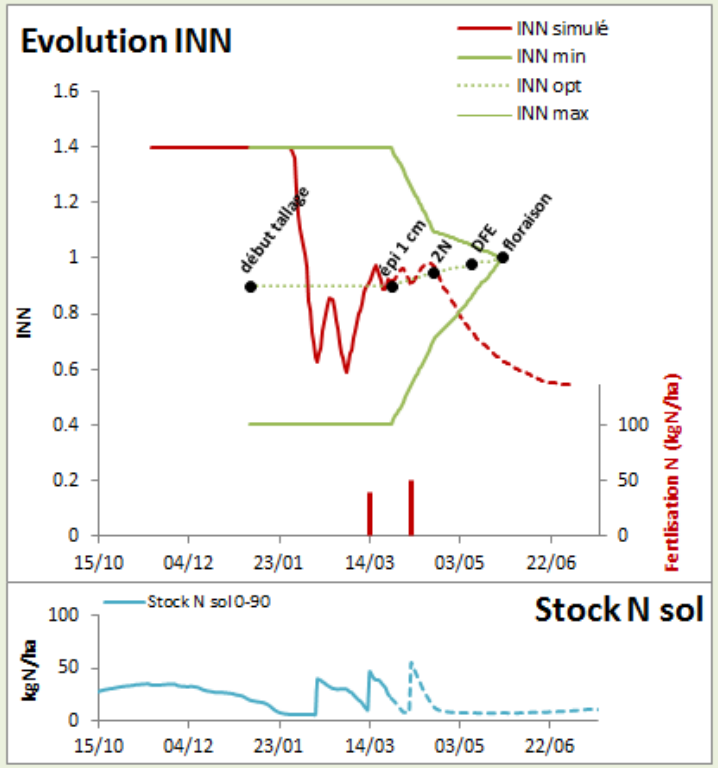
Phenology
Water
Nitrogen
Disease

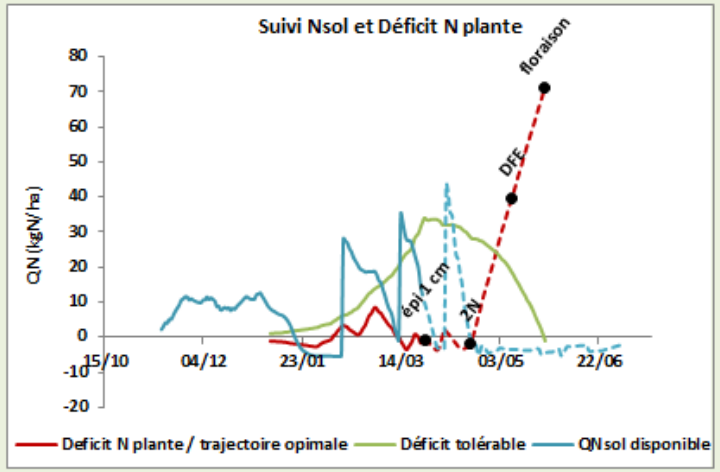
Irrigation

ARVALIS Institut du végétal



Nitrogen management





Calcul d'indicateurs :

kgN absorbé / jour (dans les 10j)	2.5	kgN/ha/j
Date franchissement INN min	02/05/2018	
Date épuisement Nsol	31/03/2018	
Prochain rendez-vous	2N	18/04/2018
Déficit au prochain rendez-vous	<0	kgN/ha

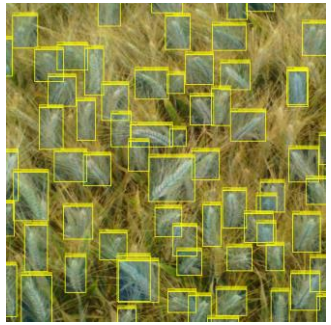
Modèle CHN
ARVALIS - Institut du végétal

Phenology
Water
Nitrogen
Disease

3.55

Disease detection

Principles guiding fusarium detection.



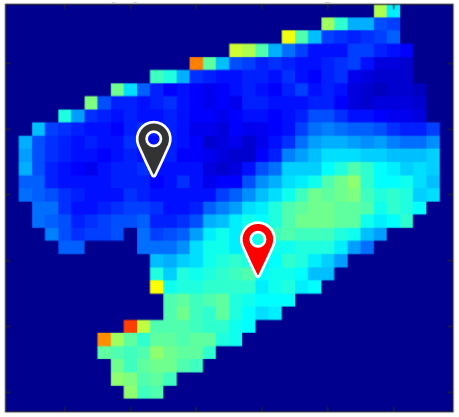
Daily image analysis → **Ear detection** → **Automatic classification (Fusarium Yes/No)**

Time in date of year

Phenology
Water
Nitrogen
Disease

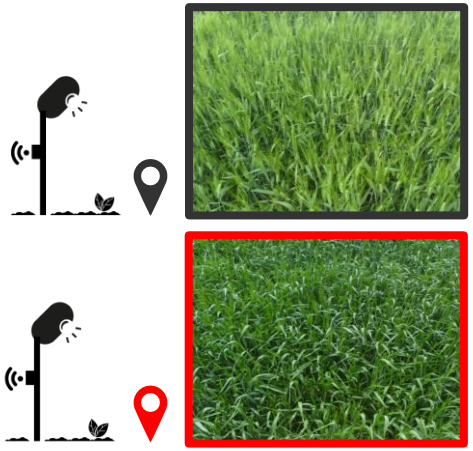
2.60

Heterogeneity maps from Satellite help to position IoT sensors



Step 1:
We study heterogeneity maps using historic satellite images.

Step 2:
We segment the field in different zones that ensure representativeness, and we position one IoT sensor in each zone.



Step 3:
We monitor your crop's health all along the phenotyping campaign.

hi-phen

3

Who are we?

3.00

Hiphen at a glance

October 2014

Creation of Hiphen by PhD Alexis COMAR

1 site

Headquarter in Avignon at INRA facilities.

4 years of growth

About 1 million revenue in 2018

12 employees

Agronomists, field specialists, engineers, business developers, etc.

1 homegrown sensor technology

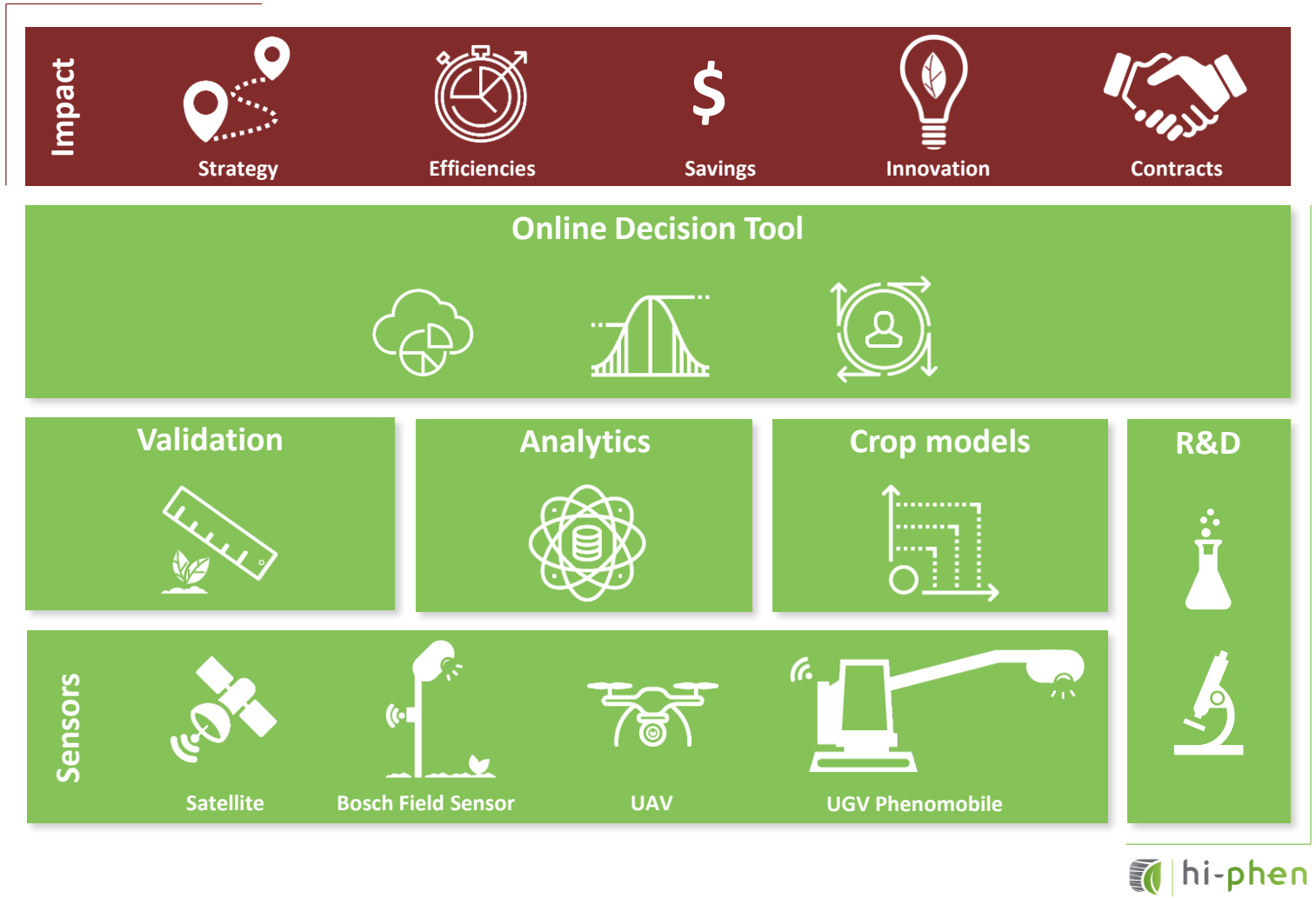
6 wavebands fully customizable

4 sensing devices

suitable for our technology

3.05

Our architecture in a nutshell



3.10

Our UAV solution emanated from a unique partnership

Hiphen is a member of a scientific research programme – code-named **UMT-CAPTE** – dedicated to the application of remote sensing solutions for phenotyping.

The programme started in 2014 and it includes **INRA**, **ARVALIS** and **HIPHEN**.

Cross-licencing is in place between Hiphen an these two Technical Research Institutes.

ARVALIS

INRA SCIENCE & IMPACT

hi-phen

CAPteurs & TElédétection CAPTE UMT

Partnership with:

BOSCH

hi-phen

3.20

Some examples of our client portofolio

3.25

Thanks to all

Our team of 12 engineers and experts are available to support you throughout the project.

Alexis Comar, Phd
Hiphen Founder & CEO

acomar@hiphen-plant.com
+33.(0)4.28.70.45.28

Hiphen Co-Founder

Hiphen's team

Hiphen

Centre INRA PACA - UMR EMMAH

228, route de l'aérodrome - CS 40509

84914 Avignon Cedex 9

France

+33.(0)4.28.70.40.01

hiphen-plant.com | contact@hiphen-plant.com