Sensors in viticulture

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Agricultural Machinery Unit. UMA

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The Agricultural Machinery Unity (UMA) is a group of transfer and research that it has as central core the world of agricultural machinery, with great experience especially in the field of technology in phytosanitary products application.

The activities developed by the UMA are divided in three sections: teaching, research and technology transfer. The relationship that the group maintains with the main companies in

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Dosaviña®

DOSAVIÑA iOS

A previous question: How equal is a plantation?

Suppose I want to do a fungicide treatment on this plot

A previous question: How equal is a plantation?

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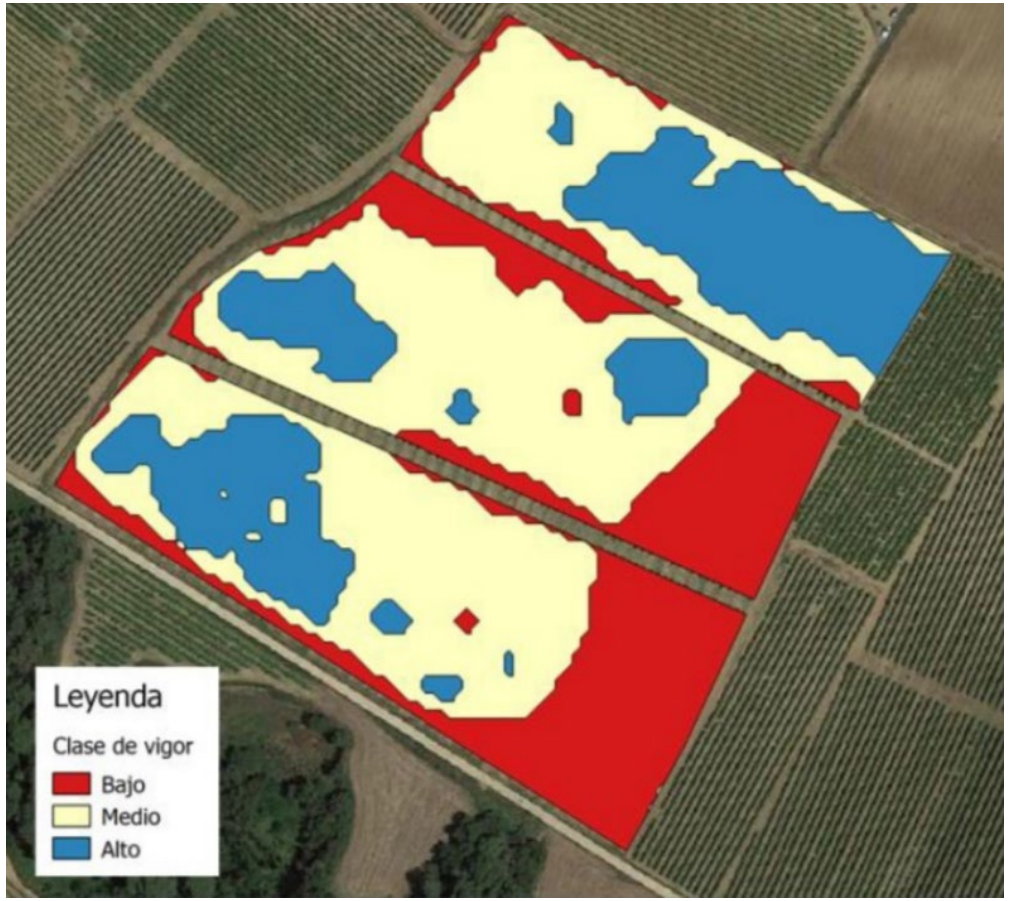
A previous question: How equal is a plantation?



A previous question: How equal is a plantation?

So, knowing this…does it make sense to treat the entire plot equally?

Why is it necessary to characterize the structure of canopies?

The correct use of pesticides is one of the biggest challenges in agriculture

Why is it necessary to characterize the structure of canopies?

The use of pesticides in agriculture contributes to pollution of soil, water and air. The Commission will take actions to:

- ✓ **reduce by 50%** the use and risk of chemical pesticides by 2030.
- ✓ **reduce by 50%** the use of more hazardous pesticides by 2030.

Why is it necessary to characterize the structure of canopies?

In general for vineyards, air-assisted sprayers are used at a constant application rate (gal/ac).

Advantages:

- Low labor
- Controlled water consumption
- Speed
- Rational use of pesticides
- Fan or turbine effect

Why is it necessary to characterize the structure of canopies?

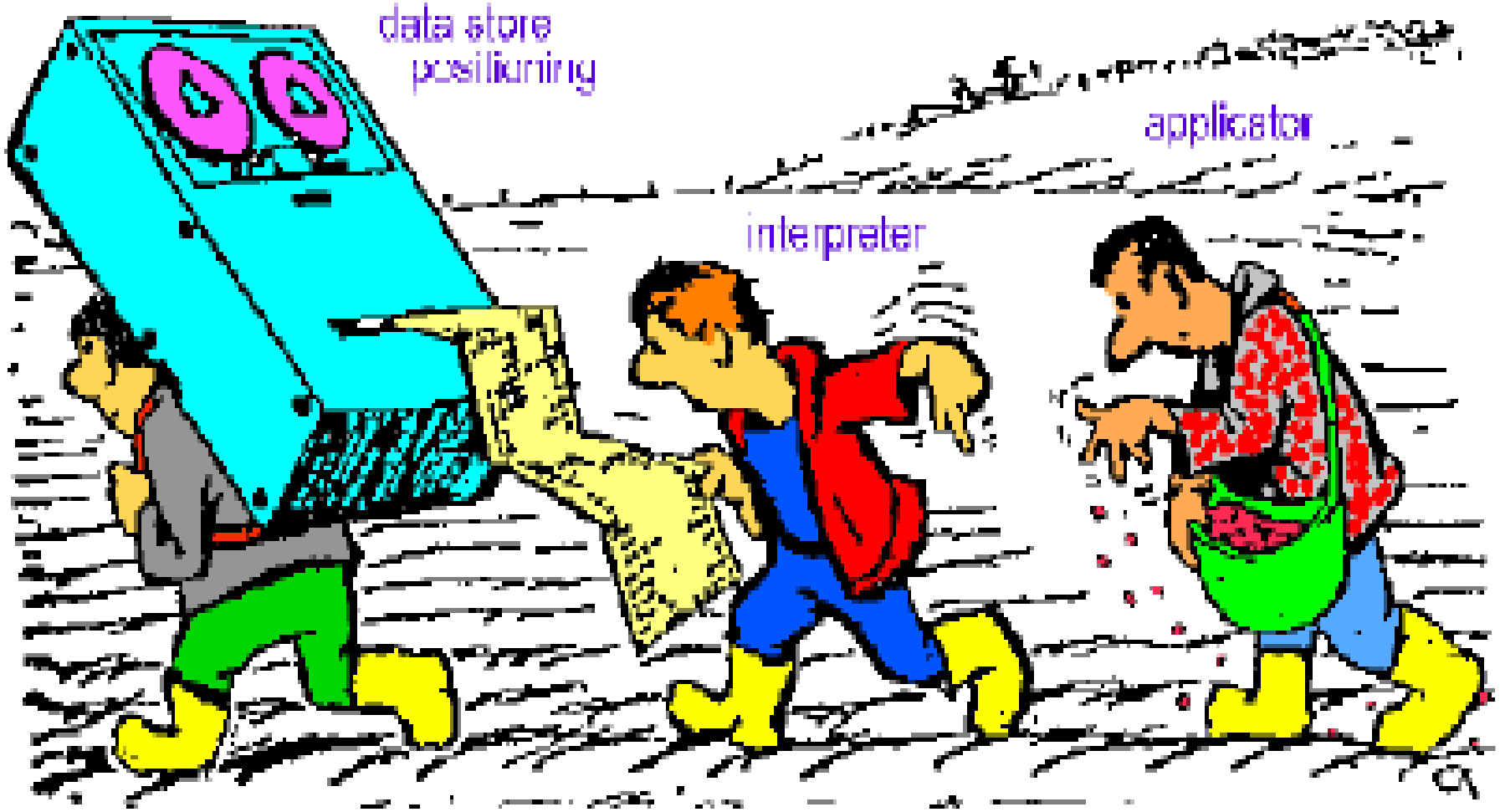
Mendoza

Penedes (Spain)

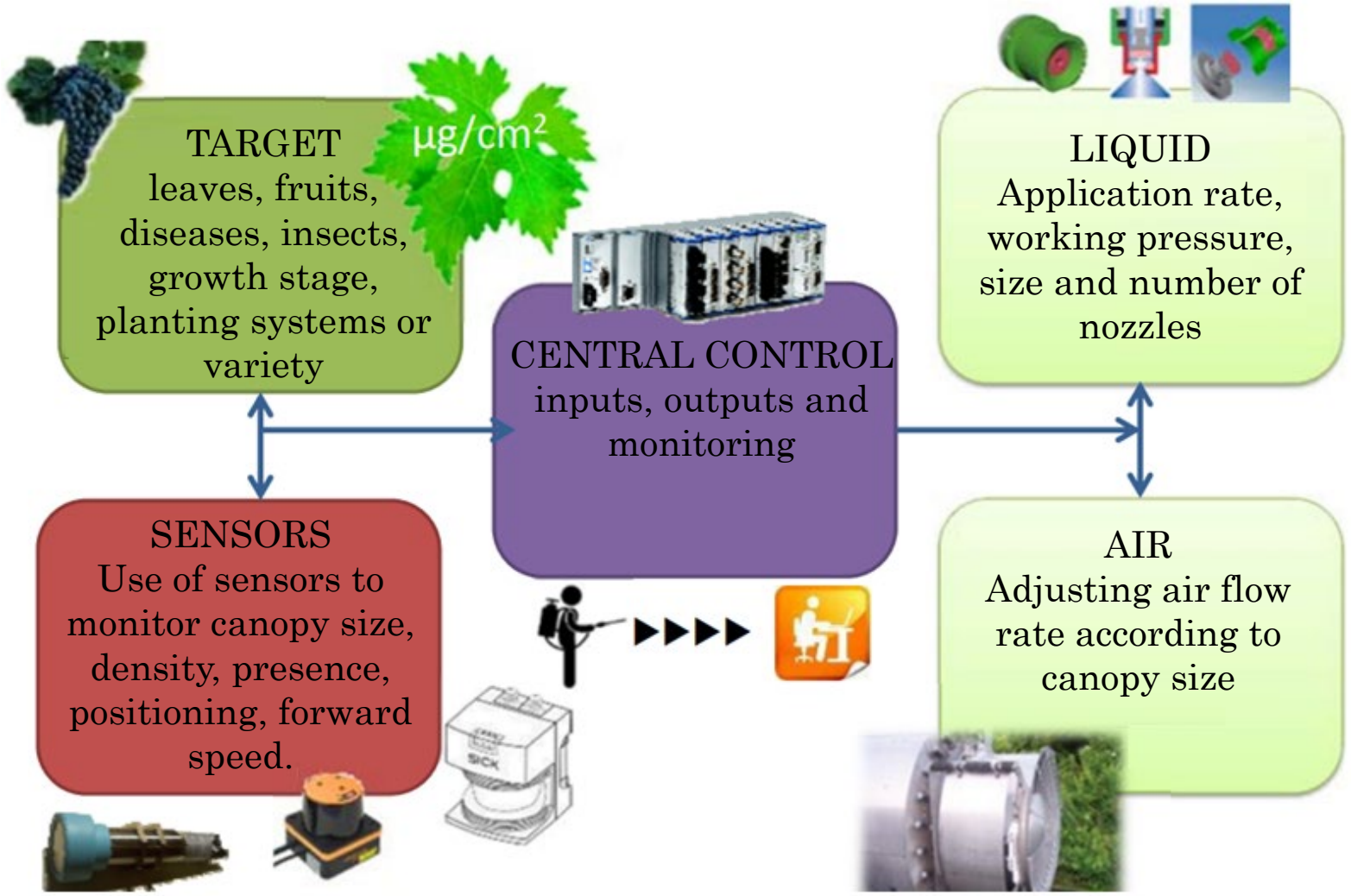
La Mancha (Spain)

Cerdeña (Italy)

Precision agriculture: introduction

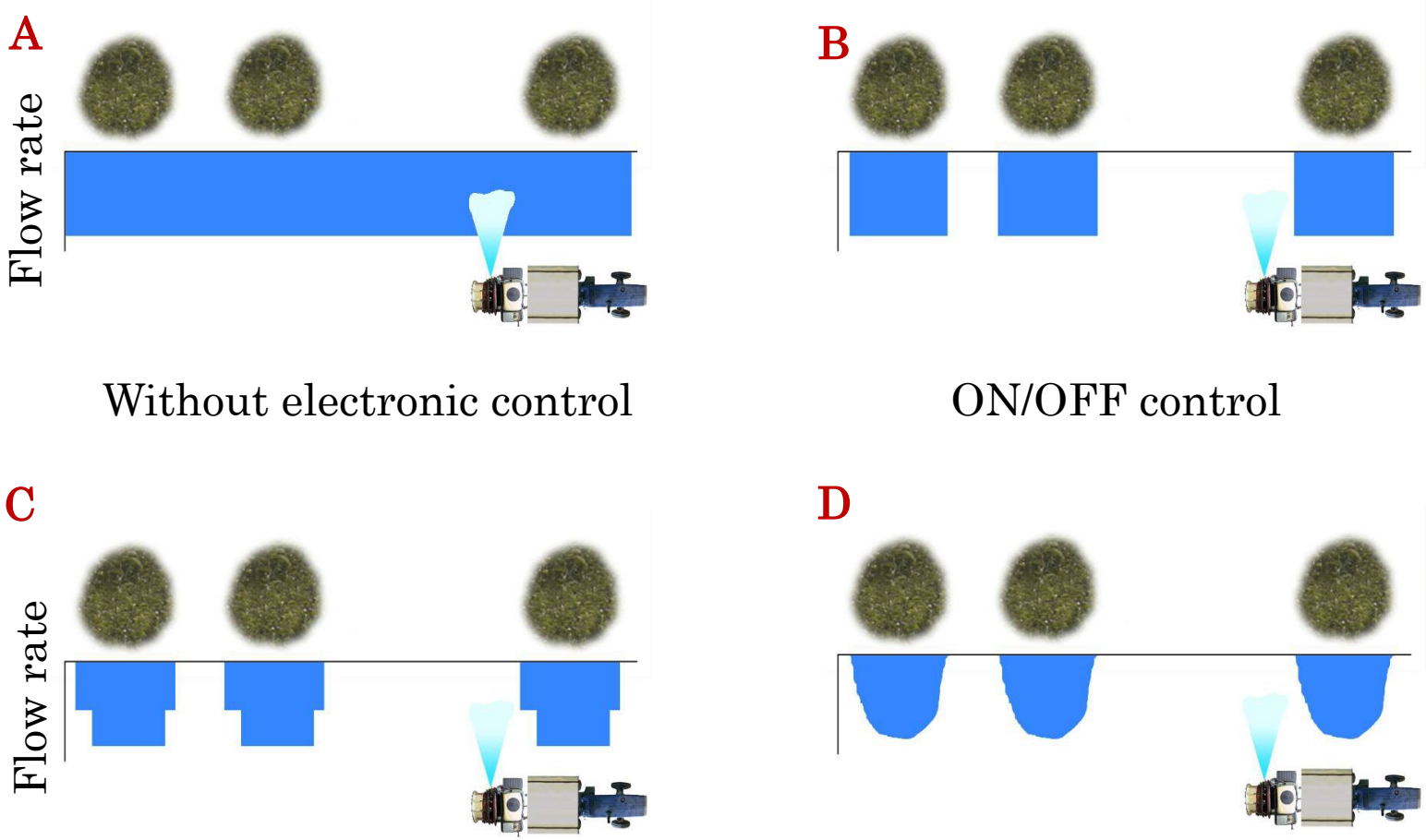


Precision agriculture: introduction



Llorens (2016)

Precision agriculture: introduction

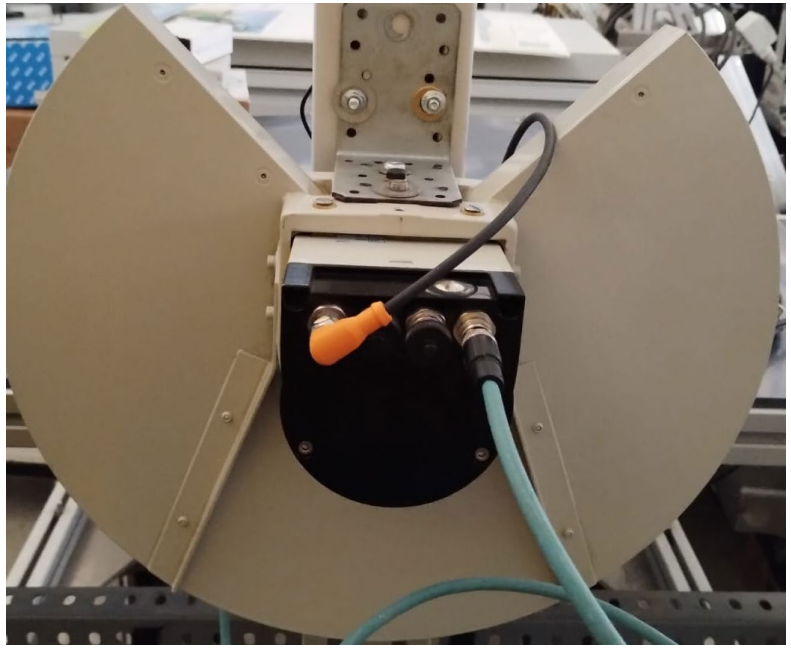


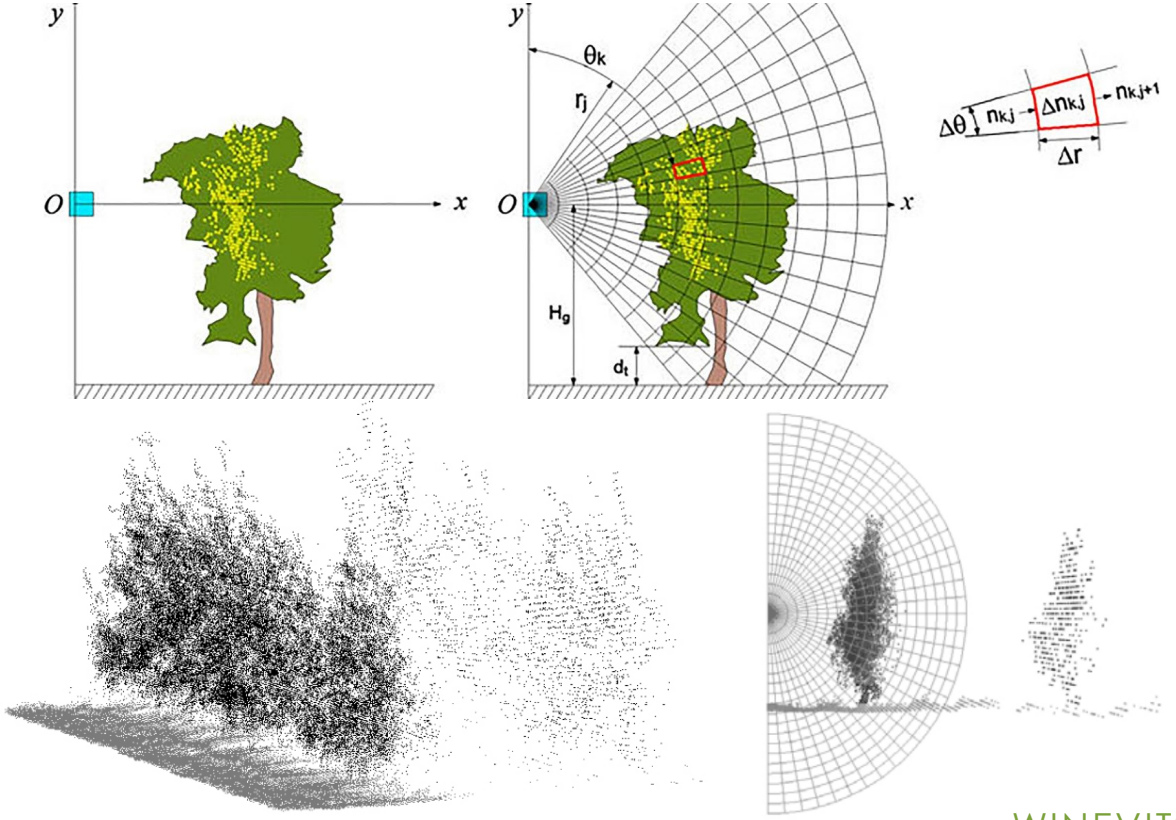
Escolà (2002)

Laser detection systems

LIght Detection And Ranging (LIDAR)

Sanz (2005)



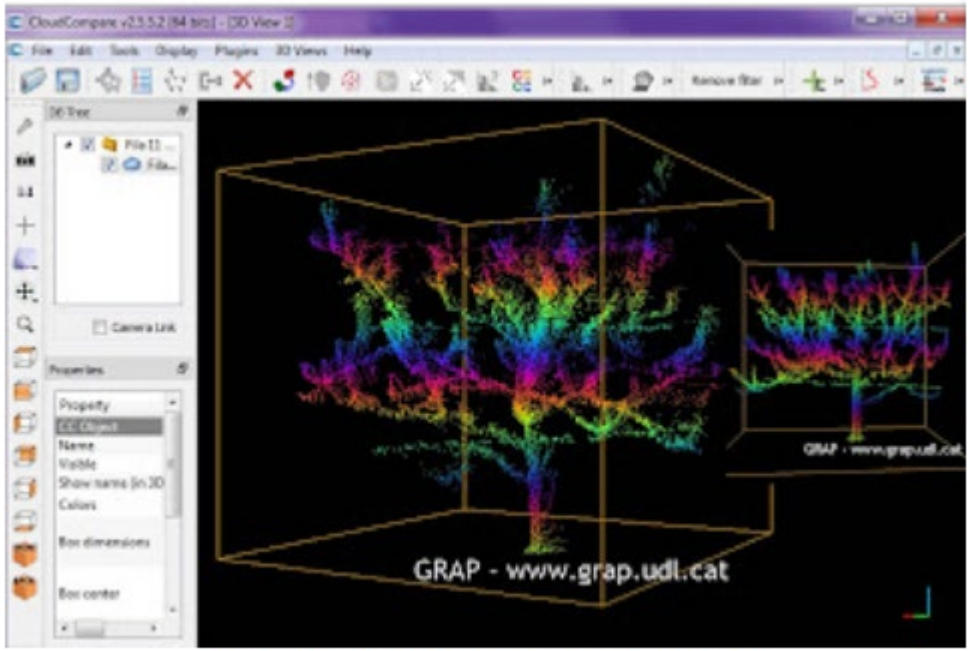


Laser detection systems

LIght Detection And Ranging (LIDAR)

The general procedure is made up of four parts:

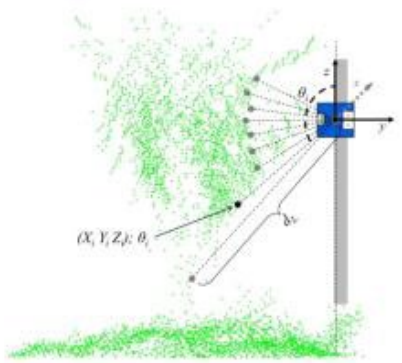
1. Find connectivity between nearby points
2. Represent geodesic paths from a reference point (bottom of the tree) to the end of all branches and leaves
3. Classification of points into different levels according to their distance from the reference point
4. Final reconstruction of the tree structure.

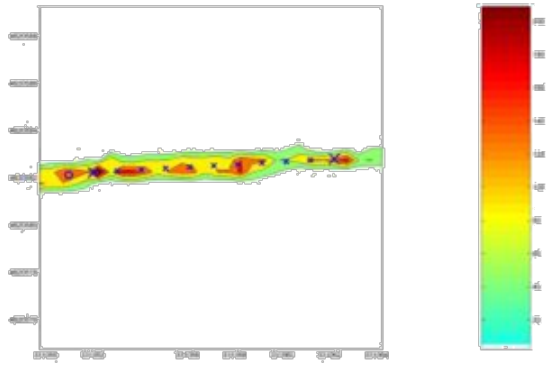


Reconstrucción árbol (www.grap.udl.cat)

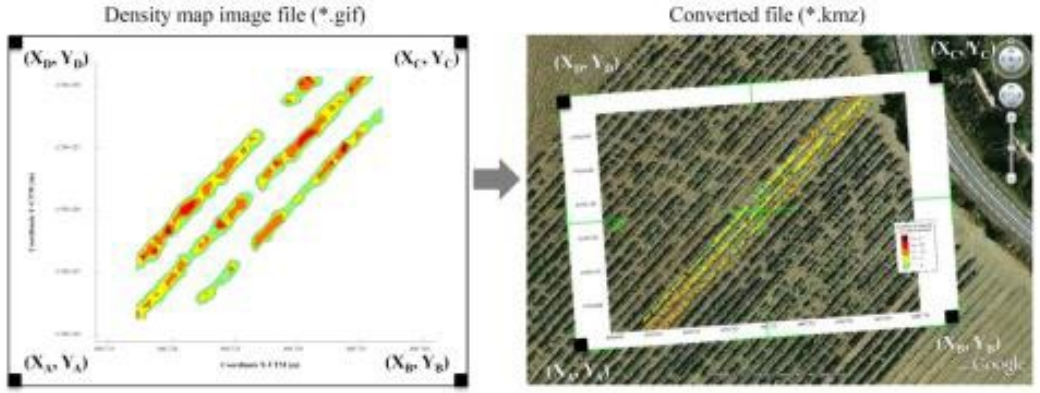
Laser detection systems

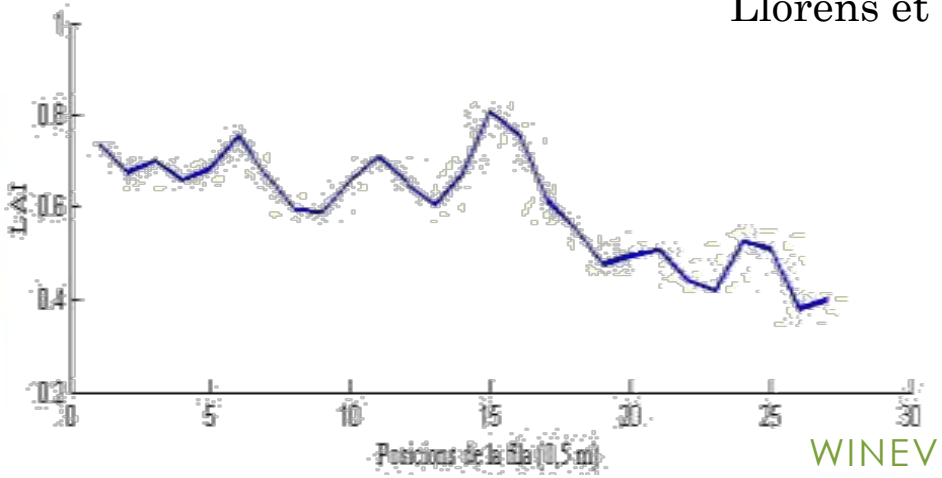
LIDAR for vegetation maps





Llorens et al. (2011)

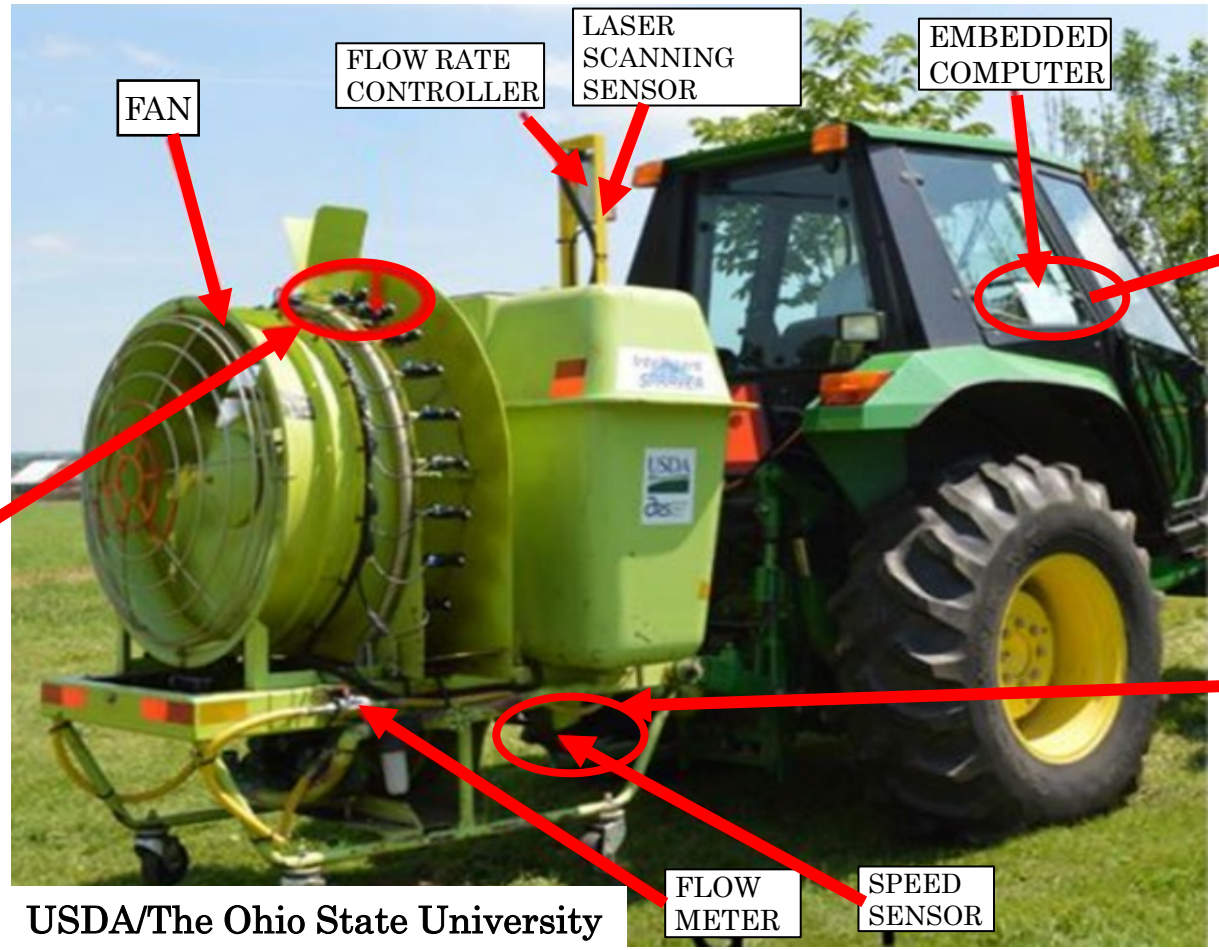




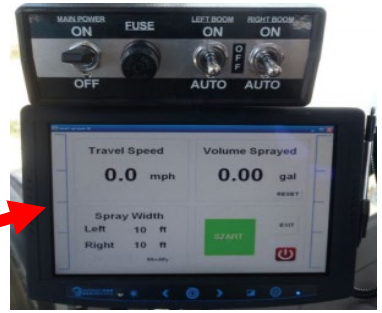
Laser detection systems

LIDAR for spray applications in real-time

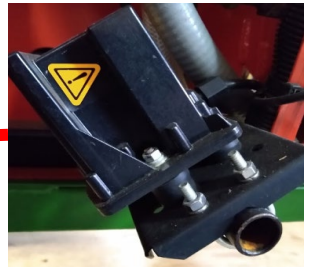
Salcedo et al. (2022)



USDA/The Ohio State University



Touch screen to control the computer



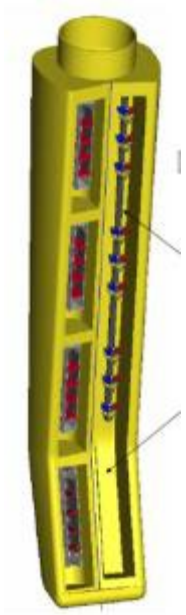
Ground travel speed sensor

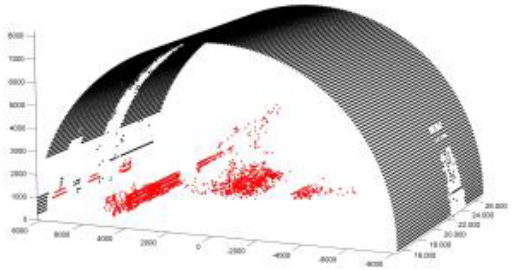
Laser detection systems

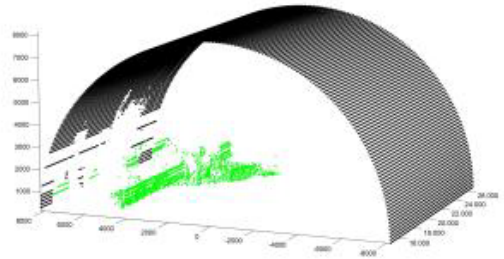
LIDAR for measuring spray drift

Laser detection systems

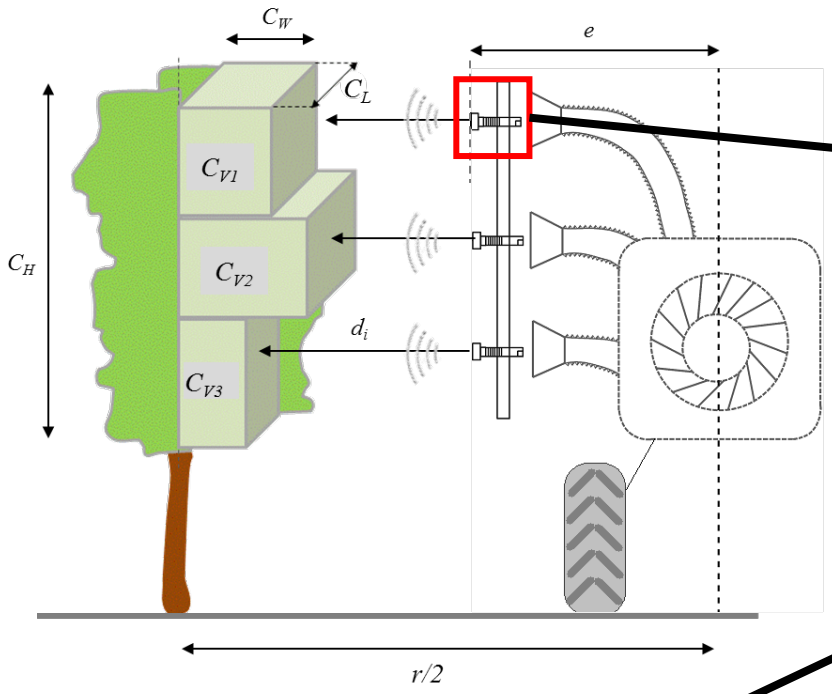
LIDAR for measuring spray drift







Ultrasonic sensors

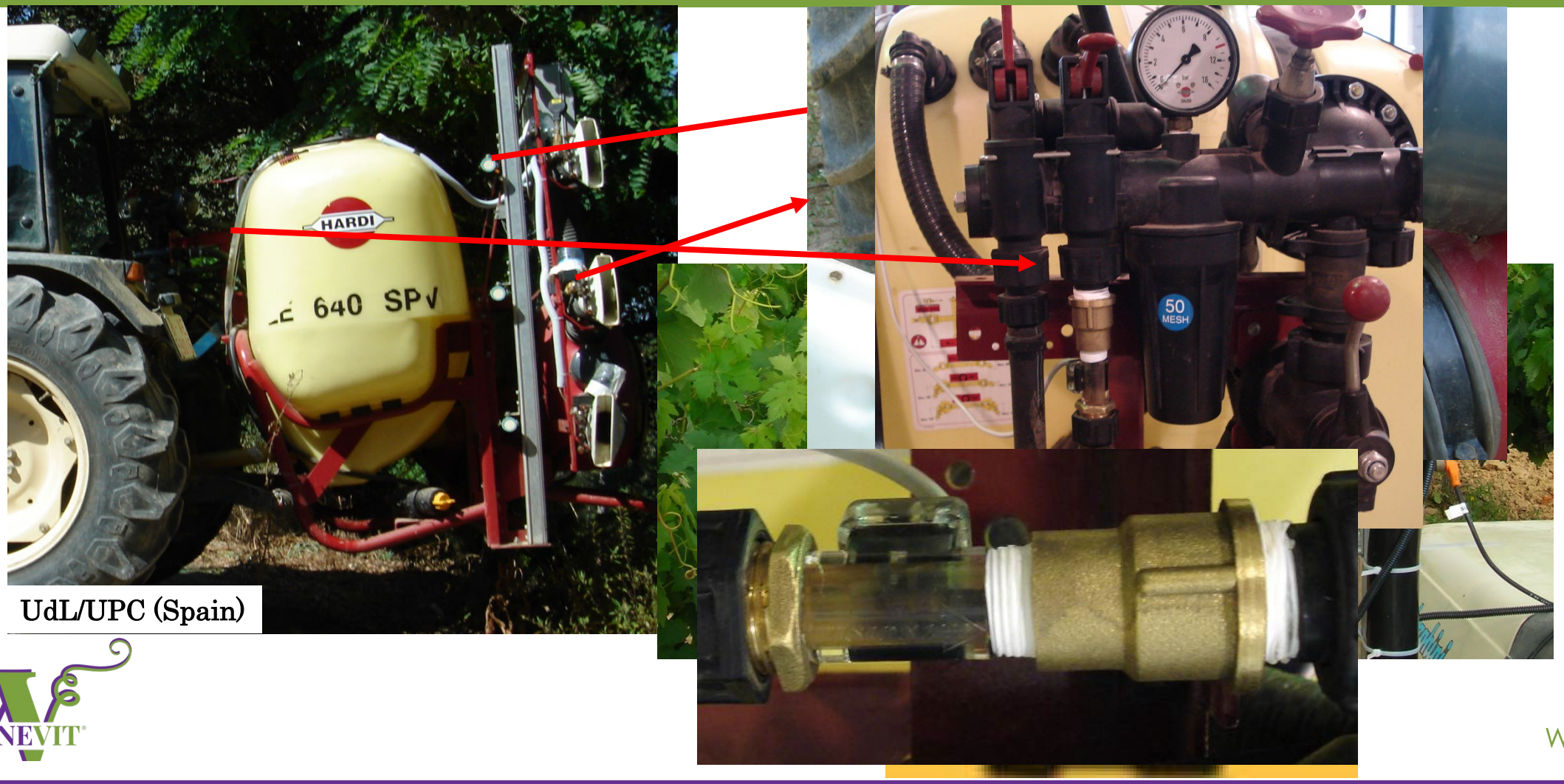


Vegetation volume

Application coefficient

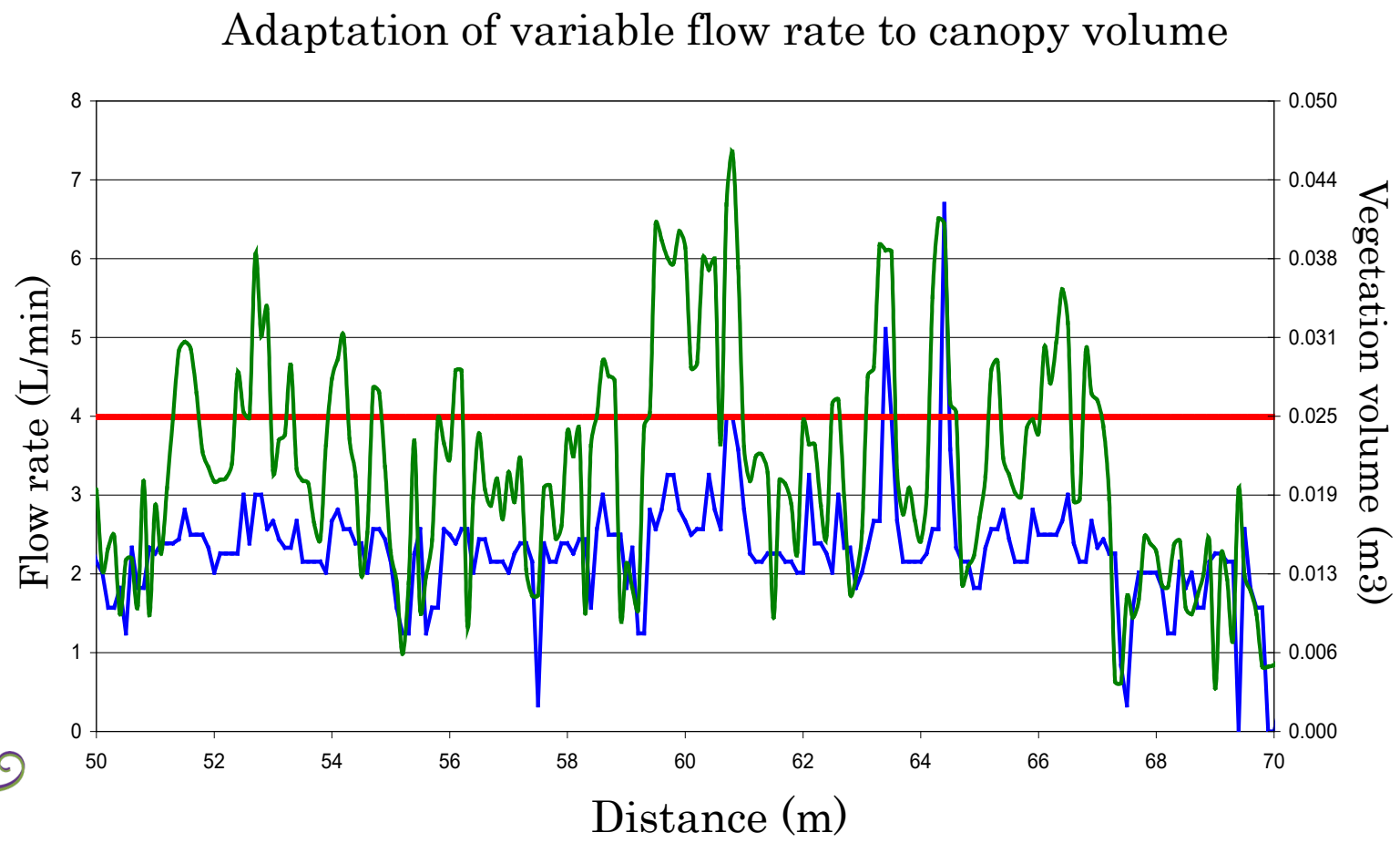
$$q\ (l\ \mathrm{min}^{-1}) = \frac{[D - d_i - e_i]\,(m) \times h\ (m)/3 \times v\ (km\ h^{-1}) \times i\ (l\ m^{-3}) \times 1000}{60}$$

Ultrasonic sensors



UdL/UPC (Spain)

Ultrasonic sensors



Ultrasonic sensors

AGVANCE Project (Spain)

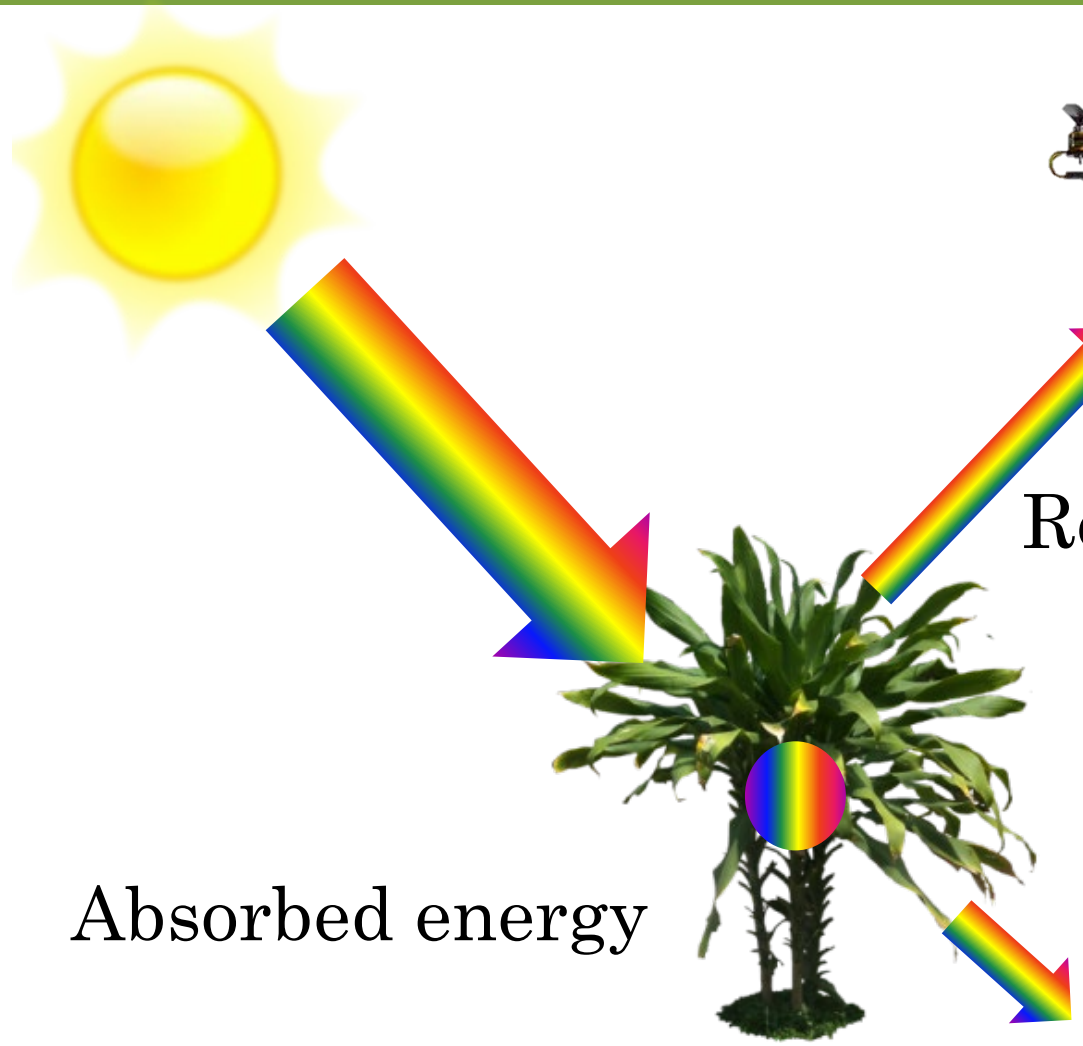
Variety and BBCH*		Applicartion rate (l·ha^{-1})		Savings (%)
		Conventional	Variable	
Merlot	85	266	141	**47.0**
Cabernet Sauvignon	75	299	179	**40.1**
	85	373	111	**70.2**
Tempranillo	75	299	127	**57.5**
	85	373	86	**76.9**

Ultrasonic sensors

Ultrasonic sensors fitted in robots

Vinescout Project - UPV (Spain)

Remote sensors

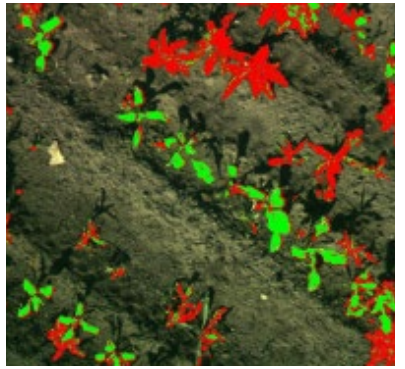


Reflected energy

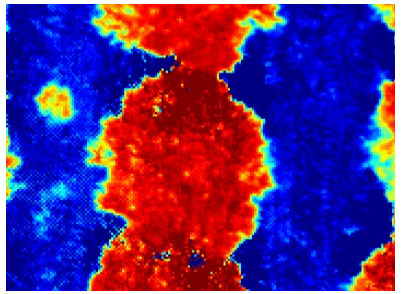
Absorbed energy

Transmitted energy

Weeds



Diseases



Remote sensors

SATELLITES

NANO-SATELLITES

DRONE

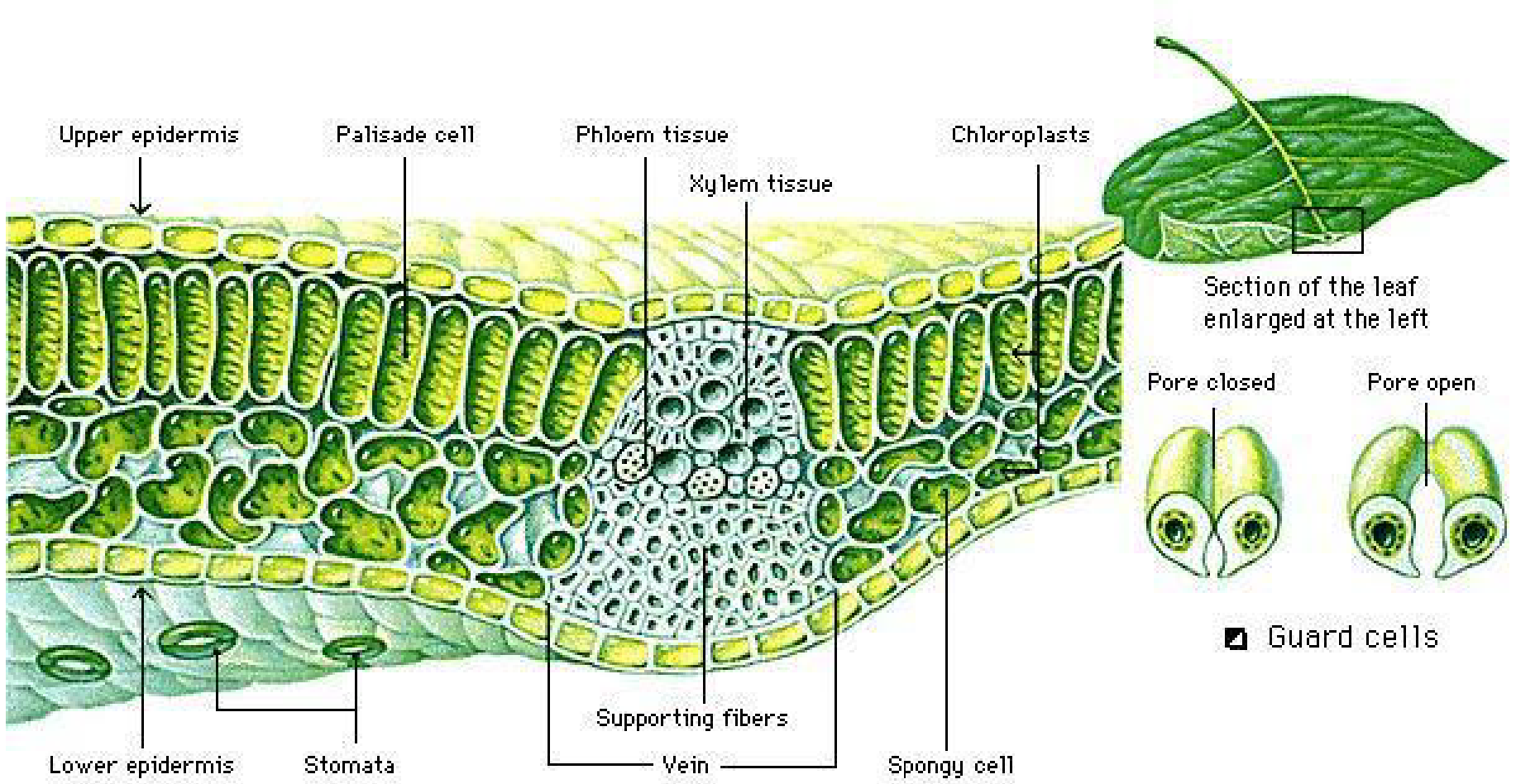
MULTIROTOR DRONE

Remote sensors

WHAT DO DRONES OFFER TO PA.?

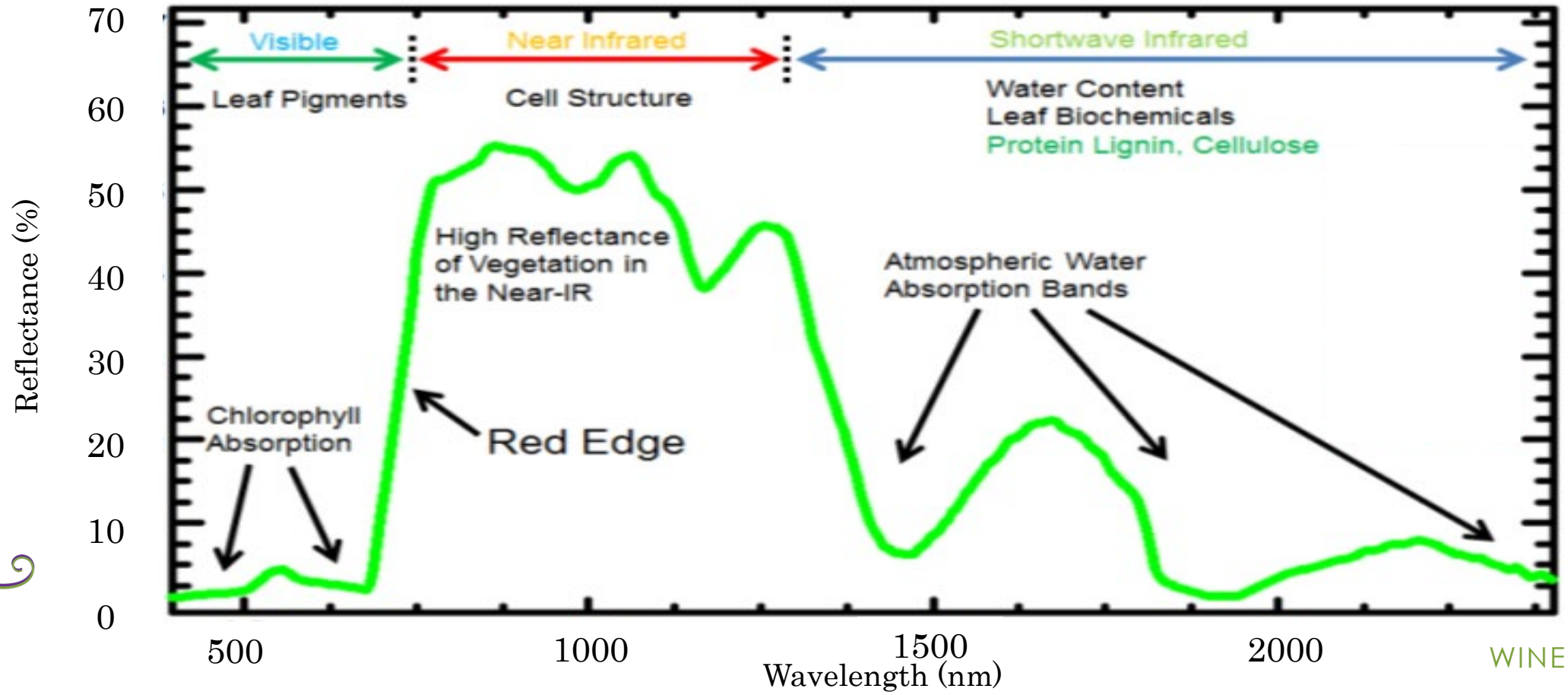
- Crop visualization at global scale (with local resolution)
- Versatility → pocket satellites
- Higher resolution → better discrimination
- Lower cost of operation and maintenance
- Economically viable for small farms
- Flight time can be adapted to crop physiological characteristics
- Flight when overcasted is possible
- Environmentally safe
- New technology → big development in next years

Remote sensors



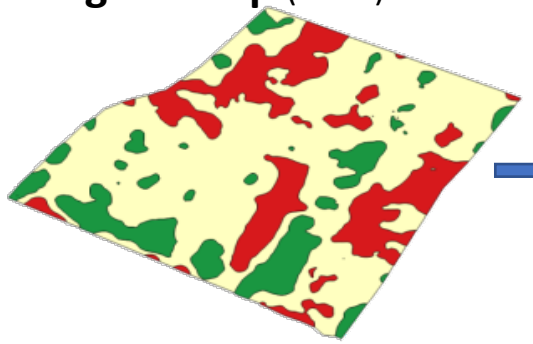
Remote sensors

Spectral indexes

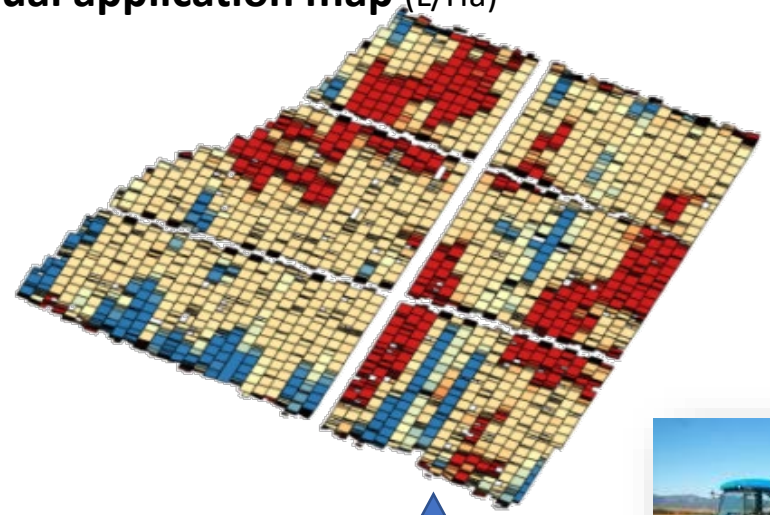


Remote sensors

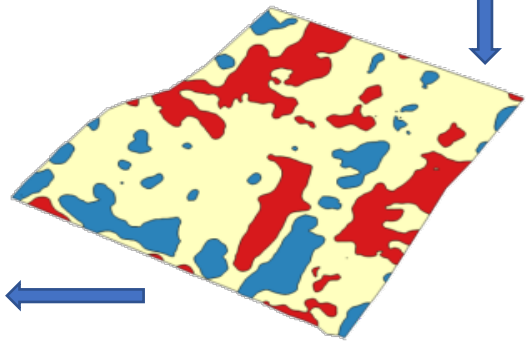
Vigour map (NDVI)



Actual application map (L/Ha)



Prescription map (L/Ha)



Remote sensors

PIVOS Project (Spain)

Remote sensors

ADOPTA Project (Spain)

PIVOS Outcomes

- Implementation of PWM technology
- Development and validation of canopy map techniques
- Generation of prescription maps
- Air adaptations

- **2 Drone** flights per season
- VRA pesticide application
- Biological efficacy assessment (Powdery and Downy mildew)

Year 1 (2023)

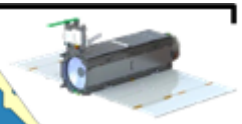
Scale up from drone to satellite based imagery

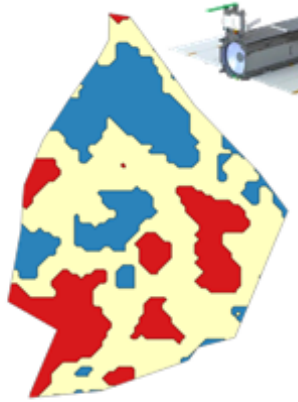
Training and Disemination

Training Courses

Scientific and technical publications

Conferences and demo farms





- **On demand nano-satellite** canopy maps
- VRA pesticide application
- Biological efficacy assessment (powdery and Downy mildew)

Year 2 (2024)

Chlorophyll

THANK YOU!

Sensors in viticulture

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