

Wine4Cast –

Spatio-temporal prediction of viticulture productivity for multi-actor usability



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WEBINAR IBÉRICO

O conhecimento ao serviço do setor vitivinícola ibérico

03 DE DEZEMBRO ONLINE





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TEMA | Spatio-temporal prediction of viticulture productivity for multi-actor usability

Predict the storm before the wind

When technology makes the difference.

- What is the usefulness of forecasts in viticulture?
- How accurate and how early can we be?
- What is the spatial and temporal scale of the prediction?
- What methodologies and technologies are available?
- What is the current outlook for predictions?



Observatório de Chichen Itzá, México



Wine4Cast:



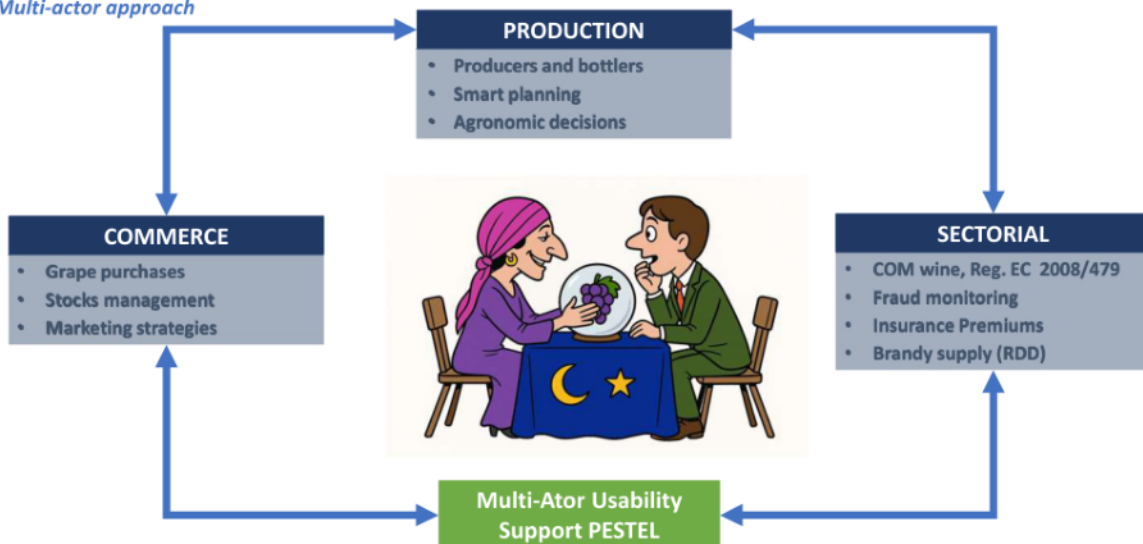


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Wine forecast

Multi-actor approach



PESTEL - Political, Economic, Social, Technological, Environmental and Legal

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Wine Forecast foundations

Productivity components

	How accurate can we get? Yield variation explanation	How early can we be? Time window
	Bunches/vine 60% (cv. > 35%)	Since bud dormant; 2 nd leaves developed (BBCH 12)
	Berries/Bunch 30% (cv. > 5-7%)	After flowering (BBCH 65)
	Berrie' weight 10% (cv. > 8%)	After berry pea (BBCH 75)

$$\text{Yield (kg/ha)} = \text{Vines/ha} \times \text{bunches/vine} \times \text{Berries/Bunch} \times \text{berries mass (kg)}$$

Cunha et al. 2016. European Journal of Agronomy

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Multi-dimensional approach

Spatio-temporal dimension of the prediction? Integrate approach

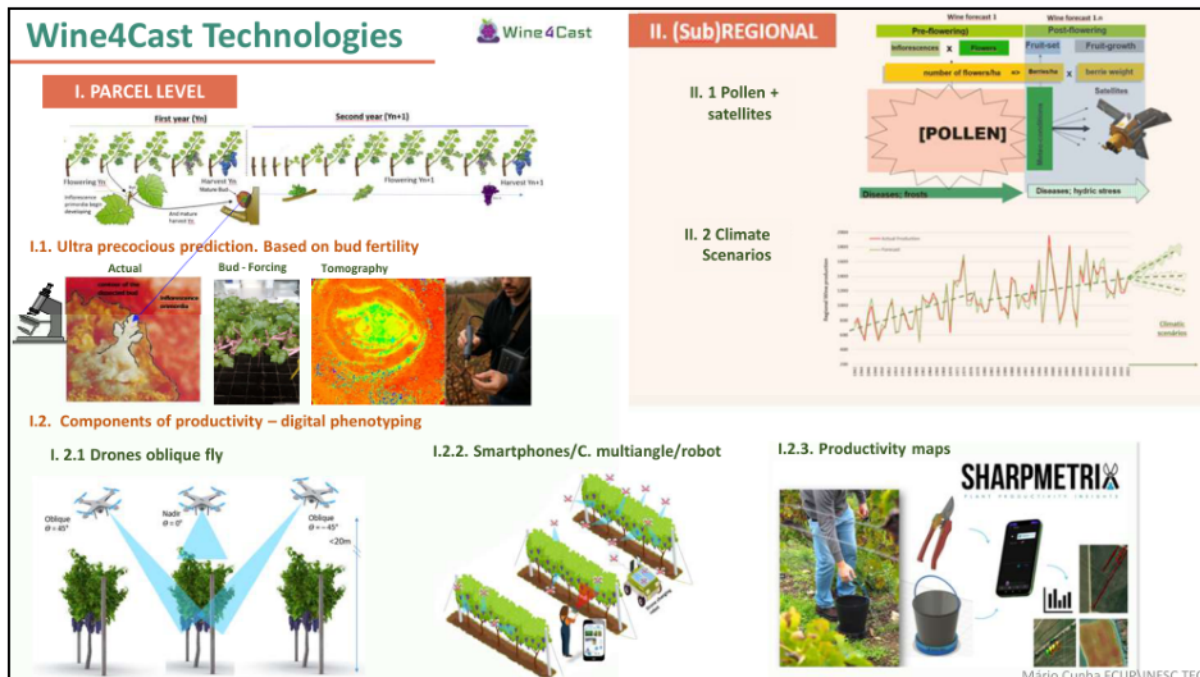
Yield forecast approaches and technologies

Spatial (Production level)	Temporal (Time window)	Approaches/Technologies
Wine company/parcel	Bud dormant (17 months)	Forcing, Bud Tomography
Wine company/parcel	Since visible inflorescences	Digital Phenotyping (micro)Drones, Smartphone, Robot
Wine company/parcel	Harvest	Harvester, "Sharpmetrix"
(Sub)Regional	Since flowering period	Airborne pollen Satellites images
(Sub)Regional	Long –term projections (> 100Y)	Climate time series (daily data >100 Y + climatic scenarios)

Complementary Information from different types of wine forecast

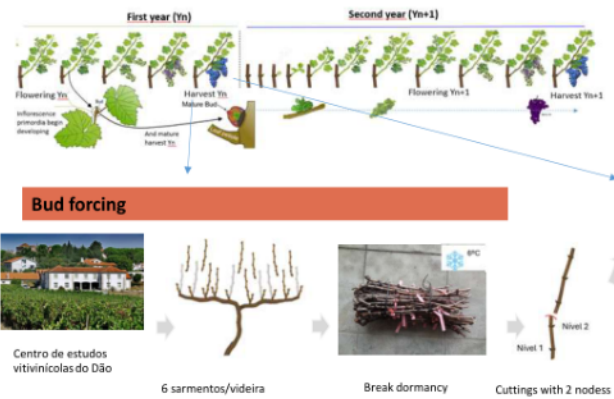
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I1. Ultra-Precocious – “Forcing”



- Destructive Approach
- Up to 12 months before harvest
 - Productivity forecast
 - Pruning decisions

et. al. Cunha, M. 2025. Revista APH

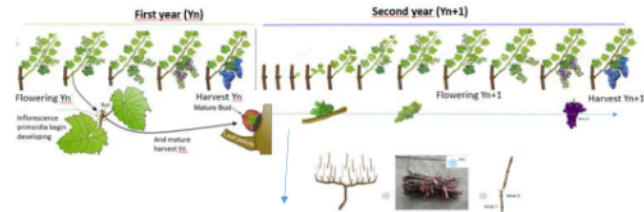
FORCING. DÃO 2023 – variety Jaen



CENTRO Wine4Cast

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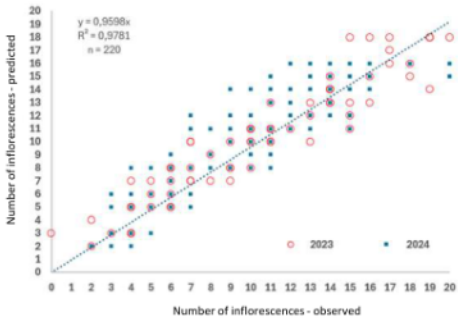
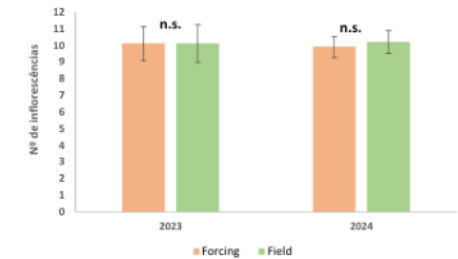
I1. Ultra-Precocious – “Forcing”



CENTRO Wine4Cast

et. al. Cunha, M. 2025. Revista APH

Bud forcing– 2023 e 2024 – Variety Jaen



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I1. Ultra precocios – “tomografias”

From Lab to Field

mutipoint hyperspectral sensor - “Tomography”

Tomography of dormant bud (non-destructive)



From Light to Yield

Spectral data vs fertility of the dormant bud



Wine4Cast
Moreira, G. PhD results, FCUP, INESC TEC, Wine4Cast, BudScan 4M

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I2. Components of productivity

Digital phenotyping - inflorescences

Shoots <50 cm (Pheno stages I-J)



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I2.2 Smartphone sticks

- RGB image
- Multiangle, 360° cameras
- <<<< occlusion

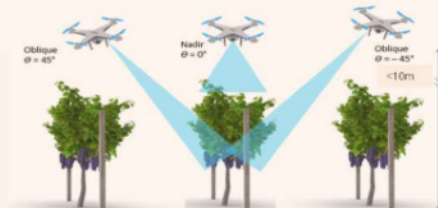


Video



I2.1 Drones

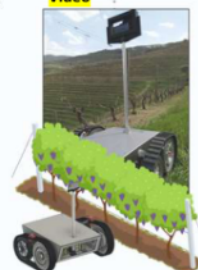
- RGB image, oblique fly, <10m
- <<<<< occlusion



I2.3 Robot “Orioos”

- Versatility
- Affordable costs
- High throughput
- 360° camera

Video



Video



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Components of productivity

Results – Camera 360° - (multiangle)

Digital phenotyping of inflorescences

Multi-variety results – Dão Region

Variety	nb grapevines	Direction	Observation	Multiangle	NMAE (%)
Jaen	71	NNW to SSE	495	461	6,9
Jaen	71	SSE to NNW	495	433	12,5
Jaen	74	NNW to SSE	510	523	2,6
Jaen	74	SSE to NNW	510	501	1,8
Jaen	74	Mean	510	512	0,4
Alfrocheiro	72	NNW to SSE	997	962	3,5
Alfrocheiro	72	SSE to NNW	997	1051	5,4
Alfrocheiro	72	Mean	997	1007	1,0
Alfrocheiro	74	NNW to SSE	970	1007	3,8
Alfrocheiro	74	SSE to NNW	970	1038	7,0
Alfrocheiro	74	Mean	970	1023	5,4
Total					
Amostra	802	---	8421	8518	4,6

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Centro de estudos do Dão, Moreira, G. PhD results, Wine4Cast

- Images from different angles (multiangle)
- AI Algorithms:
 - Detection, Occlusion, avoiding double counting
- Mapping of productivity components

Video



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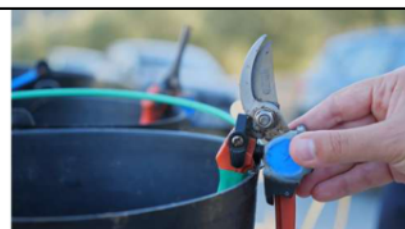
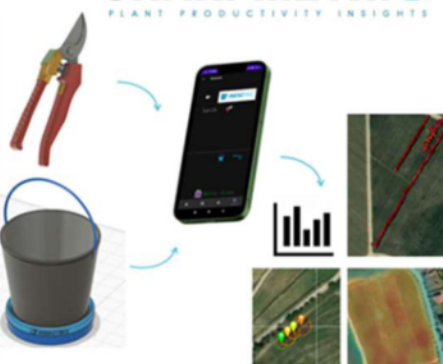
I.2.3. Productivity maps

Sensorized scissors

- Sensor system adapted to any scissors
- Automatic weighing bucket,
- Coordinate by mobile phone processing (GNSS, data processing and mapping)



SHARPMETRIX
PLANT PRODUCTIVITY INSIGHTS



Main operations:

- Number of grapes
- Weighting/Counting
- Geolocation data



Applications

- Productivity maps
- Vineyard Operation management

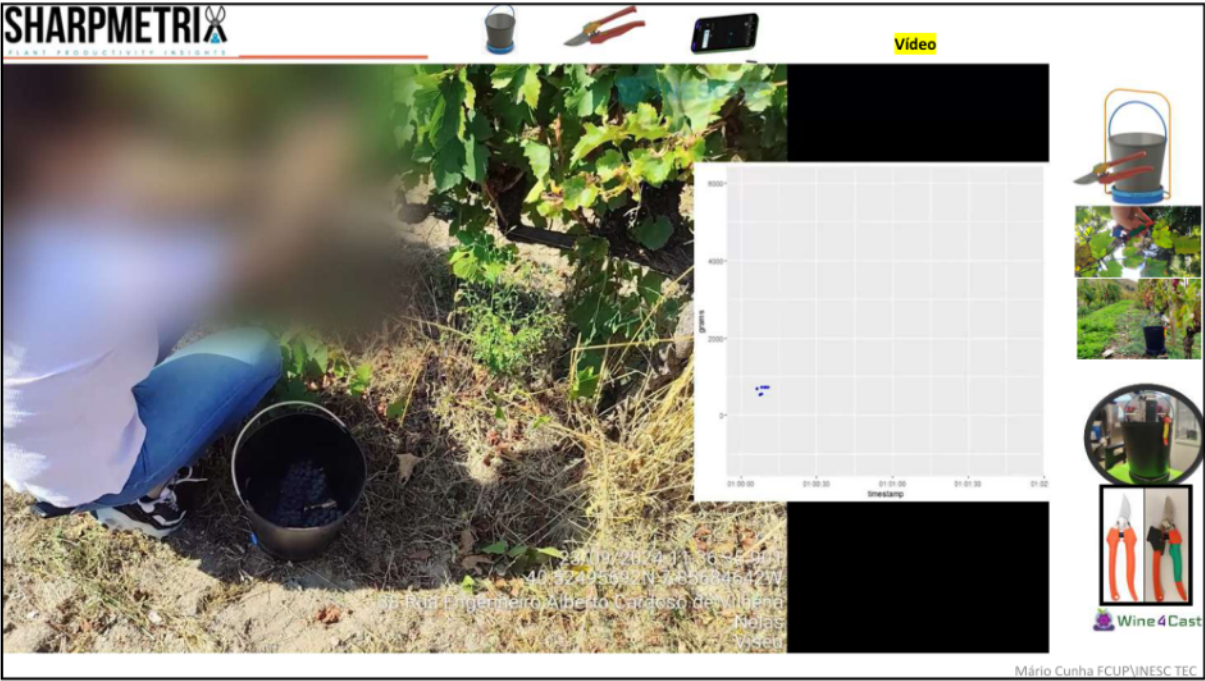
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WO 2025/088592 A2 — Add-on Monitoring Apparatus for a Cutting Tool, Respective Cutting Tool, Monitoring System and Method.

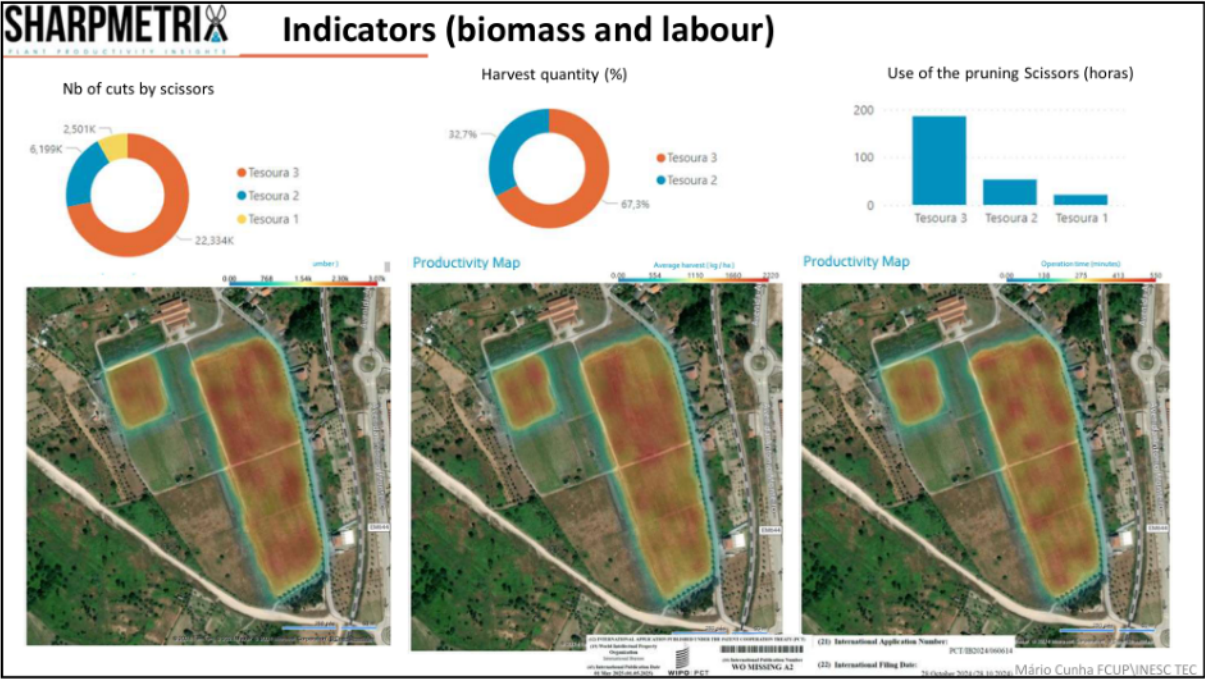
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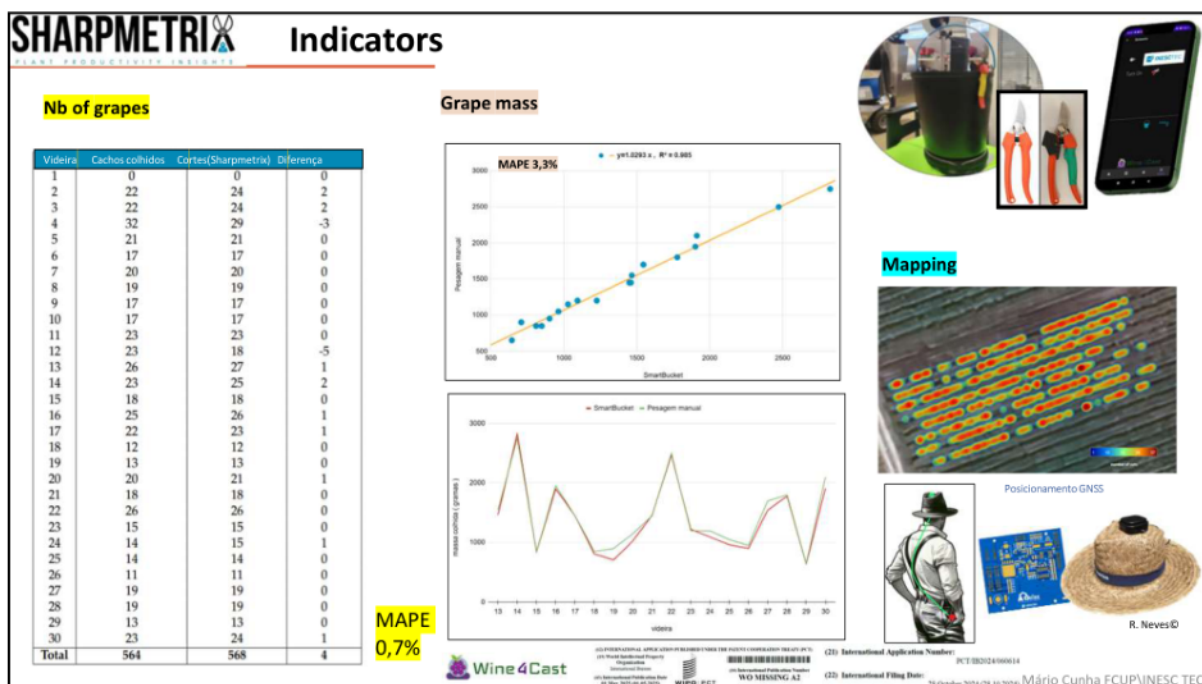
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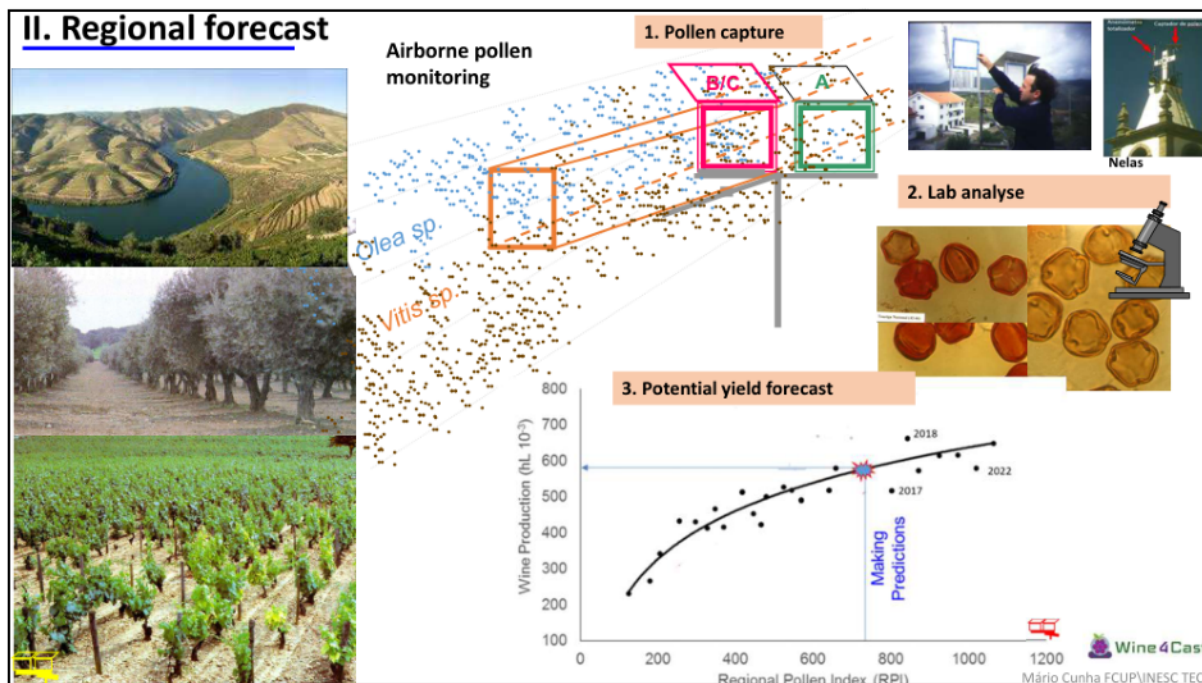
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II. Regional forecast

Airborne pollen-based – Dão wine region (Example)

Airborne pollen sample



Airborne pollen monitoring



*Cunha, et. al. 2000. Ciência e Técnica Vitivinícola,

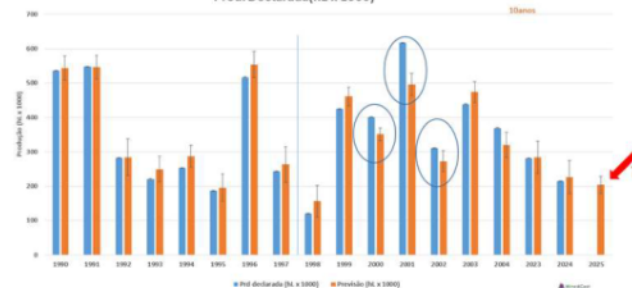
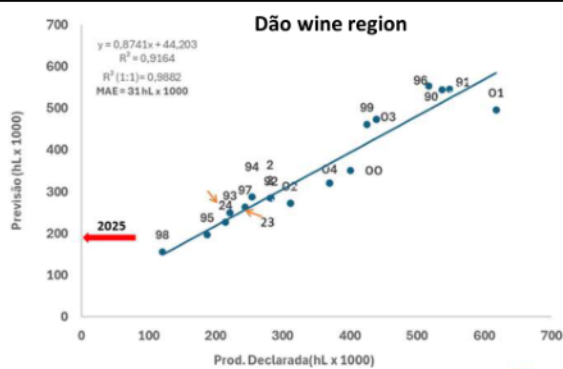
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II. Regional forecast

Baseadas no pólen atmosférico – região do Dão

Amostragem Polínica no Dão



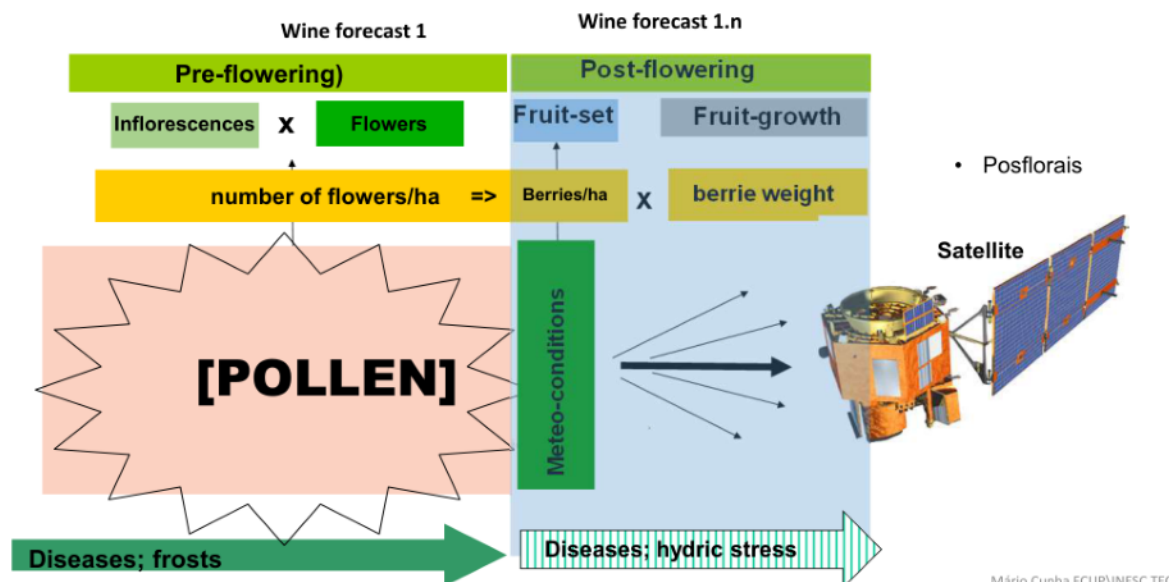
et al. Cunha, 2016. European Journal of Agronomy <https://doi.org/10.1016/j.eja.2015.10.008>

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II. Regional forecast

Airborne pollen + Satellites



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DUORUM
From the Golden Douro Valley

Francisco Donas
Botto Rodrigues



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