GEOProcessing 2025

Development of a geospatial predictive system of crop yield in vineyards. A case study in Spain

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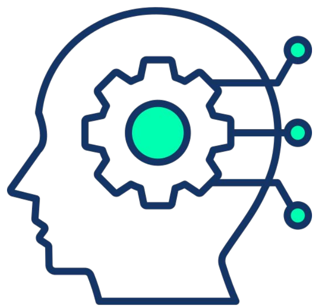
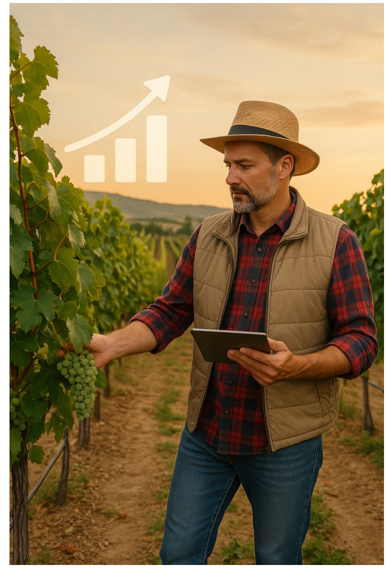
Motivation of the research



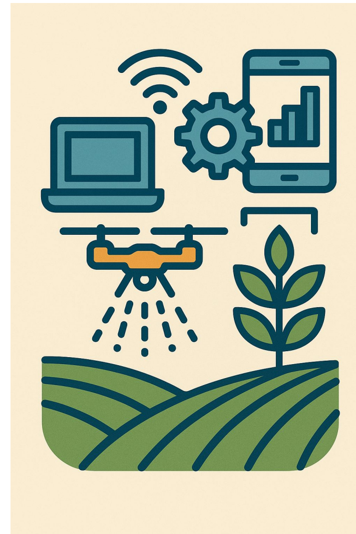
Machine learning



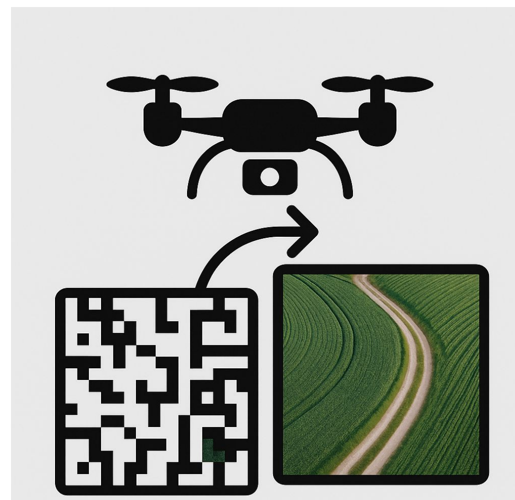
Profitability

Sustainability

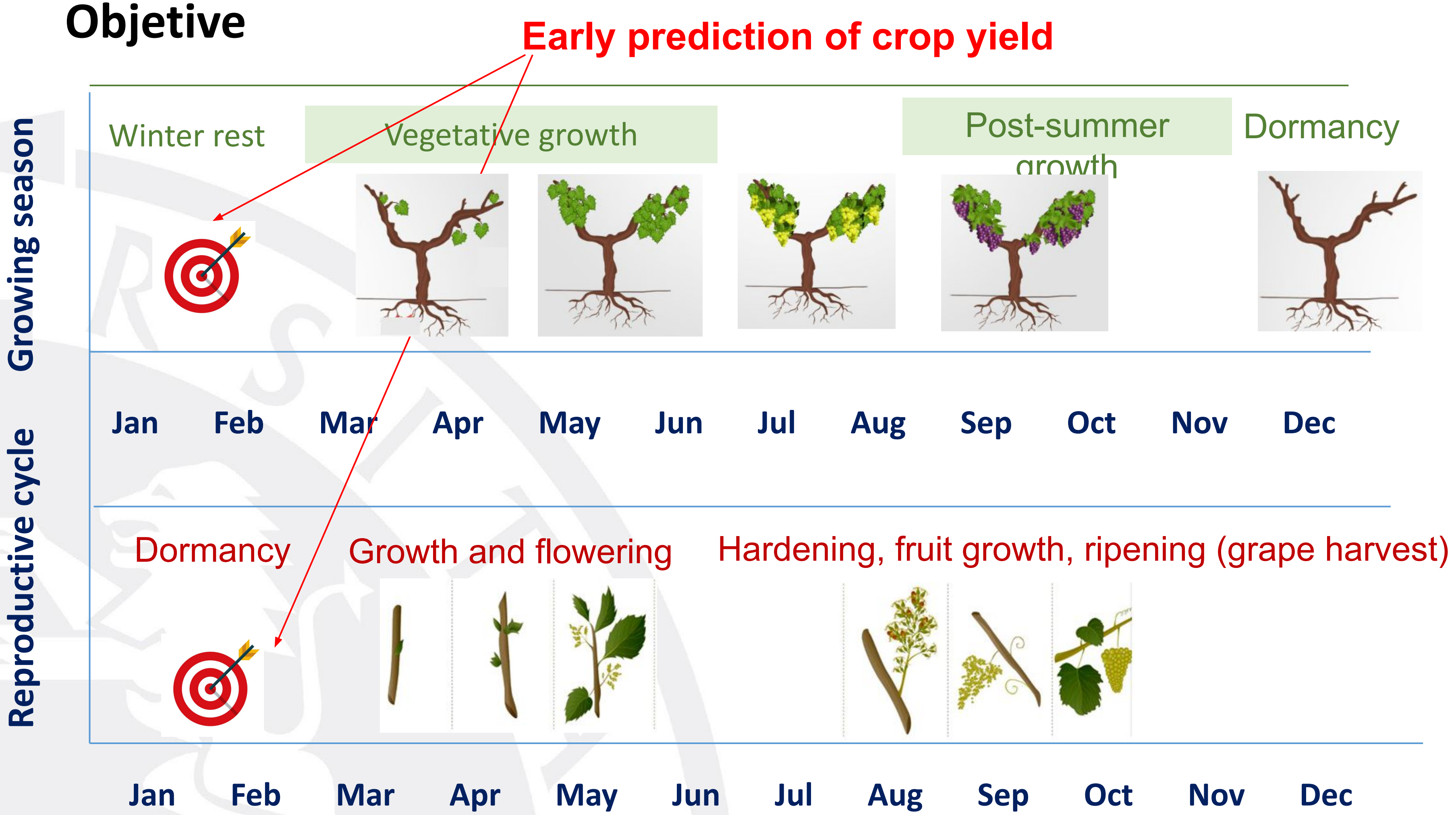
State of the art



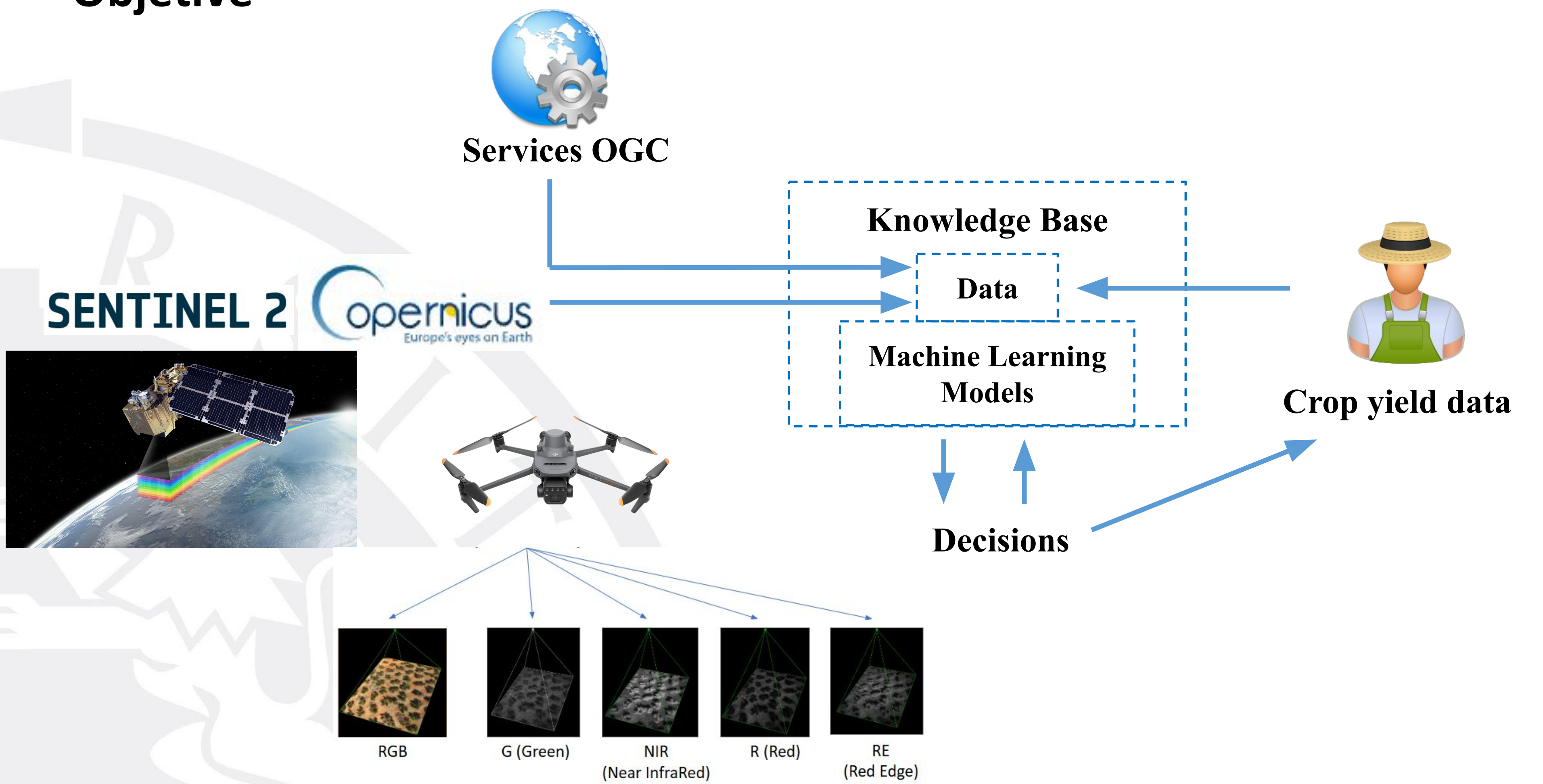
- Lack of effective tools and challenges
- Technology advances(ICT y PA)
- Use of Machine Learning (ML)
  - Identification of significative factors.
  - Weather as key factor.
  - Importance of historical data and remote sensing.
- Multi-scale work. Difference in resolution with drones
- Specific methodologies for each crop.



Objetive

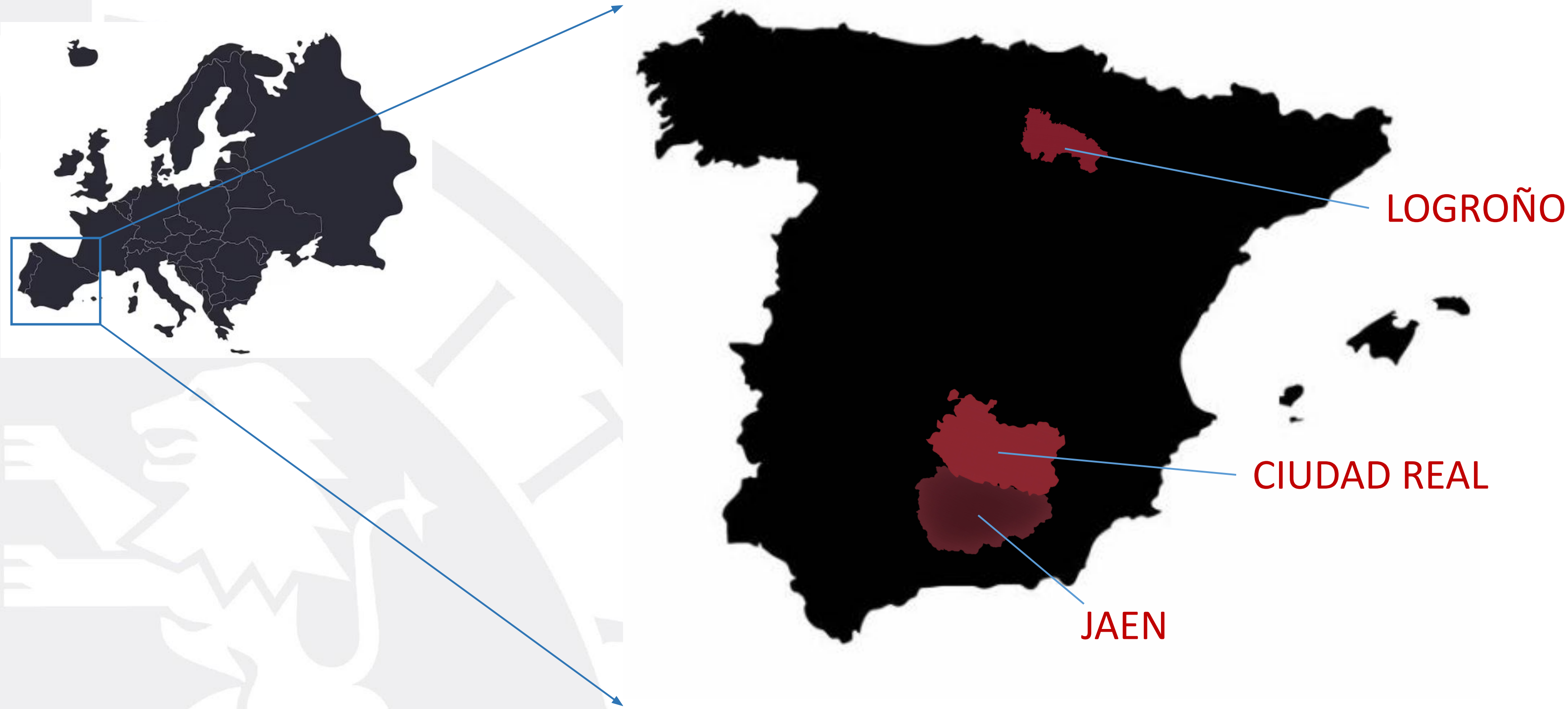

Early prediction of crop yield
Growing season
Winter rest
Vegetative growth
Post-summer growth
Dormancy
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Reproductive cycle
Dormancy
Growth and flowering
Hardening, fruit growth, ripening (grape harvest)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Objetive


Services OGC
Knowledge Base
Data
Machine Learning Models
Crop yield data
Decisions
SENTINEL 2
opernicus
Europe's eyes on Earth
RGB
G (Green)
NIR
(Near InfraRed)
R (Red)
RE
(Red Edge)

Methodology

Research Area



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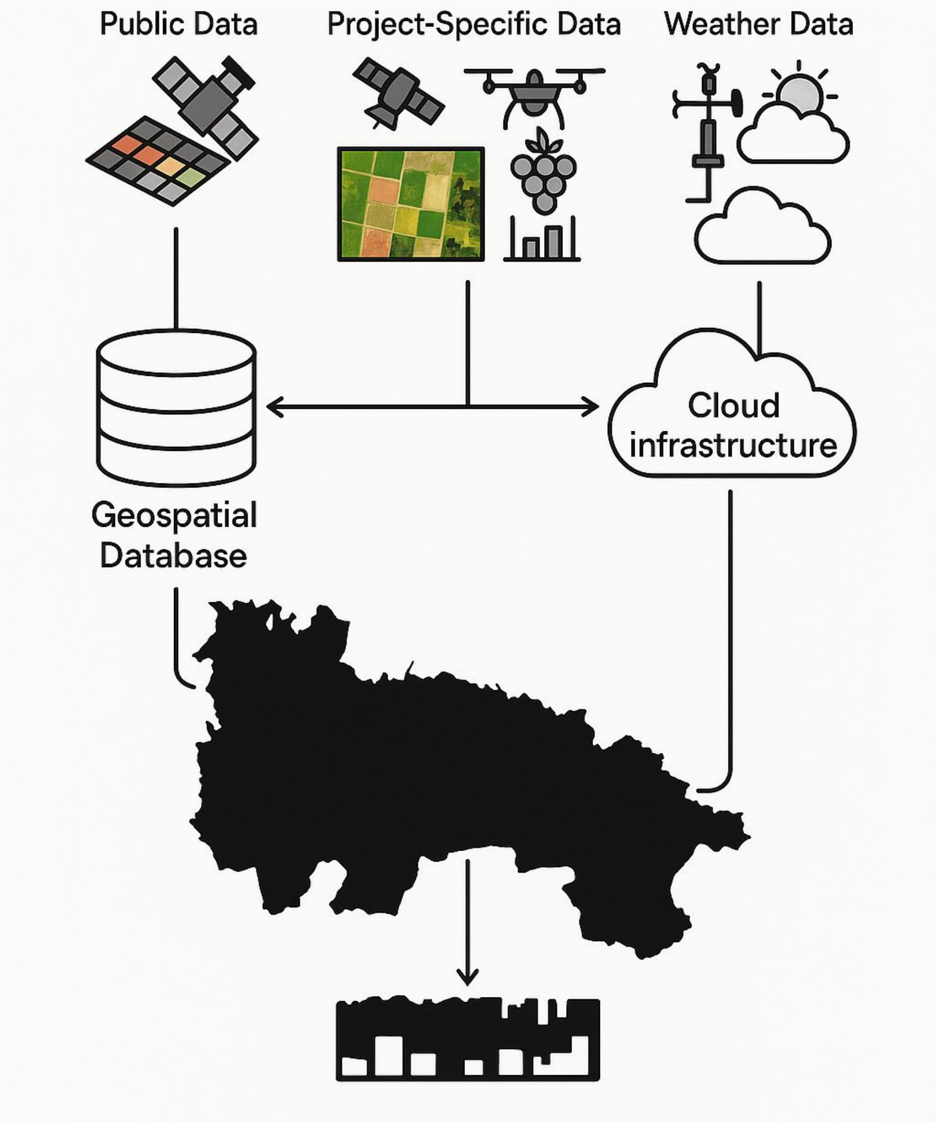
Methodology

A. Planning and design of the **system architecture**

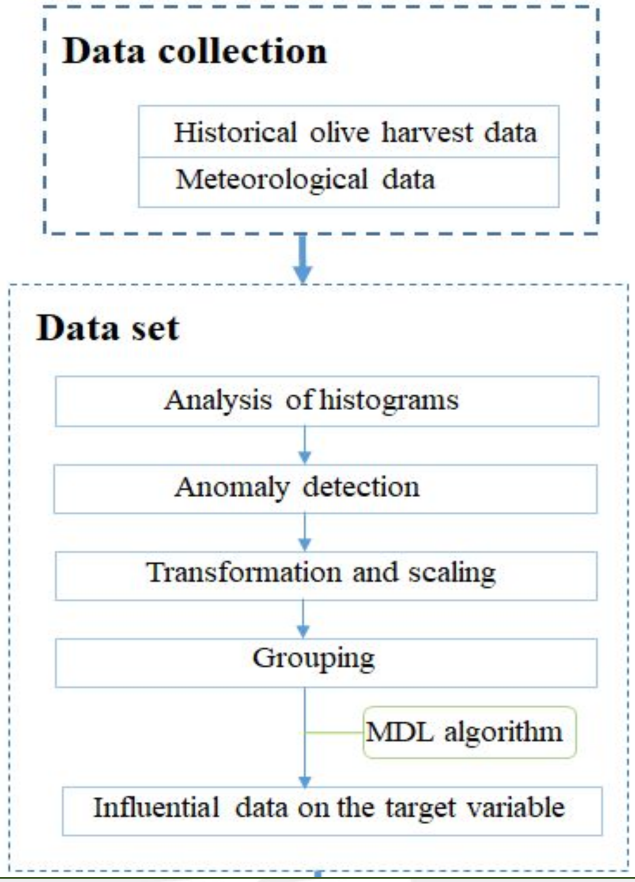


Methodology

B. **Data** acquisition and processing

Methodology

B. Data acquisition and processing



Nº Pesada	Fecha	Rendimiento	Kgs Pesada
197	26-dic	17,89	1.054
289	27-dic	17,94	1.323
368	28-dic	17,99	1.168
425	29-dic	14,77	1.343
515	30-dic	18,43	1.590
597	31-dic	17,21	2.241
1666	03-ene	18,39	1.208
666	04-ene	14,5	1.791
735	05-ene	15,92	1.322
833	06-ene	16,85	2.151

Methodology

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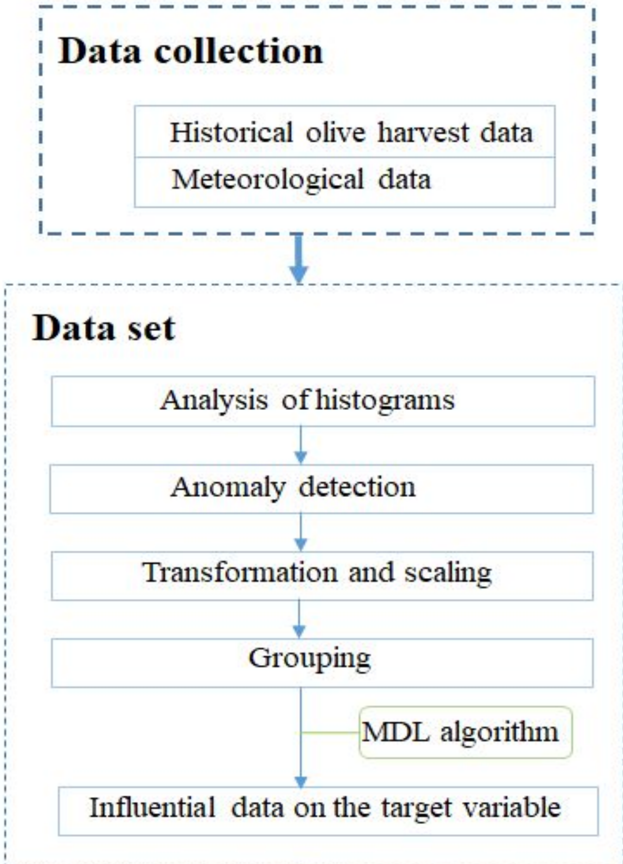

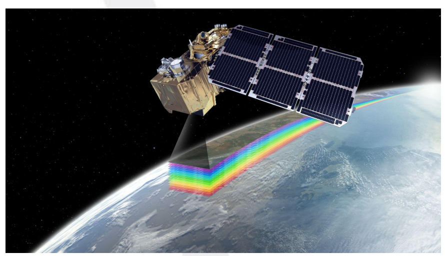

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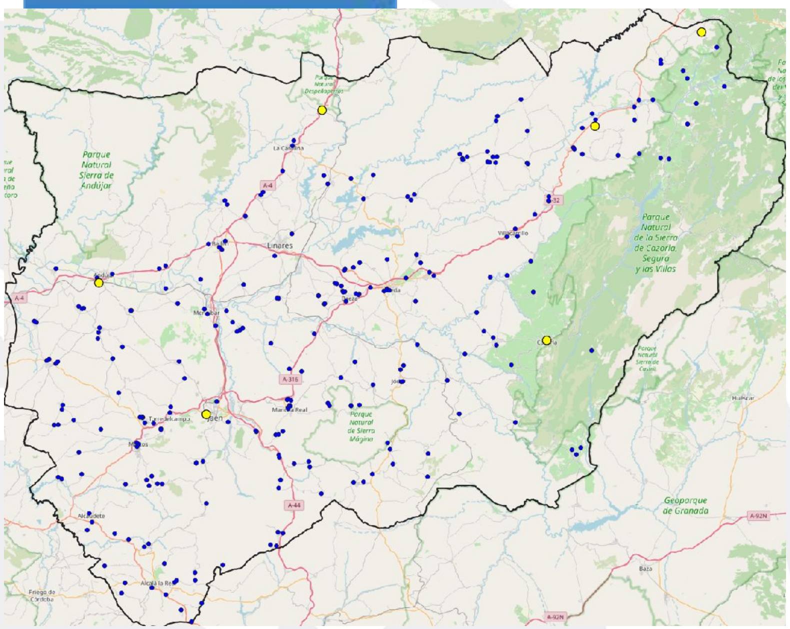
Agencia Estatal de Meteorología



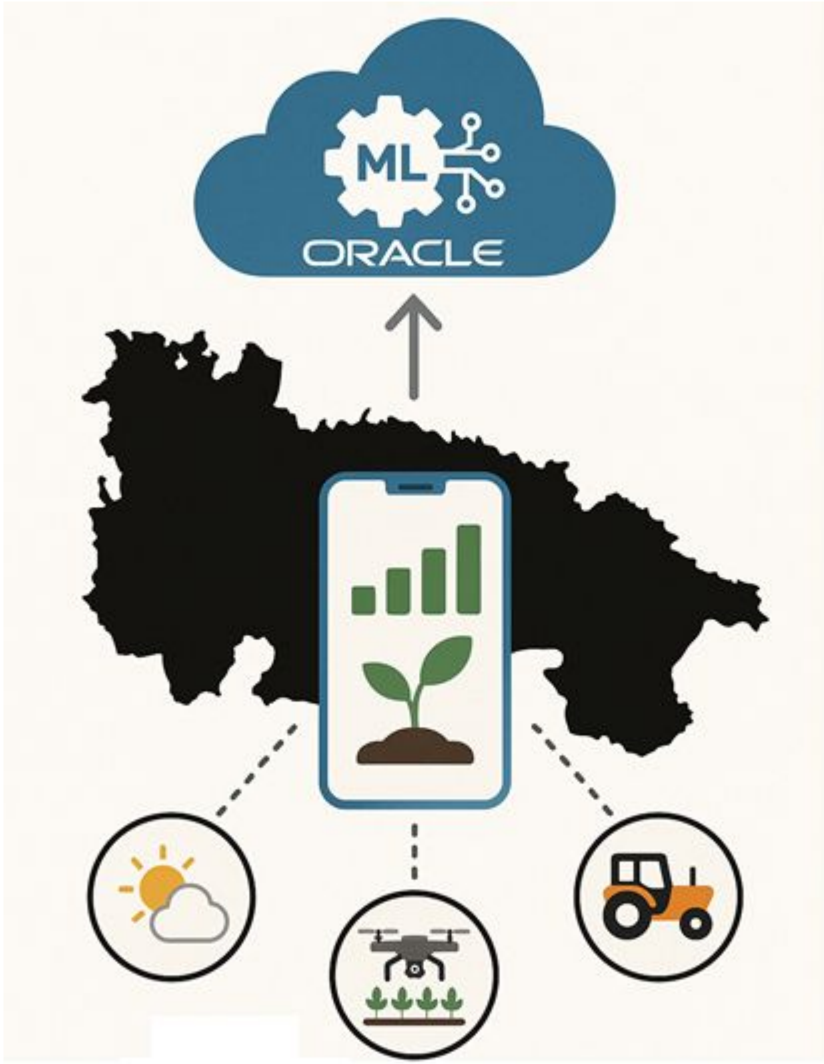
MODIS
ERAS5
SENTINEL-2

Methodology

C. Implementation of the **geospatial database**

Methodology

D. Design and implementation of the **predictive system in the cloud**



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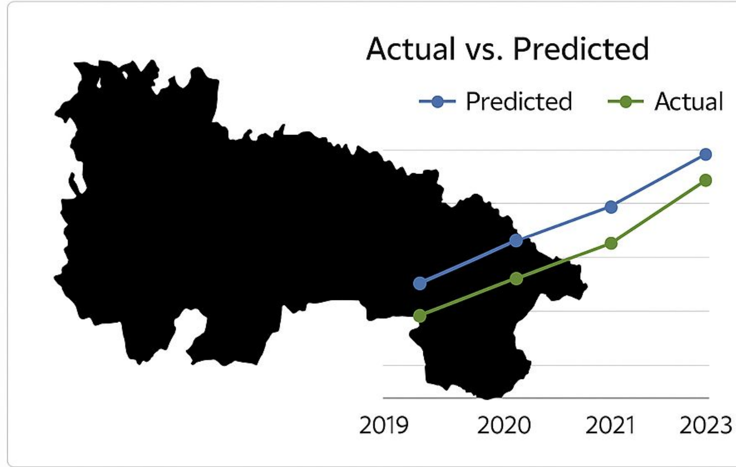
Methodology

E. Design and development of the **graphic interface** for the use of the system.

Crop Yield Prediction



Year	Actual	Predicted
2019	3.0	3.5
2020	4.0	3,7
2021	3,8	4,0
2022	4,1	4,3
2023	4,5	4,5

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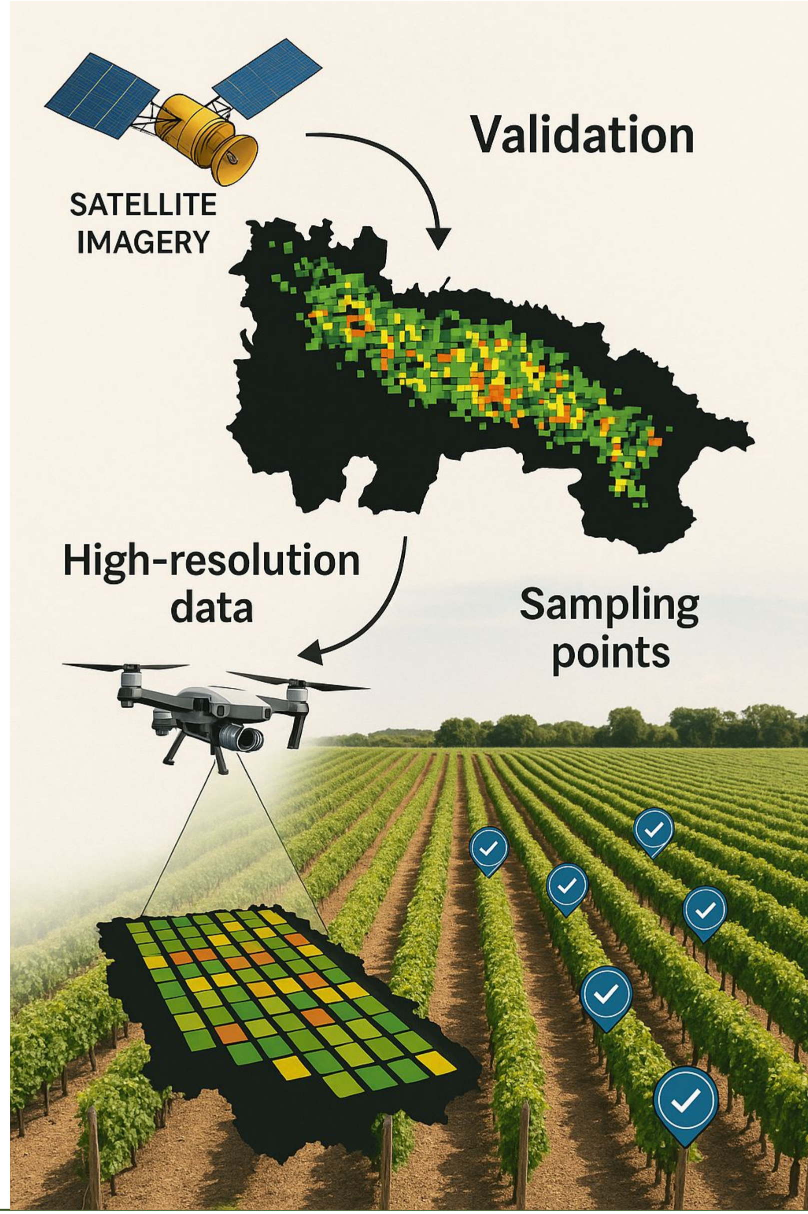
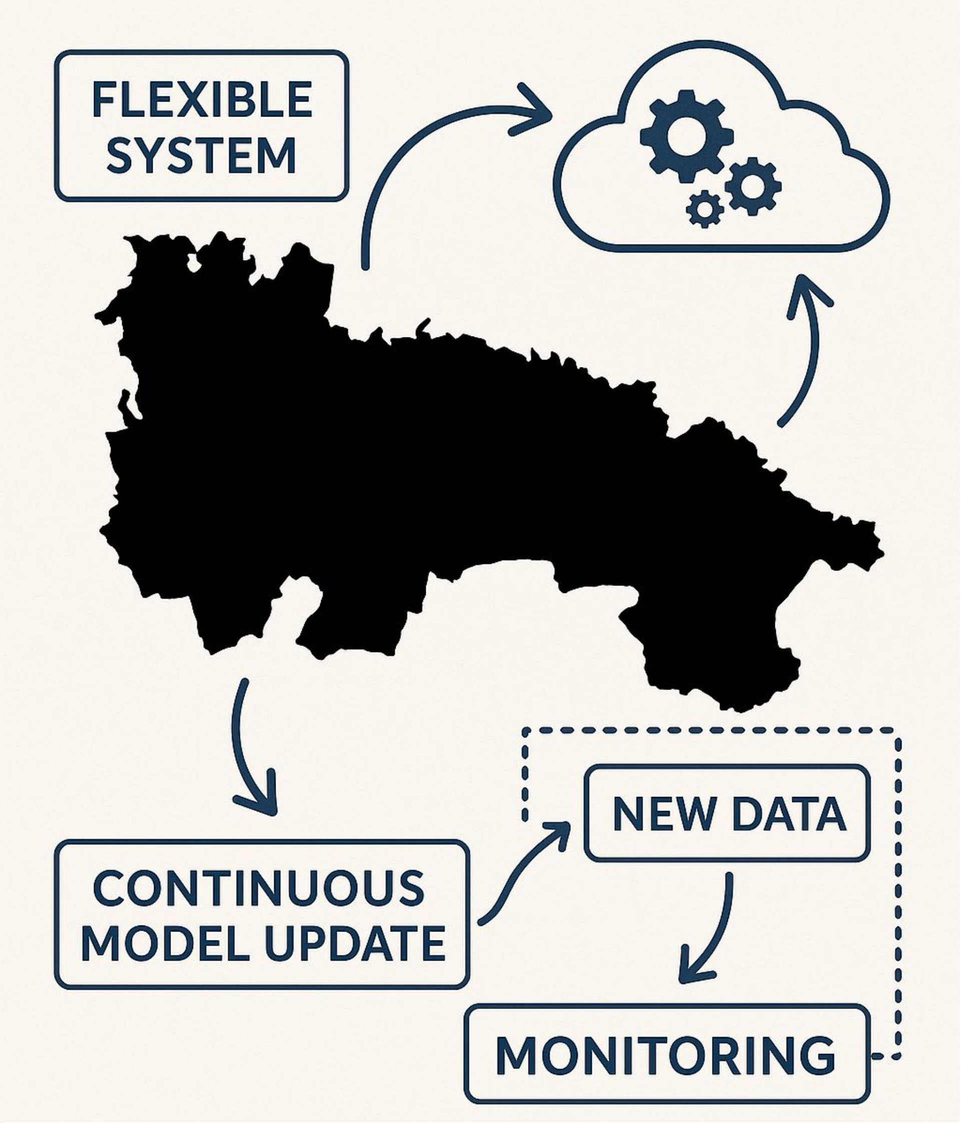
Methodology

F. **Validation** and adjustment of the model with drone data.



Methodology

G. **Scalability and maintenance** of the system



Conclusions

1. **Advances in precision viticulture and uncertainty reduction**. The implementation of Machine Learning models for the early prediction of grape harvest marks a significant advance in precision viticulture, achieving a considerable reduction of uncertainty in its management.
2. **Optimised planning and operational efficiency.** The ability to accurately anticipate crop yields months in advance will allow winegrowers to optimise activity planning and quality management, increasing operational efficiency.
3. **Deep understanding and informed decision making**. The system not only improves prediction, but also deepens the understanding of the factors affecting the vineyard and provides valuable information for informed decision making based on the identification of influential variables.
4. **Robustness and rigorous model validation.** Rigorous validation with high-resolution data (drones and satellites) and quantification of performance through metrics ensure the model's robustness, applicability, accuracy and reliability in a variety of scenarios.
5. The **short-term future** development of this work includes the generation of an intelligent system in which the variables obtained from the satellite images are extracted automatically as well as the downloading of the meteorological values from web services. Thus, a non-expert user will be able to use the system by simply inserting the harvest values of the farm or the area under study.

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