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PARTNERSHIP FOR RESEARCH AND INNOVATION IN THE MEDITERRANEAN AREA

Practice innovations on wild forest products

26th May 2022

Quantifying pinecone production, using sensors and drones.

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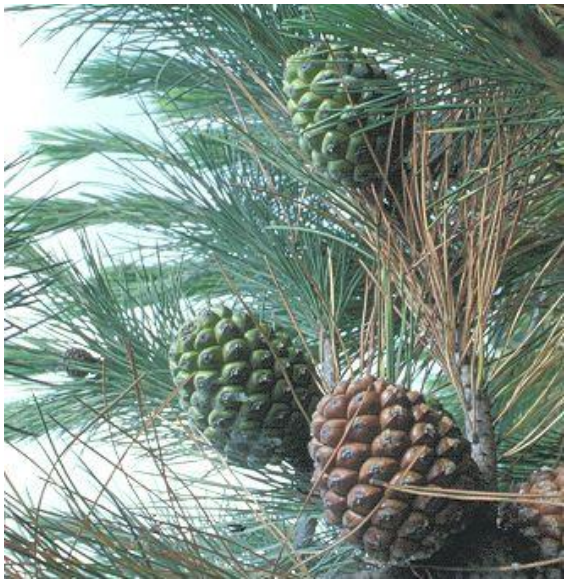
Context:

- The edible pine nut of the stone pine (*Pinus pinea* L.) **has a great value.**

- **Cone production is highly variable between trees and years**, making it difficult to predict annual production and consequently to organize the harvesting of the pinecones.

- It is very common that forest owners (private or public) **do not know the production of their forests or plantations and are not able to organize the correct collection** of cones in time and space, with proper harvesting techniques, avoiding collection outside the harvest season or pinecones robberies.



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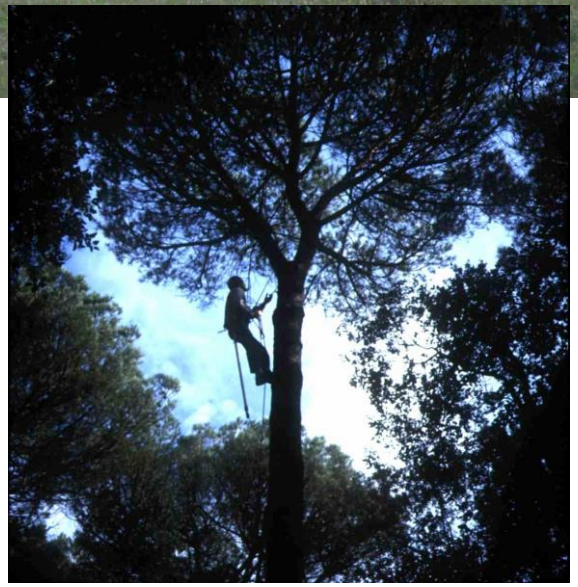
Context:

- Currently, **pinecone production is quantified visually** before the start of the collection with a subjective estimate of the number of pinecones in a selection of trees within the forest.

- **Visual evaluation of cone production is complex,** both in plantations and in forest stands, where in addition mobility and observation conditions are complicated.

- In this context, the use of **cone production models with remote sensing** has incalculable potential. Studies on cone production estimation with sensors are scarce (Schneider *et al.*, 2020).



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Objective and innovation

- To establish an **provide new technologies and protocols for directly quantifying pinecone production, using drones and multispectral sensors**, to develop more efficient and precise evaluation of pine cones than the current visual pinecone estimation.

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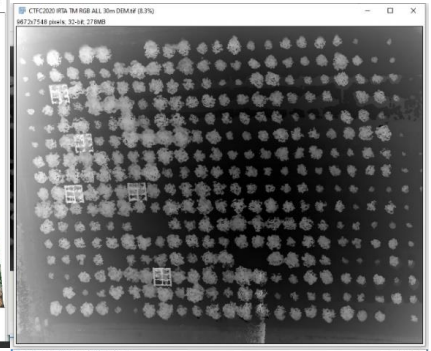
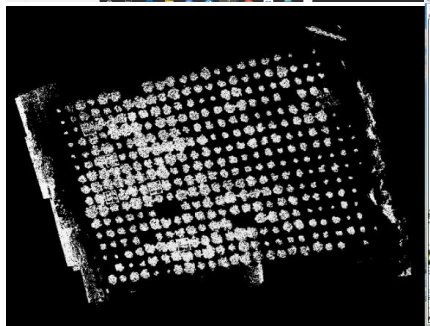
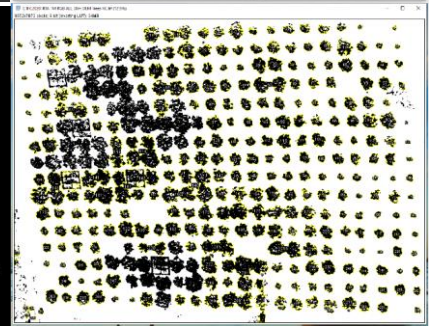
Specific objectives:

1. Definition of the **spectral regions** for differentiating pinecones from the rest of the tree and environment, and the **combination of UAV (unmanned aerial vehicles) and sensors** needed to capture this information.
2. Definition of the **optimal image capture techniques** for evaluating forest productivity (pines sampling, etc.)
3. Definition of **optimal techniques for processing images** and obtaining objective results.







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Activities done:

1. **Pilot sites: experience implementation** (Girona and Barcelona, N-E Spain).

Drons flights implementation

Images and 3D models

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Activities done:

2. Sensor selection Test flight and UAV image captures performed with different sensors, RGB and multi-spectral (multi-sensor NDVI) sensors of different spatial and spectral characteristics, over *Pinus pinea* plantations/forsests and subsequent image analyses.

RGB Orthomosaic made from the images captured from the drone at 30m a.g.l.

The pinecones appear to be more visible in the RGB image and also in the Saturation image.

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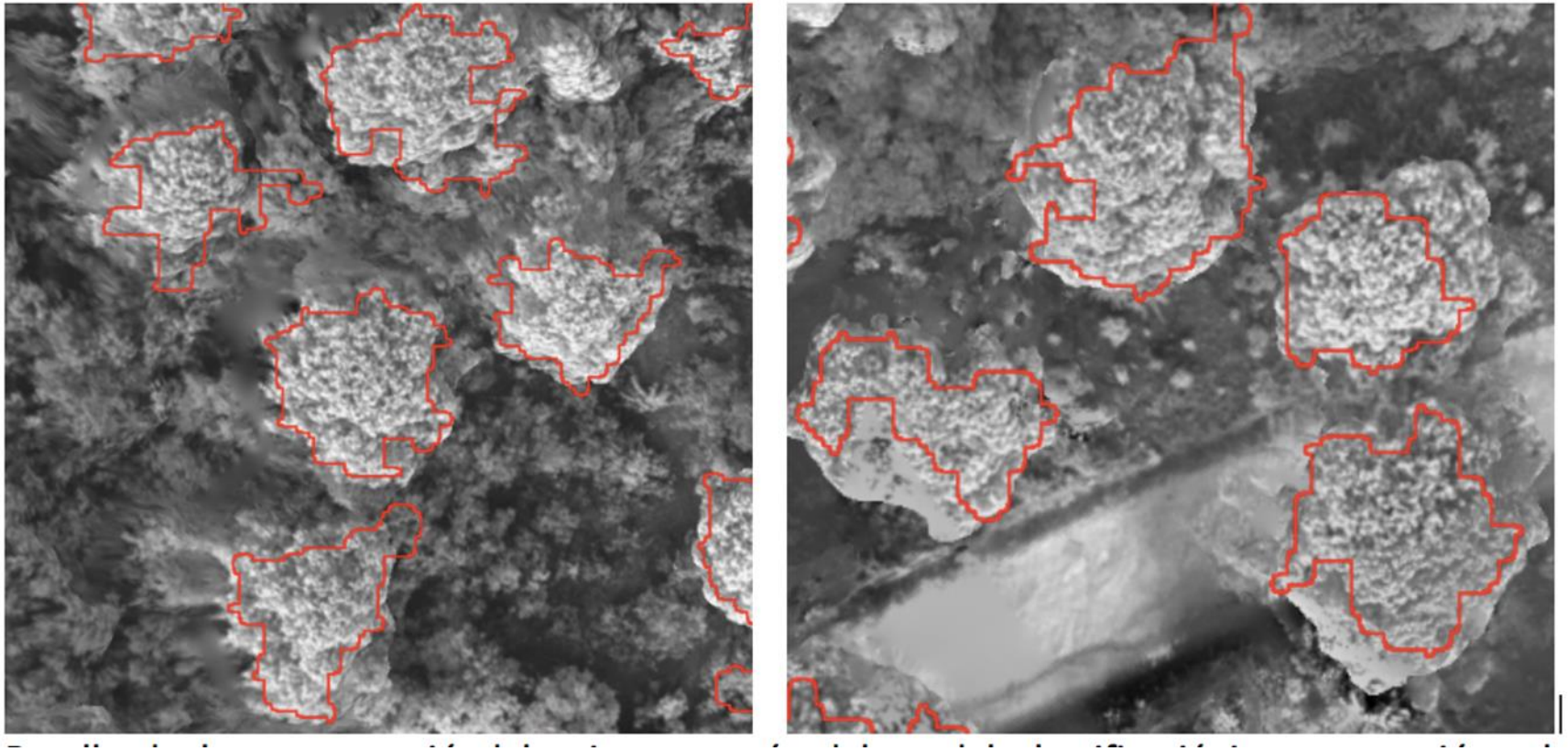
Activities done:



Details of the segmentation of the *P. pinea* pines through the classification model.

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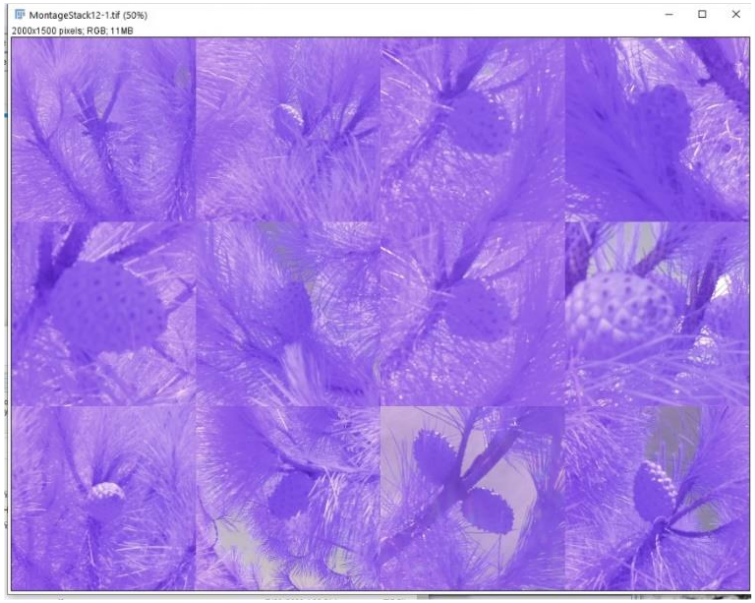
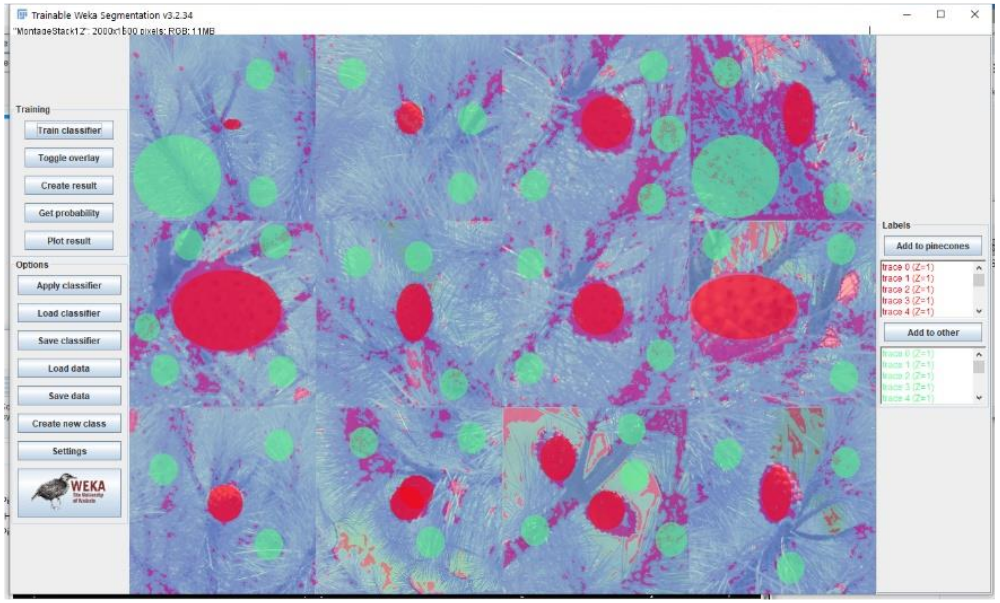
In process

3. **Processing images** and cones estimation by means of Machine Learning.





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Thank you for your attention

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