#EUSpace

SWIFTT

EUSPA AI week 2026

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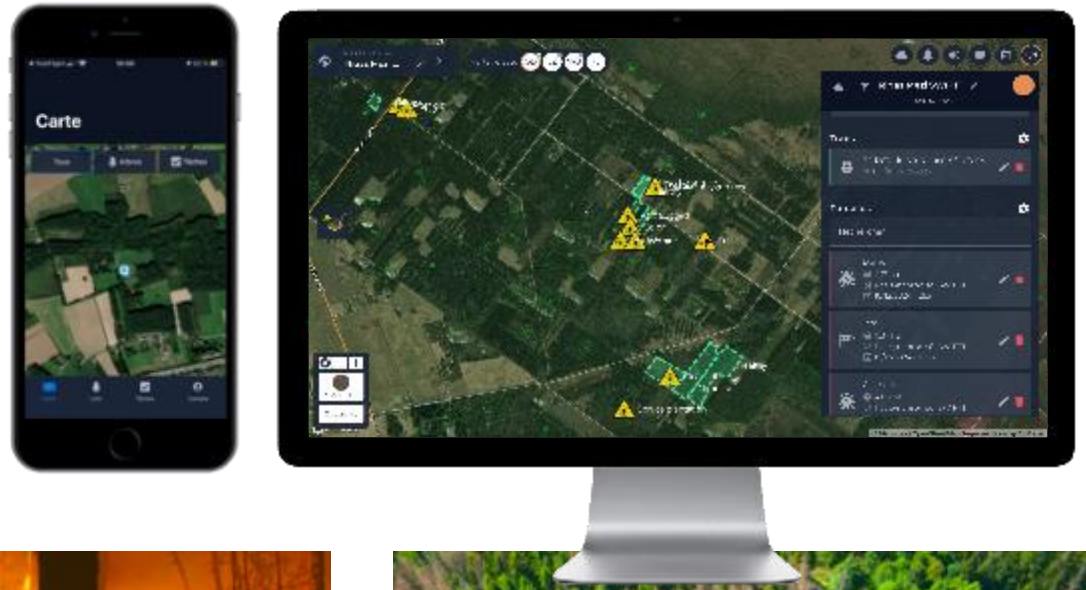
SWIFTT Project expected outcome

The project SWIFTT aims to automate the detection of bark beetle attacks in forests, evaluation of fire risks and of the damages after a storm, using Copernicus Satellite imageries and AI.

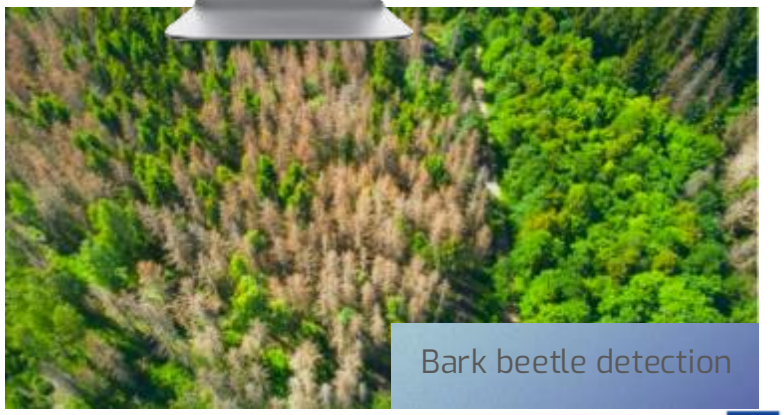
Two tools are created for forest stakeholders:

- ✓ a web platform displaying interactive maps with key information;
- ✓ a mobile platform for foresters to collect in-situ data.



Windthrow damage

Fire risk



Bark beetle detection

SWIFTT Services description

Bark beetle damage

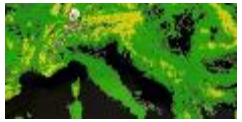
- ✓ Objective: Bark beetle damage assessment
- ✓ Model: supervised machine learning-based model (Random Forest)
- ✓ New data available on a monthly basis
- ✓ Monthly bark beetle damage assessment at 10m resolution
- ✓ On-demand computation of volume affected

Wildfire risk

- ✓ Objective: Fire risk prediction
- ✓ Model: ML algorithm model (XGBoost)
- ✓ New data available on a monthly basis
- ✓ Monthly fire risk indicator at 25km resolution
- ✓ On-demand computation of volume affected

Windthrow damages

- ✓ Objective: wind damages assessment
- ✓ Model: supervised machine learning model (Random Forest)
- ✓ Available six-weeks post-storm
- ✓ Evaluation of parcels damaged at 10m resolution
- ✓ Computation of volume affected



Forest Basemap

- ✓ Objective : Provide high quality forest land cover map
- ✓ Model: Random Forest based on forest maps (broadleaved, coniferous, mixed) created for all Europe

Value proposition on the SWIFTT tool

- ✓ **ALL-IN-ONE TOOL** to support for climate resilience and proactive forest management for monitoring, data collection, and threats analysis & report delivery (centralization of the services)
- ✓ **CUSTOMIZED** tool depending on the risks faced: spruce bark beetle detection, forest fire monthly risk, storm damage assessment
- ✓ **TIME-SAVING** by removing the need for manual data processing
- ✓ **PRECISION** with 10m resolution analysis across different European countries
- ✓ **FORESTERS-FRIENDLY DESIGN** with foresters embarked in the app construction and iterative approach
- ✓ **AFFORDABILITY** with low costs using Copernicus satellite data and IA
- ✓ **DATA-BASED** analysis to extract valuable knowledge

Process to create AI models in SWIFTT: the Bark Beetle example

1. Field Data Collection

- ✓ Carried out by foresters using the SWIFTT collection app
- ✓ Healthy and damaged polygons recorded
- ✓ With timeline and degradation stage annotations (stages 2 and 3) related to the bark beetle outbreak

2. Retrieving of Satellite images

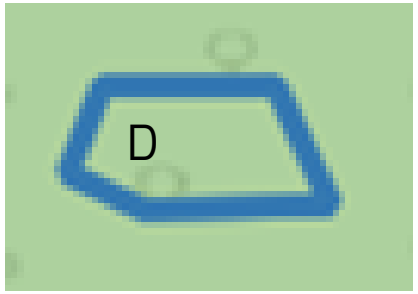
- ✓ Download Sentinel-2 images
- ✓ Apply masks based on damaged polygons and healthy spruce polygons collected via the app

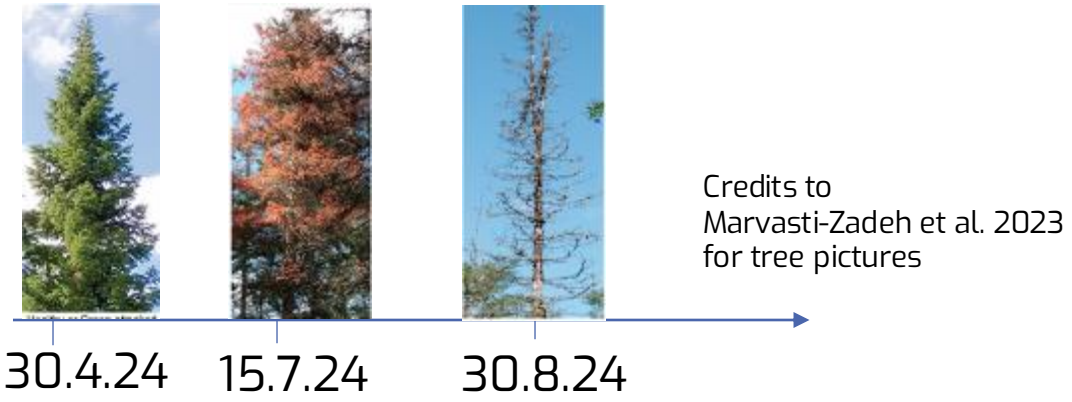
3. Model training

- ✓ Create a training dataset (80% of all polygons) for AI model (Random Forest) development, and a testing dataset (20%) for model evaluation

1. Field Data Collection

- ✓ Both damaged polygons and healthy polygons must be collected with accurate foresters' field work in accordance with the real distribution of the two classes in the monitored forest
- ✓ Polygons must accurately delimit damaged or healthy forest patches
- ✓ Polygons must be timestamped with the acquisition time and stage value
- ✓ Damaged polygons must be annotated with the outbreak timeline (time-line to describe the evolution green phase - red phase - grey phase)

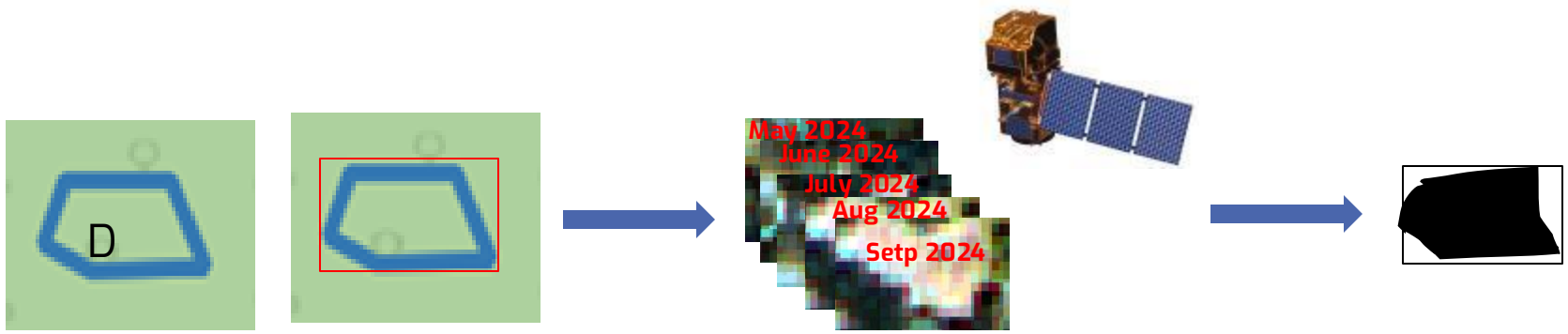




Credits to
Marvasti-Zadeh et al. 2023
for tree pictures

2. Retrieving of Satellite images

- ✓ AI developers use field data provided by foresters to create a dataset for AI model development
- ✓ Given a healthy or damaged polygon annotated by foresters:
  - ✓ Draw the limits of the polygon
  - ✓ Download the Sentinel-2 images of the box in the time horizon identified with the timeline annotation
  - ✓ Create the ground truth mask according to the polygon annotation and label each Sentinel-2 image with the mask



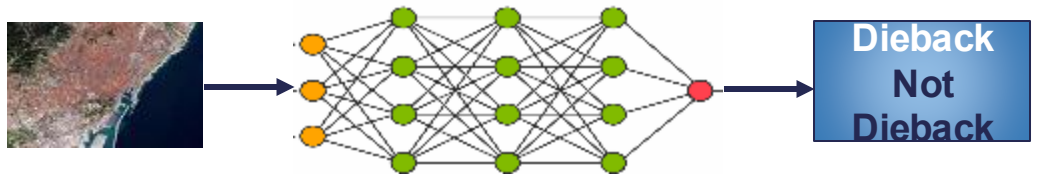
3. Model training

AI approaches:

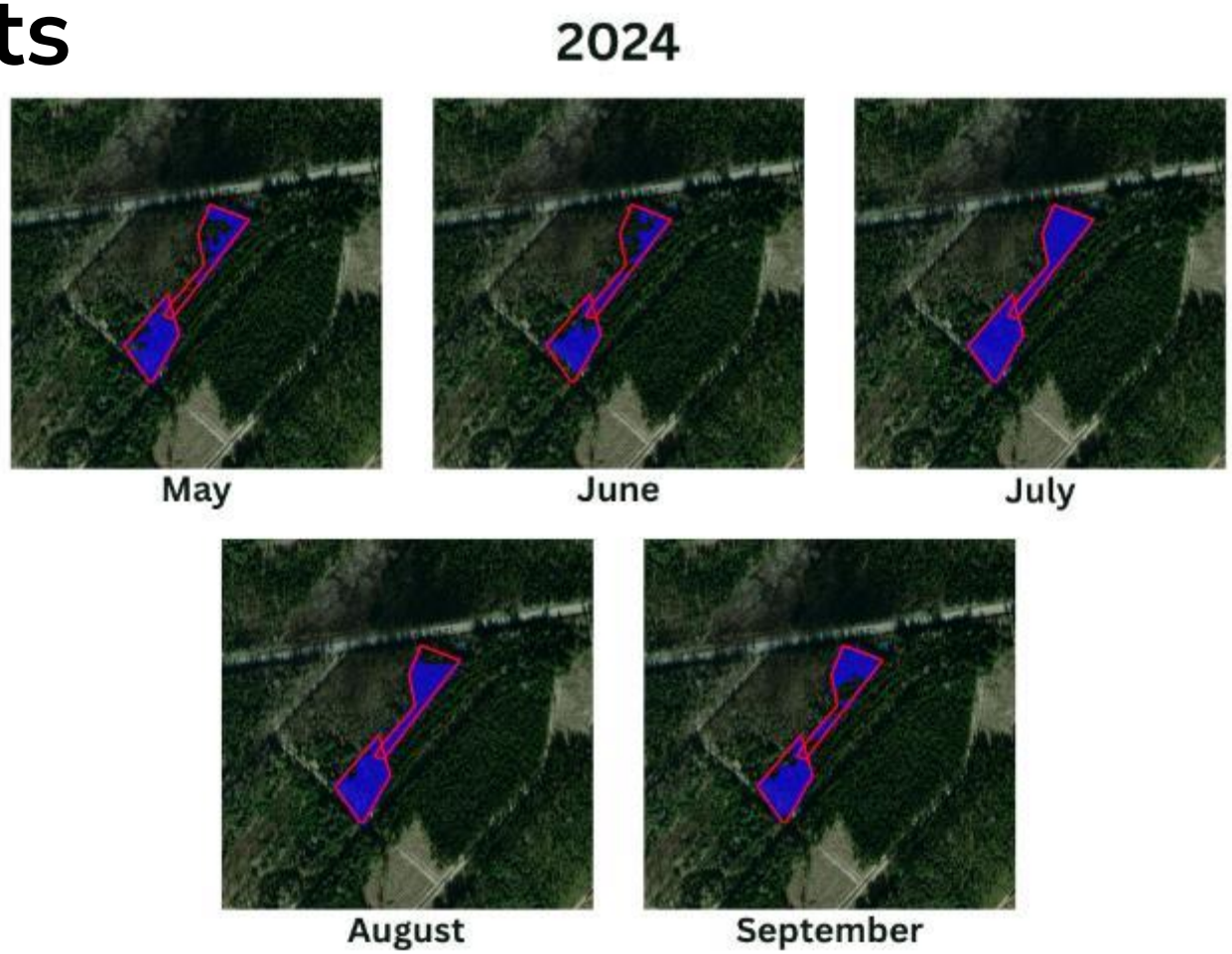
- ✓ Unsupervised learning
  - ✓ no need of labels to fuel supervision, but labels are required for evaluation
- ✓ Supervised learning
  - ✓ Labels required to perform supervision and perform evaluation
  - ✓ More accurate predictions ⟵

Machine Learning versus Deep Learning:

- ✓ ML approaches have been proven to achieve good performance in the bark beetle detection but they require manually selecting features ⟵
- ✓ Instead, DL approaches automatically discover hidden data structures and learn relevant features from raw data without separate data engineering



Example SWIFTT results



- ✓ In red: actual damage
- ✓ In blue: model prediction

Conclusion

Forest risk monitoring poses challenges…

- ✓ Usually separate services for fire, bark beetle, and storm damages
- ✓ Field inspections require foresters on-site
- ✓ Mapping and reporting take weeks or months
- ✓ High operational costs and delayed response

…that the SWIFTT AI-driven platform helps solve…

- ✓ Automated analysis of satellite data
- ✓ Near-real-time alerts and maps
- ✓ Scalable coverage

…benefitting foresters time- and money-wise

- ✓ Faster decisions
- ✓ Lower costs
- ✓ Proactive forest protection
- ✓ Data-driven policy and management

Research results on SWIFTT:

Github

SWIFTT

Satellites for Wilderness Inspection and Forest Threat Tracking

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