UAV Technology Revolutionizing Forest Management in the Eastern Alps

The Forest management is crucial for maintaining sustainable ecosystems, particularly in fragmented forest areas like the Friuli Venezia Giulia region in Italy. The project GO-PRI.FOR.MAN is harnessing Unmanned Aerial Vehicles (UAVs) to accurately map and monitor forest growing stock volumes. This innovative approach is set to transform forest management practices in the region, improving sustainability and fostering better collaboration among forest owners.

The Challenge of Forest Fragmentation

In Europe, forest fragmentation poses a significant threat to effective management, especially since around 60% of forests are privately owned in small parcels averaging 12.7 hectares. This fragmentation is particularly pronounced in Eastern and Southeastern Europe, where parcels can be as small as 1 hectare. Fragmentation complicates management and contributes to land abandonment, leading to increased risks of wildfires, flooding, and decreased carbon sequestration.

A Collaborative Approach

The Shared Private Forest Management in Eastern Alps (Pri.For.Man.) project is tackling these challenges by creating a cooperative model for forest management. By integrating private forest owners, service companies, and foresters, the project aims to enhance forest ecosystem services, boost rural economies, and support the bioeconomy. UAVs are a critical tool in this process, providing precise data on forest conditions to inform management decisions.

UAV Data Acquisition

To capture high-quality data, WingtraOne Gen II UAVs equipped with SONY DSC-RX1RM2 RGB cameras and PPK modules were used to survey a 450-hectare area. The flights were conducted during the leaf-on season, ensuring full canopy cover for accurate mapping.

Key flight parameters included:

- Flight altitude: 120 meters
- Longitudinal overlap: 70%
- Lateral overlap: 84%
- Flight duration: 26 minutes per flight (3 flights total).

Figure 1 - Example of automatic flight performed in one of the areas

Photogrammetric Data Processing

Once captured, the UAV data was processed using Agisoft Metashape software, generating several important outputs:

- Dense Point Cloud: With a density of 28.1 points/m²
- Digital Surface Model (DSM): With a resolution of 18.9 cm/pixel
- RGB Orthomosaic: Resolution of 1.68 cm/pixel.

These outputs provide detailed insights into forest structure, aiding the mapping of forest variables such as canopy height and growing stock volume.

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Figure 2 – Details of 3D photogrammetric point cloud

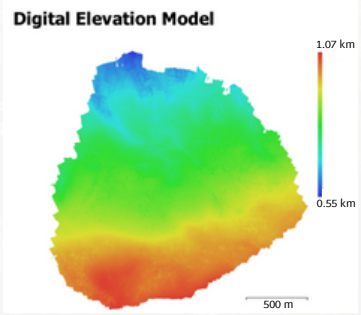

Figure 3 – Reconstructed digital elevation model

Figure 4 – Digital surface model

Forest Inventory and Modeling

On the ground, 15 circular forest inventory plots were measured across the area, each with a radius of 13 meters. Using a systematic sampling design, tree data were collected and integrated with UAV data to calculate growing stock volume (m^3/ha). This hybrid approach, combining LiDAR-derived Digital Terrain Models (DTMs) with UAV photogrammetry, resulted in a Canopy Height Model (CHM), providing even greater accuracy for forest management.

Figure 5 – Location of Field Points

Predictive Modeling of Forest Variables

By extracting predictive variables from the CHM, a multivariate linear regression model was developed to estimate forest growing stock volume across the entire area. The final product, a comprehensive map of growing stock volume, offers a valuable tool for sustainable forest management.

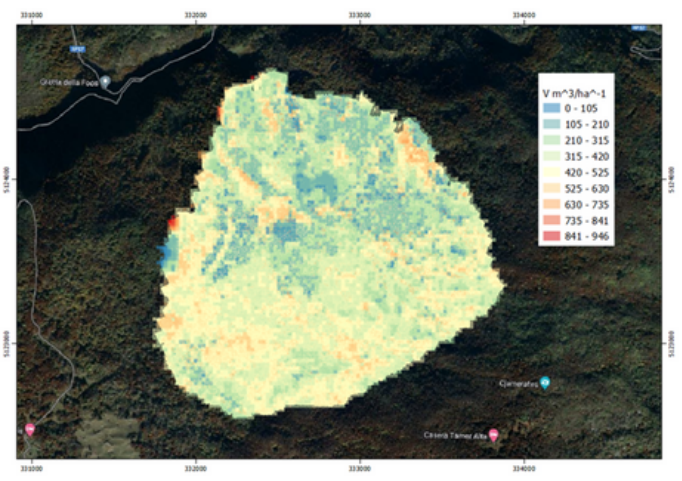

Figure 6 - Map of Growing Stock Volume

To conclude, the GO-PRI.FOR.MAN project exemplifies the potential of UAV technology in revolutionizing forest management. By addressing the challenges of forest fragmentation and promoting shared management strategies, this project is paving the way for more sustainable forest ecosystems in the Eastern Alps.

This UAV-based approach offers an exciting model for other regions facing similar challenges, demonstrating the power of technology to enhance sustainable land management and contribute to broader environmental goals.
This newsletter article provides an overview of how UAVs are reshaping forest management in the Friuli Venezia Giulia region, delivering data-driven solutions for sustainability.

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FOREST4EU project links:

Website: https://www.forest4eu.eu/
YouTube channel: https://youtube.com/@forest4euproject?si=DtN18eJus0JZ3C3H
LinkedIn: https://www.linkedin.com/company/93598372/dashboard/

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