Open, Scalable, and Community-Driven Forest Intelligence with deadtrees.earth and 3Dtrees.earth

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Forests across Europe and globally are experiencing accelerated structural change due to drought, pests, storms, and long-term climatic stress. Despite the rapid growth of remote sensing technologies, the operational use of these data for forest monitoring remains hampered by fragmented workflows, computational barriers, and a lack of standardized, FAIR-accessible data infrastructures. This contribution presents two complementary platforms—**deadtress.earth** and **3Dtrees.earth**—that address these challenges by providing open, scalable, and AI-enabled forest information services designed for researchers, practitioners, and public agencies.

Both platforms address the central challenge of making **advanced forest remote sensing and AI-based analytics accessible, reproducible, and operational at scale**.
Deadtress.earth (https://deadtrees.earth/) focuses on **spatiotemporal monitoring of forest cover and tree mortality**, leveraging community-sourced drone data, open satellite time series, and advanced computer vision methods.
3Dtrees.earth (https://3dtrees.earth/) addresses the equally pressing challenge of **analyzing and harmonizing 3D point clouds** from terrestrial, drone-based, and airborne LiDAR—data that are essential for understanding forest structure, biomass, single-tree characteristics, and diversity, yet remain difficult to process at scale. Both platforms further tackle systemic barriers: lack of computational resources, fragmented RDM practices, insufficient long-term storage, and limited availability of state-of-the-art AI tools for non-experts.

The work directly impacts—and is co-developed with—a broad set of stakeholders:

- **Forest managers and practitioners**, who need operational indicators of deadwood, forest cover, biomass, and structural change.
- **Scientists** in forestry, biodiversity, climate, and remote sensing who rely on high-quality, standardized datasets for model development.
- **Public agencies and policy initiatives**, including those involved in climate adaptation, Natura 2000 reporting, emergency response, and forest risk assessment.
- **Citizen scientists and local institutions**, who contribute drone imagery to deadtrees.earth, expanding geographic coverage and democratizing data acquisition.
- **AI developers and data scientists**, who rely on well-curated, large-scale datasets such as 3Dtrees.earth for developing generalizable forest analytics models.

Practical Relevance

deadtress.earth acts as a community-based hub for drone imagery, providing multiple services to users:

- **Crowdsourcing and hosting drone data**, offering long-term archiving and FAIR access.
- **AI-based prediction of forest cover and tree mortality**, based on drone RGB imagery and upscalable to satellite observations.
- **Upscaling services using Sentinel-2**, producing spatially continuous deadwood and forest cover maps at continental scales.

- **Automated orthoimage generation** and **interactive visualization tools**, allowing users to explore their data and analytics results immediately.

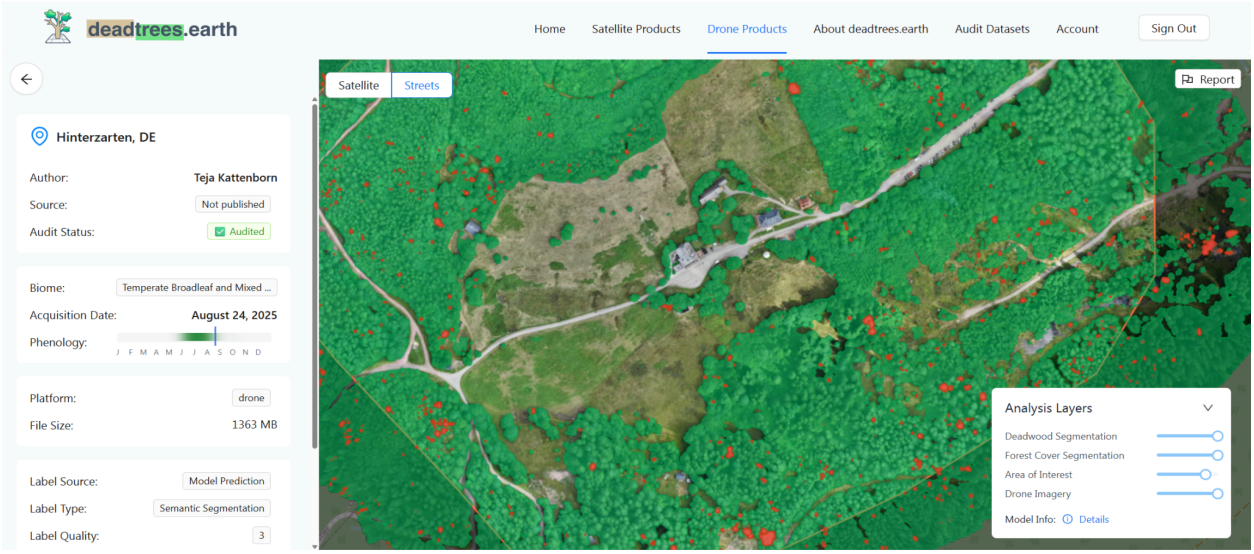

Fig. 1: Example orthoimage on deadtrees.earth. Each uploaded orthoimage can will be analyzed with AI tools for forest cover and standing deadwood cover. Each dataset can be inspected, archived and target to user feedback. See https://deadtrees.earth/dataset/6167 for an interactive visualization.

3Dtrees.earth provides cloud-based, high-performance analytics for 3D forest data:

- **Point cloud analysis for forest inventory**, species identification, single-tree detection, structural metrics, biomass estimation, and trait extraction.
- **Execution on Europe's largest HPC system (Galaxy Europe)**, enabling computationally intensive analyses at no cost to the user.
- **Scalable cloud workflows**, removing the need for in-house computational resources.
- **Harmonized, AI-ready LiDAR datasets** ensuring interoperability and reproducibility across projects and regions.

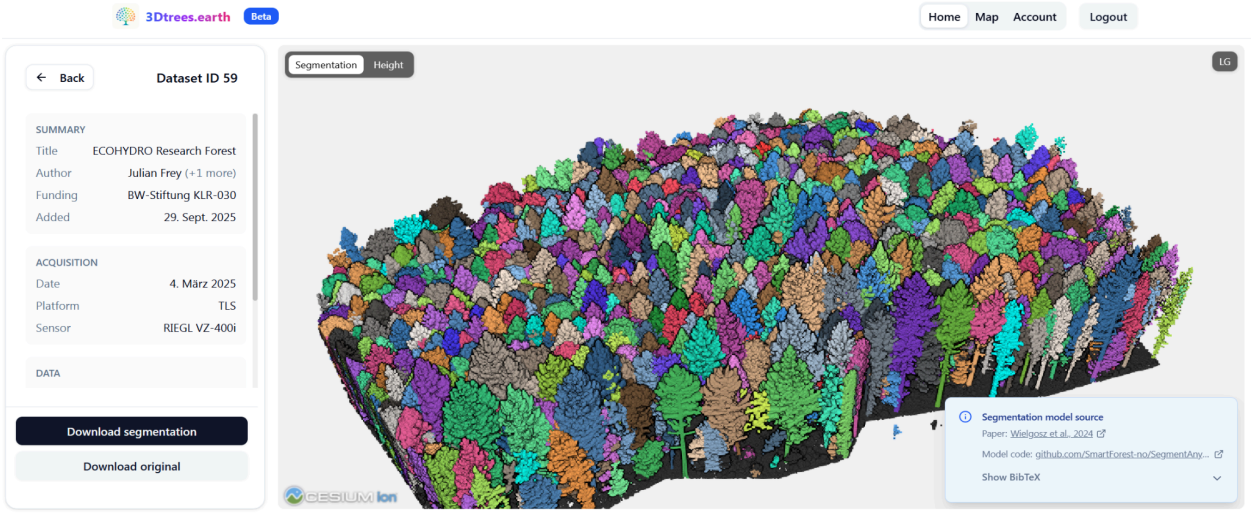

Fig. 2: Example point cloud on 3Dtrees.earth. Each uploaded point cloud can be analyzed with state of the art tools and visualized interactively. See https://3dtrees.earth/datasets/59 for an interactive visualization on any device.

Together, these platforms enable operational forest monitoring pipelines that combine ground-level detail with satellite-based generalizations—supporting practical decision-making and long-term forest resilience strategies. The approaches are fully workable and actively used in research and practice:

- deadtrees.earth is already used in operational forest health assessments, regional monitoring programs, and large-scale remote sensing studies.
- 3Dtrees.earth has successfully processed large national and international LiDAR datasets and supports HPC-scale analyses for segmentation, classification, and structural modeling.
- Both infrastructures rely on robust, containerized, and cloud-compatible workflows, ensuring scalability from local to continental applications.
- The platforms provide **state-of-the-art AI models directly to end-users**, removing barriers related to training data, pipeline complexity, or compute requirements.
- Integrated research data management ensures long-term accessibility, versioning, documentation, and FAIR compliance.

Conclusion

Both platforms are rapidly expanding through contributions from a large, interdisciplinary community spanning forestry, remote sensing, citizen science, and AI research. Their open and collaborative nature enables institutions, agencies, and research groups to join and shape their development. We explicitly invite new partners to contribute data, methods, or expertise and to participate in building a shared ecosystem for next-generation forest monitoring.

By combining community-sourced drone imagery, satellite-based upscaling, and large-scale 3D forest analytics, deadtrees.earth and 3Dtrees.earth provide an integrated, open, and scalable foundation for forest monitoring. They lower barriers to advanced AI and HPC tools, ensure FAIR data practices, and deliver actionable forest intelligence to practitioners, policymakers, and scientists. Both platforms exemplify a community-driven approach to SmartForest technologies and offer a pathway toward transparent, reproducible, and accessible forest monitoring at global scale.