Deep4Sat43

Optimising energy efficiency for AI-driven autonomy

With its geospatial data platform and artificial intelligence (AI) algorithms, the ITEA project Deep4Sat43 (Geo-AI Ecosystem for tree (43) health inspection and early warning) uses satellite and drone data to inspect the health of individual trees across vast areas.

Approximately 68% of EU farms utilise precision agriculture technologies, with satellite and drone adoption on the rise. This is partially due to EU policies like the Green Deal and Farm to Fork strategy that promote digital transformation and sustainable farming practices. However, it remains difficult to provide health maps of single trees or plants that show the spatial distribution and severity of any damage. To enable quick action and widespread uptake, solutions must be cost-effective, non-destructive, user friendly, machine-ready and applicable on a large scale.

Deep4Sat43 has presented such a solution by integrating AI-based algorithms into a platform that can inspect the type and health status of a single tree using satellite and drone data. This was developed by analysing the context and barriers in climatically diverse regions, through which the project could carry out use cases demonstrating the platform's detection of (1) unhealthy apple and grape trees, (2) unhealthy pine and palm trees and weeds in grasslands, and (3) hogweed and unhealthy orange trees. With this information, farmers and land operators will be better able to manage disease control over large areas, thereby increasing agricultural production, yield and quality while minimising financial losses.

Technology applied
As a Software-as-a-Service-based geospatial data platform, Deep4Sat43 provides infrastructure to collaboratively manage, visualise and distribute satellite or drone data and AI outputs.

< Deep4Sat43: AI-powered insights for healthier trees and sustainable farming

This includes automatic processing pipelines for mapping tree health to satellite and drone data, demonstrating high-precision detection of unhealthy trees and plants. The platform also supports integration with multiple application programming interfaces (APIs) and AI algorithms, enabling rapid deployment and future interoperability. At the same time, it demonstrates that satellite images collected many years ago were not a waste of money or resources; the technical progress made by the project gives existing data an added value that was previously absent due to the almost complete lack of available services for individual trees.

The platform also makes use of Ellipses Drive's foundation in raw and post-process data management to facilitate the activation, storage, exchange and visualisation of AI models' input data and results at scale by automating and standardising these steps. With

the data management layer, suppliers can pipe in their data in accordance with their standards of choice, while users are able to connect with analytics via their preferred tools, endpoints or protocols. Through all of these factors combined, Deep4Sat43 serves as a one-stop-shop for collaboration between AI companies active in plant inspection, as well as a single-entry point for AI-based plant diagnostics that automate map generation and accelerate disease diagnosis.

Making the difference
One of the major advantages of precision agriculture technology is greater efficiency that translates into lower input costs and higher yield. By extending this precision to the level of single trees over wide areas, Deep4Sat43 has demonstrated a significant boost in efficiency: the average processing time per square kilometre has been reduced from one to two weeks when performed by humans to less than 24 hours when performed by the platform. With the project's automated pipelines, users can therefore expect a 50% reduction in

manual survey costs. In the process, the detection accuracy rate of the algorithms has been increased from less than 50% to as high as 80% depending on the disease's complexity. Additionally, five algorithms have been shown to be fully generalisable to new cases not included in the original training datasets, thereby extending the scope of the project.

As the Deep4Sat43 platform is fully operational, commercial pilots are underway and promising results have already been achieved. Dutch partner Spectro-AG, for example, has been subcontracted by the Netherlands Food and Consumer Product Safety Authority (NVWA) for early summer inspection of pine trees using Deep4Sat43 and by Oman's Ministry of Agriculture to test algorithms for unhealthy palm detection. The former is worth EUR 60,000 per year from 2024 onward while the latter is worth EUR 120,000 annually from 2024 to 2026. In Denmark, meanwhile, Deep4Sat43's hogweed detection system is being tested with eight municipalities for an initial expected annual recurring revenue of EUR 78,000, rising to EUR 1.8 million after five years as more and more farmers are onboarded.

Future outlook

Looking ahead, Deep4Sat43's comprehensive market analysis and community engagements have laid a strong foundation for regional adoption. Almost all partners are now planning workshops before the next growing season to promote the results to their national authorities, aiming to drive client acquisition and expansion across Europe and beyond. With full uptake of its targeted interventions, the project expects to reduce pesticide and fertiliser use by up to 30% (promoting healthier ecosystems and soil conservation) while cutting water consumption by 10-15% in orchards and palm plantations to support sustainable resource management. Deep4Sat43 is therefore positioned to benefit society from the level of individual farmers right through to continental policymakers – all starting from a single tree.

Major project outcomes

Dissemination
> 2 publications: project results summary + contributions in workshop proceedings in Türkiye.
> 6+ presentations at conferences/fairs: GeoBuzz NL, TValley NL, Tekirdağ workshops TR, Eskişehir Technical University TR, Oman Ministry of Agriculture meeting, ITEA review presentations.

Exploitation (so far)
New products:
> Deep4Sat43 Geo-AI SaaS platform – cloud-based platform for tree health inspection at scale.

New services:
> AI tree health diagnostics – detection of unhealthy trees and weeds across multiple species. (5 validated AI algorithms detecting tree/plant health issues (apple, grape, pine, palm, orange, hogweed, bitter dock, weeds). Accuracy improved from <50% to ~80%.)
> Automated health mapping service – processing of satellite/drone data with <24h turnaround (used to be 1-2 weeks with manual surveys).
> Decision support for authorities – integration with government inspections (NVWA, Oman, Danish municipalities).

New systems:
> Automatic AI pipeline for geospatial data – end-to-end workflow for data ingestion, model application, and map generation.

Standardisation
> Developed an internal template for AI engines (data/model standardisation approach), paving the way for potential future contributions.

Deep4sat43
AI2021–098

Partners

Denmark
> Cellari

The Netherlands
> Ellipsis Drive
> Spectro-AG BV

Türkiye
> B TECH ANALYTICS TECHNOLOGY
> Bewell Teknoloji Sanayi Ticaret A.S.
> Sarıçiçek Tarım Ürünleri San. ve Tic. A.Ş

Project start - end
January 2022 - June 2025

Project leader
Hamed Mehdipoor,
Spectro-AG BV

Project email
h.mehdipoor@spectroag.com

Project website
https://itea4.org/project/deep4sat43.html

ITEA 4

∑ eureka