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Conference Abstract

GeoPl@ntNet: A High-Resolution Biodiversity Mapping Platform for Environmental Forensics

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Abstract

The increasing frequency of environmental crimes (Rippingille 2023), from illegal deforestation and habitat degradation to biopiracy, requires new digital tools for collecting, verifying, and communicating biodiversity evidence. GeoPl@ntNet addresses this need by transforming citizen-science and expert plant observations into auditable, high-resolution biodiversity intelligence suitable for research, conservation, and forensic applications.

Built upon the globally used Pl@ntNet infrastructure, which hosts more than 20 million users contributing georeferenced plant observations from 200 countries, GeoPl@ntNet Leblanc et al. (2025a) integrates this vast dataset with environmental predictors to generate predictive biodiversity maps at 50×50m spatial resolution. At its core, GeoPl@ntNet employs a multi-species deep learning model (DeepSDM Botella et al. 2018) and a Habitat Distribution Model based on a transformer model.

The DeepSDM is first trained on approximately 30 million Global Biodiversity Information Facility (GBIF) species occurrence records and 5 million European Vegetation Archive (EVA) surveys to infer species presence, habitat types, and biodiversity indicators across Europe. The model combines environmental variables, Sentinel-2 RGB and near-infrared

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imagery, elevation, land cover, and long-term climatic time series. Species distribution predictions are then computed over a European grid of 50×50 m cells within 25×25 km meta-tiles. The species distribution predictions are subsequently fed into a transformer-based model (Pl@ntBERT Leblanc et al. 2025b) to predict habitats under the EUNIS 2020 standard. Finally, derived biodiversity indicators, such as counts of protected, local, or invasive species, are aggregated into reproducible spatial layers that users can explore, download, or integrate via WMS or STAC services.

Beyond ecological research, GeoPl@ntNet demonstrates strong potential for environmental forensics. Investigators can detect non-native or invasive taxa near ports and industrial areas, monitor biodiversity decline before and after disturbance events, and generate standardized biodiversity reports that support legal or regulatory proceedings.

GeoPl@ntNet implements a provenance-based auditing system that tracks the full lifecycle of each biodiversity layer. Every map is linked to machine-readable metadata describing the source datasets, model versions, and environmental predictors used to generate it. These metadata are exposed through STAC and WMS services, enabling external verification, reproducibility of outputs, and legally traceable biodiversity reporting.

The platform's design: Nuxt and Leaflet for the frontend, Python backend with MapProxy and TiTiler services, also ensures transparency and reproducibility, enabling alignment with TDWG data standards including World Geographic Scheme for Recording Plant species Distributions (WGSRPD) and EUNIS habitat classifications. By coupling scalable AI models trained on both citizen-science and expert data with diverse maps and reports, GeoPl@ntNet connects biodiversity informatics with environmental governance, enabling auditable, site-level verification of biodiversity integrity.

Accessible via https://geo.plantnet.org, the platform will be extended to global coverage and integrated within Pl@ntNet to support scalable and legally robust biodiversity assessments worldwide.

Keywords

biodiversity informatics, species distribution modeling, citizen science, deep learning, habitat mapping

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Conflicts of interest

The authors have declared that no competing interests exist.

References

- Botella C, Joly A, Bonnet P, Monestiez P, Munoz F (2018) A Deep Learning Approach to Species Distribution Modelling. Multimedia Tools and Applications for Environmental & Biodiversity Informatics169-199. https://doi.org/10.1007/978-3-319-76445-0_10
- Leblanc C, Picek L, Deneu B, Bonnet P, Servajean M, Palard R, Joly A (2025a) Mapping Biodiversity at Very-High Resolution in Europe. 2025 IEEE/CVF Conference on Computer Vision and Pattern Recognition Workshops (CVPRW)2340-2349. https://doi.org/10.1109/cvprw67362.2025.00221
- Leblanc C, Bonnet P, Servajean M, Thuiller W, Chytrý M, Aćić S, Argagnon O, Biurrun I, Bonari G, Bruelheide H, Campos JA, Čarni A, Ćušterevska R, De Sanctis M, Dengler J, Dziuba T, Garbolino E, Jandt U, Jansen F, Lenoir J, Moeslund JE, Pérez-Haase A, Pielech R, Sibik J, Stančić Z, Uogintas D, Wohlgemuth T, Joly A (2025b) Learning the syntax of plant assemblages. Nature Plants 11 (10): 2026-2040. https://doi.org/10.1038/s41477-025-02105-7
- Rippingille B (2023) Editorial: Beyond all boundaries the meteoric rise of environmental crime. Journal of Financial Crime 30 (5): 1113-1116. https://doi.org/10.1108/jfc-10-2023-311