ARPHA Conference Abstracts 8: e152715
doi: 10.3897/aca.8.e152715

OPEN ACCESS

Conference Abstract

Biodiversity Digital Twin Project: Grassland biodiversity dynamics

Sarah Venier‡, Thomas Banitz§, Franziska Taubert§, Christoph Wohner‡

‡ Environment Agency Austria, Vienna, Austria
§ UFZ, Leipzig, Germany

Corresponding author: Sarah Venier (sarah.h.geiger@gmail.com), Thomas Banitz (thomas.banitz@ufz.de), Franziska Taubert (franziska.taubert@ufz.de), Christoph Wohner (christoph.wohner@umweltbundesamt.at)

Received: 11 Mar 2025 | Published: 28 May 2025

Citation: Venier S, Banitz T, Taubert F, Wohner C (2025) Biodiversity Digital Twin Project: Grassland biodiversity dynamics. ARPHA Conference Abstracts 8: e152715. https://doi.org/10.3897/aca.8.e152715

Abstract

European grassland management has traditionally prioritized high production through frequent mowing and heavy fertilization, often at the expense of biodiversity conservation, which thrives under less intensive management. With climate change and extreme weather increasingly affecting grassland productivity and biodiversity, adaptive management practises are essential.

This project describes the development of a prototype Digital Twin (pDT) for monitoring and projecting grassland biodiversity dynamics under different management and climate scenarios. Grasslands cover approximately 30% of Europe's agricultural land and are subject to diverse practizes such as grazing, mowing, fertilization, and irrigation. Intensive management often leads to biodiversity loss, whereas less frequent interventions can support a high richness of plant species and contribute to ecosystem resilience. However, climate change further challenges the balancing act between productivity and biodiversity.

In this pDT, we employ and further develop GRASSMIND, an individual-based, mechanistic ecological model, to simulate biodiversity dynamics in grasslands. GRASSMIND explicitly models processes such as plant establishment, growth, and mortality at individual levels, providing insights into emergent biodiversity patterns.

© Venier S et al. This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

The project developed a robust data processing pipeline to prepare input data, recalibrate the model, and minimize deviations between simulations and observations. High-performance computing resources, including the LUMI petascale supercomputer, were utilized to parallelize GRASSMIND simulations across hundreds of cores.

Data on plant species composition (plus additional data on site conditions and grassland dynamics if available) from different eLTER sites is used as input data and observational data for the GRASSMIND model.

The data is provided following the FAIR principles (Findable, Accessible, Interoperable, Reusable) as defined by the project requirements. The data provision workflow builds on the eLTER IT infrastructure and complies with eLTER data best practices.

This research highlights the potential of integrating ecological modeling, advanced computing, and open data standards to address critical questions in biodiversity and ecosystem management.

Keywords

digital twin, vegetation, vegetation composition, biodiversity, data modeling

Presenting author

Sarah Venier

Presented at

POSTER

Funding program

HORIZON Research and Innovation Actions

Grant title

HORIZON-INFRA-2021-TECH-01

Conflicts of interest

The authors have declared that no competing interests exist.