

Environmental Modelling and Forecasting Workshop Report

The Alan Turing Institute – Wednesday 14th January 2026



Executive Summary

The application of AI forecasting models holds significant potential for addressing key environmental challenges. On 14 January 2026, the SPHERE-PPL Team brought together more than 40 leading environmental stakeholders at The Alan Turing Institute in London for a day of presentations and discussions focused on advancing the use of AI forecasting in environmental science. Participants represented a broad range of sectors—including academia, industry, NGOs, and the public sector—with attendees from DEFRA, Natural England, Kew Gardens, and the Environment Agency, among others. The event included three insightful keynote presentations: Julie Smith (ADAS) introduced DEFRA's Crop Pest and Disease Survey data; Dr. Robin Freeman (ZSL) discussed trends in the Living Planet Index (LPI) metric; and Dr. Eric Daub (The Alan Turing Institute) presented the Met Office's FastNet forecasting project. Contest winners from the previous year's Lyme Disease forecasting contest were also announced. In addition, three brainstorming workshops were conducted. The first identified key environmental challenges that could benefit from the application of AI forecasting models. The second further developed a selection of challenges to design a series of potential forecasting contests, including modelling species abundance trends, estimating biodiversity net gain (BNG) uplift potential across the UK and Europe, and forecasting crop pests and water quality. The final session identified targeted opportunities for training and capacity development to better support participants. A strong interest in collaboration emerged throughout the event—particularly in data sharing and forecasting contest design—with the ultimate goal of operationally integrating model outputs and accelerating progress in environmental forecasting.

Table of Contents

Executive Summary	2
Introduction	4
Key Highlights and Insights:	5
Activity 1 – Key Environmental Challenges.....	5
Activity 2 – Forecast Challenge Design.....	7
Activity 3 – Training Support and Events.....	9
Lyme Disease Contest Prize Winners.....	10
Next Steps	11
Attending Organisations.....	11

Introduction

AI forecasting models hold immense potential to address pressing environmental challenges. Combined with newly available datasets with high spatial and temporal resolution, these methods are becoming increasingly powerful tools for generating accurate predictions of complex environmental systems. SPHERE-PPL aims to capitalize on this opportunity by connecting stakeholders with advanced analytical capabilities through workshops and forecasting contests. The overarching goal is to enhance predictive accuracy and promote the use of forecasting and modelling to support data-driven decision-making across environmental fields.

The core themes explored in this initiative include:

- Environmental Monitoring & Biodiversity
- Agriculture, Pests & Pathogens
- Pollution, Water & Environmental Health



Key Highlights and Insights:

Activity 1 – Key Environmental Challenges

The first workshop invited teams to identify challenges within their respective fields that could benefit from the application of AI forecasting models. The key outputs from this session are summarised below.

Environmental Monitoring & Biodiversity

- Can we forecast whether the UK will meet 2030 biodiversity and environmental targets?
- Can we accurately forecast the abundance of key species?
- How can we forecast tree recruitment and sapling survival under changing climate and soil conditions?
- How can AI be leveraged to hindcast or fill spatial and temporal gaps in environmental monitoring data (e.g., soil chemistry, water quality)?
- Can we predict biodiversity uplift from land rewilding or BNG (Biodiversity Net Gain) interventions, and identify where gains will be greatest?
- How can we forecast the future supply and demand for Biodiversity Net Gain (BNG) units?
- Can we identify “ecological mirror sites”—areas with similar ecological or habitat characteristics to potential offset sites—using spatial clustering or embedding models?
- Can we accurately forecast above-ground biomass and carbon storage potential to identify where the greatest carbon gains can be achieved?
- How can we forecast land-use change (e.g., solar installations, agricultural transitions) and its trade-offs with biodiversity and ecosystem services?
- How transferable are models developed in the UK to other regions or sectors, and what data is needed for generalisable forecasting?

Agriculture, Pests & Pathogens

- Can we more accurately forecast agricultural pest and disease outbreaks in UK crops under changing climate and management conditions?

- How can we forecast pest and disease burdens in UK crops under reduced pesticide use and changing climate?
- What factors drive outbreaks and spread of crop pests and pathogens (e.g., yellow rust, cabbage flea beetle, Septoria, wheat dwarf virus)?
- Can we build mechanistic or ensemble models to predict pathogen dynamics under land-use change?
- Can we predict when and where migratory birds carrying pathogens will arrive?
- How do shifts in avian migration timing, routes, and stopover locations affect disease transmission potential?

Pollution, Water & Environmental Health

- How can we forecast freshwater and soil pollution (e.g., nitrates, phosphates, PFAS) and their combined impacts on biodiversity and human health?
- How do land-use changes, agricultural practices, and extreme weather events influence nutrient loading and water chemistry across catchments?
- Can we use new and emerging water quality datasets (e.g., WIMS, remote sensing, citizen science) to build high-resolution, spatially explicit pollution forecasts?
- Can we predict short-term (e.g., daily) variation in nutrient and pollutant concentrations to better anticipate ecological thresholds and regulatory exceedances?
- How can we link forecasted water quality to ecosystem responses — such as impacts on fish, invertebrates, and other aquatic biodiversity?
- What are the long-term health and wellbeing consequences of green space loss or degradation under urban expansion and water quality decline?

Hazards, Climate Impacts & Human Systems

- Where should we target nature-based interventions (e.g., beaver reintroduction, wetland restoration, floodplain reconnection) to most effectively mitigate flooding?
- How can we forecast the societal impacts of environmental hazards—such as floods, droughts, or extreme heat—on health, poverty, and migration?
- How can we model and quantify risk from rare or “long-tail” environmental events (e.g., solar flares, meteor impacts) given sparse data?

Activity 2 – Forecast Challenge Design

During the second workshop, teams refined several of the challenges proposed in the first session into forecasting contest concepts, discussing potential datasets, methodological approaches, and output formats. Six of these proposals are summarised below.

1. Species Abundance Trends

How accurately can we spatially and temporally predict the abundance of key species?

Response data include sources such as the Living Planet Index (ZSL), BTO surveys, NBN Atlas, GBIF, and DEFRA indicators. Predictor variables span land cover and land-use intensity (UKCEH, CORINE), climate (CHELSA, Met Office), habitat and soil variables, and anthropogenic pressures such as pesticide use and roads. Additional data from fisheries and algal bloom monitoring may be integrated for aquatic species. Outputs will include forecasted abundance or index values at multi-year horizons, presented as high-resolution spatial rasters and regional summaries.

2. Biodiversity Net Gain (BNG) Uplift Potential

How accurately can we predict sites with the highest biodiversity net gain (BNG) or rewilding uplift potential?

Key datasets include the Biodiversity Gain Register, BNG Map, Knepp and CEH biodiversity data, and remote sensing or LiDAR-derived habitat change datasets. Predictors also cover management history, agricultural data (ADAS, Muddy Boots), and different rewilding interventions. The model outputs will quantify BNG potential scores or forecasted biodiversity uplift as spatial rasters and tabular summaries.

3. Disease Vectors

How accurately can we model migratory bird movements and associated disease vector risks (e.g., West Nile Virus) under changing climate conditions?

Response data will include virus incidence from ECDC, CDC, and UKHSA, while predictors combine avian migration data (eBird, BTO, Movebank), environmental variables (temperature, precipitation, humidity from ERA5 and CHELSA), and vector distributions (*Culex* spp.). Outputs will consist of spatiotemporal forecasts of migratory bird distributions and vector suitability, overlay maps of virus risk, and early-warning indicators for disease outbreaks to inform public health surveillance.

4. Crop Pests

Can we more accurately forecast agricultural pest and disease outbreaks in UK crops under changing climate and management conditions?

Response data will come from ADAS pest monitoring datasets, while predictors include weather and climate data (Met Office, ERA5), soil and crop information, land cover maps (Sentinel-2, UKCEH), and pesticide or IPM management data. Outputs will predict pest abundance or outbreak probability for specific crops and regions, producing forecasts across weekly, seasonal, and annual timescales. Results will be visualized as pest pressure maps, outbreak likelihood surfaces, and summary dashboards showing risk categories, expected losses, and uncertainties to support farmers and policymakers.

5. Water Quality

Can we accurately forecast water quality across space and time, and identify how land use, agriculture, and climate drive changes in freshwater systems?

Response data include WIMS and PRTR water quality records, while predictors encompass land cover (UKCEH, Sentinel), agricultural emissions and runoff data (DEFRA, ADAS), soil, hydrology, topography, and climate datasets. Remote sensing indices like NDVI and vegetation cover further support prediction. Outputs include forecasted pollutant concentrations and water quality indices, along with spatial maps of hotspots and scenario-based projections under different land-use and climate futures. These outputs will inform catchment management and mitigation strategies.

6. Carbon Biomass

Can we accurately forecast above-ground biomass and carbon storage potential to identify where the greatest carbon gains can be achieved?

Response datasets include the Forest Research and Sylvera Biomass Atlas, LiDAR-derived biomass estimates, and forest inventory data (NFI, Forestry Commission). Predictors include remote sensing indices (NDVI, EVI, canopy height), climate variables (CHELSA, ERA5), soil and geology datasets, and management or restoration data. Outputs will quantify biomass (t/ha), carbon stocks (tCO₂e/ha), and forecasted carbon accumulation at multi-year horizons. Products include spatial maps, carbon uplift potential indices and scenario analyses (e.g., reforestation, land-use change).

Activity 3 – Training Support and Events

The third and final workshop focused on identifying how SPHERE-PPL can best support the community through training, events, and other opportunities. The suggestions have been grouped by approximate time horizons below.

Timeline	Opportunities
Short term (<6 months)	<ul style="list-style-type: none"> • Run regular networking events to connect the community • Set up a mailing list for updates and announcements • Host workshops to clean and standardise patchy datasets • Skill- or knowledge-sharing sessions among community members
Medium term (6-12 months)	<ul style="list-style-type: none"> • Workshops on best practices for data curation and management • Develop resources on combining environmental datasets effectively • Training sessions in using TREs (Tools for Reproducible Environments) • Training in applying foundation models (e.g., TESSERA)
Long term (12 months +)	<ul style="list-style-type: none"> • Build a Docker image containing generic, standard biodiversity datasets for easy access • Launch an internship matchmaking service linking MSc students with external organisations

Lyme Disease Contest Prize Winners

During the afternoon, we also had the pleasure of congratulating the winners of last year's Lyme Disease Forecasting contest. Team 1 included Harrison Zhu (University of Copenhagen), Elizaveta Semenova (Imperial College London), and Samir Bhatt (University of Copenhagen), while Team 2 comprised Huw James and Gordon Yong (both from AtkinsRéalis).



Next Steps

SPHERE-PPL will host at least three environment-focused forecasting challenges in 2026, based on the concepts outlined above. We plan to hold a series of online sessions in early March to introduce the contests and guide participants on how to take part. The contests will then run in three-month blocks starting from mid-March, continuing through to the end of the year.

If there are any questions, please don't hesitate to email us at info@sphere-ppl.org.

Attending Organisations

- ADAS
- Animal and Plant Health Agency
- Centre for Disaster Protection
- DEFRA (Department for Environment, Food and Rural Affairs)
- Durham University
- Environment Agency
- Imperial College London
- Keele University
- NBN (National Biodiversity Network)
- Natcap
- Natural England
- Nattergal Ltd.
- NHS (BNSSG Integrated Care Board)
- Rothamsted Research
- Royal Botanic Gardens, Kew
- SPHERE-PPL
- The Alan Turing Institute
- The Biodiversity Consultancy
- UCL (University College London)
- UK Centre for Ecology & Hydrology
- UKHSA (UK Health Security Agency)
- University of Bristol
- University of Exeter
- University of Oxford
- University of Veterinary and Animal Sciences, Lahore (Pakistan)
- University of Warwick
- UWE Bristol (University of the West of England, Bristol)
- ZSL (Zoological Society of London)