National-Scale EBH Risk Mapping for Potato Late Blight in Ireland Using Interpolated Historical Meteorology and Ensemble Forecasts

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Effective Blight Hours (EBH) – What and Why

What's EBH?

Effective Blight Hours (EBH) quantify accumulated periods of weather favourable for *P. infestans* infection and development

Why is it useful?

- Links meteorological conditions to disease risk
- Widely used in operational late blight warning systems
- Supports fungicide timing and disease management decisions

Current limitations?

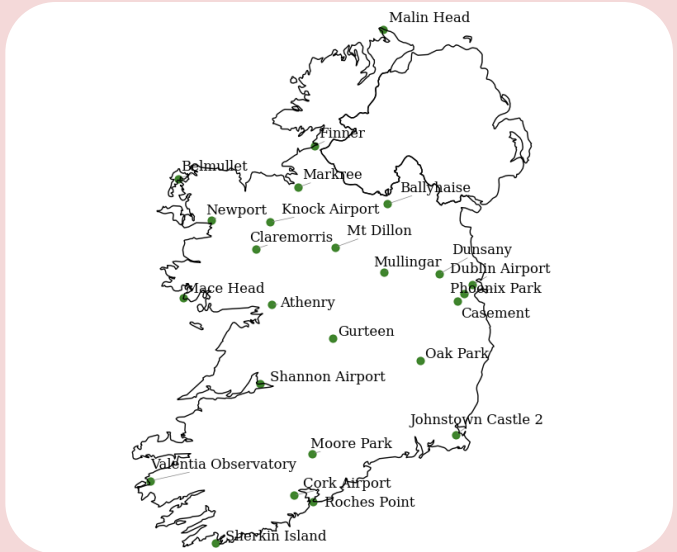
- Sparse station coverage
- Deterministic forecasts
- Often reset to zero

This motivated the development of a national-scale, continuity-preserving probabilistic EBH framework

Met Data & System Framework

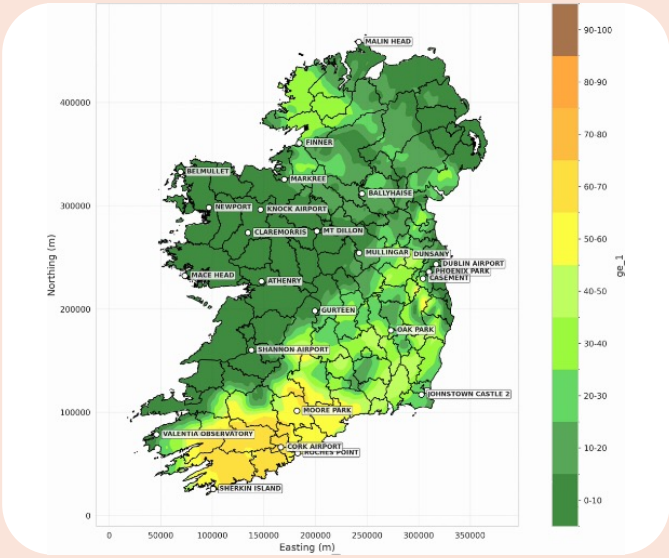
Historical observations

- 25 Met Éireann stations
- Hourly T, RH, and rainfall
- From 1990 to 2024



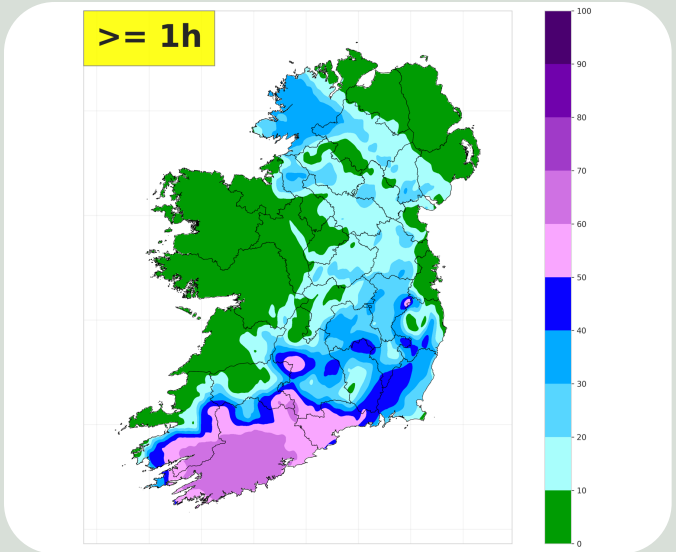
Spatial reconstruction

- Missing value interpolation
- ~5 km national grid system
- EBH initialisation spatially



Forecast integration

- ECMWF ensemble
- Probabilistic exceedance
- Operational outputs



Long-Term Spatial & Seasonal EBH Patterns

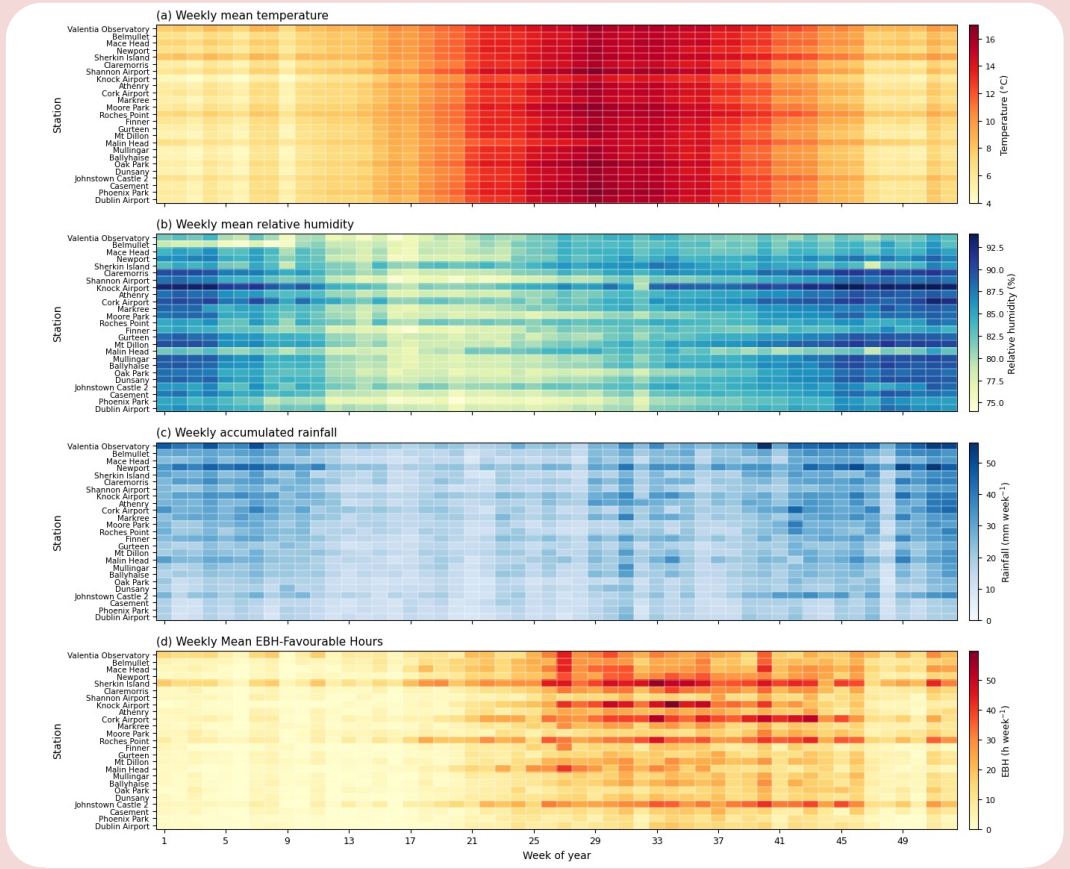
Weekly Met Data V.S. EBH

Temperature

Humidity

Rainfall

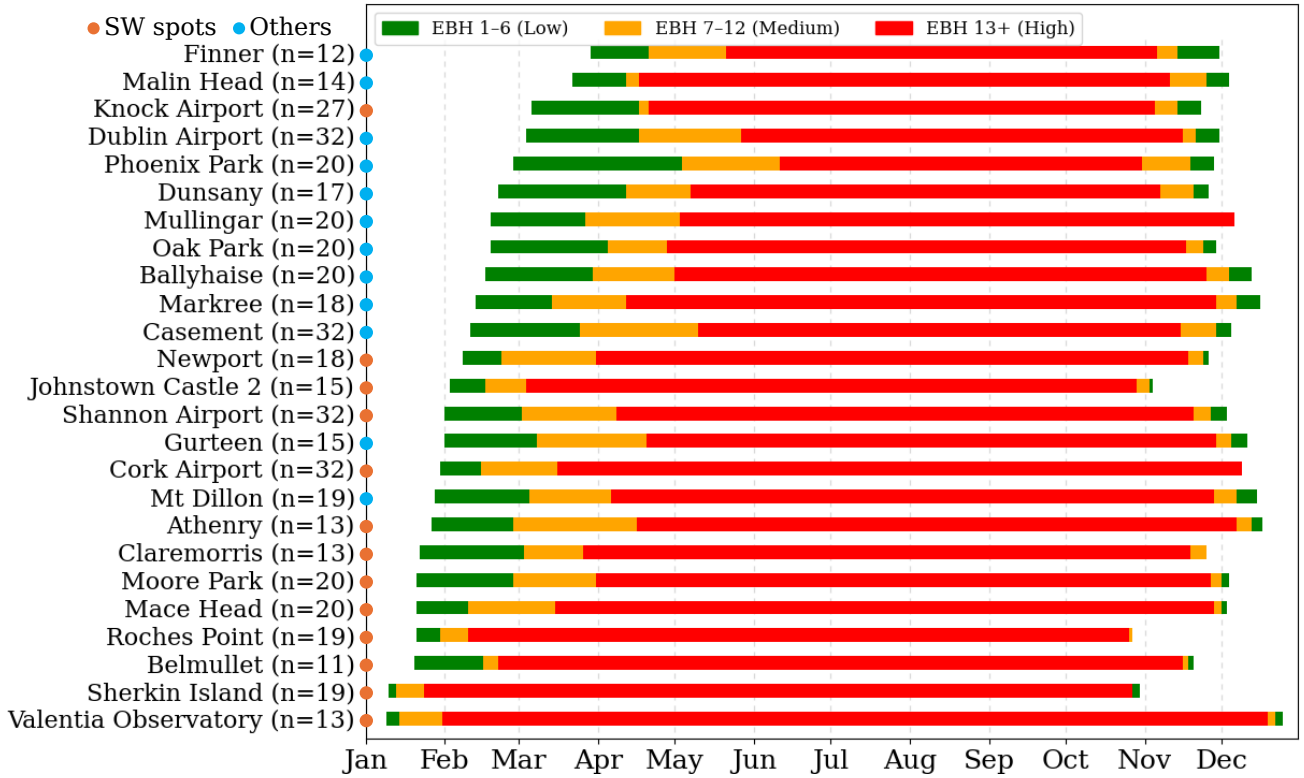
EBH



Ireland Spatial Map

Long-Term Spatial & Seasonal EBH Patterns

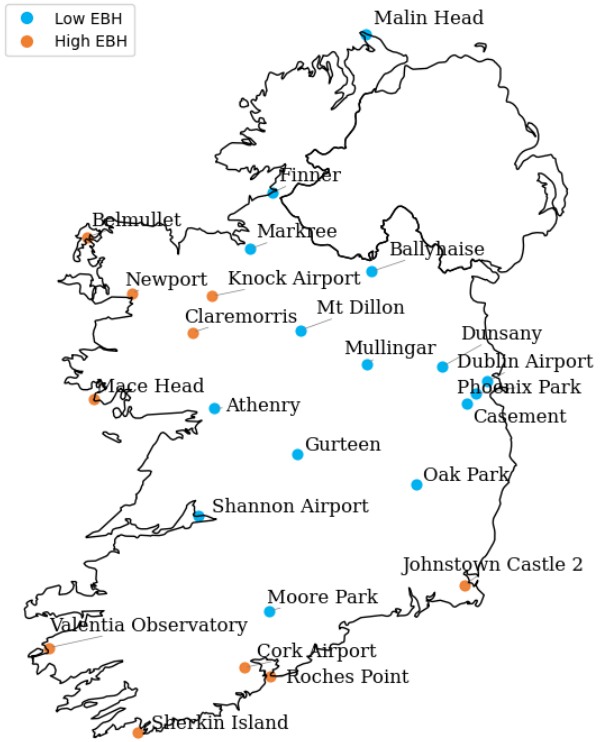
EBH Accumulation



Ireland Spatial Map

National Interpolation Framework

Ireland Spatial Map



Interpolation Framework

Station Observations

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Spatial Interpolation

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Continuous Met Fields

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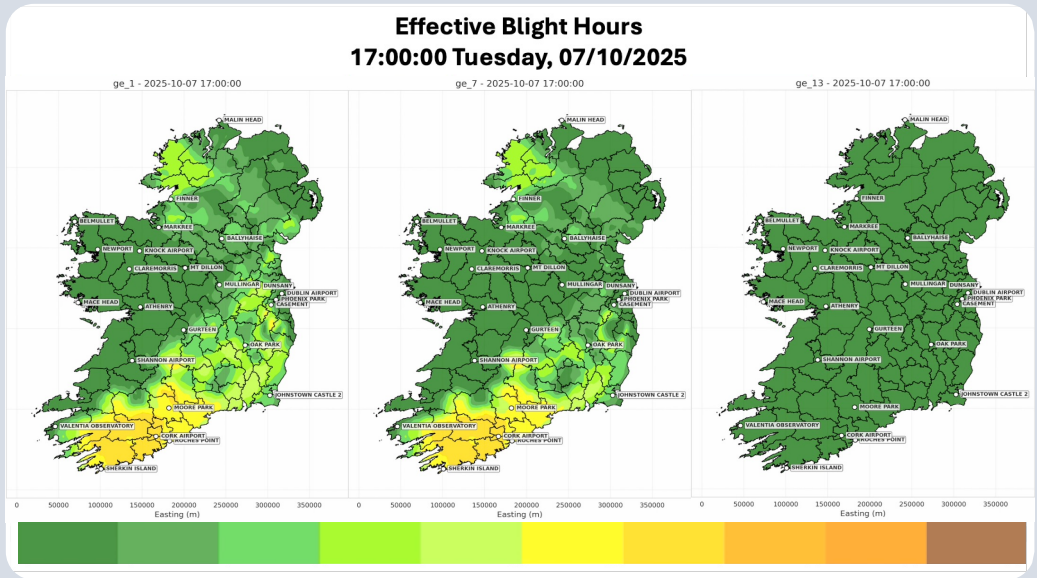
Grid-Based EBH Calculation

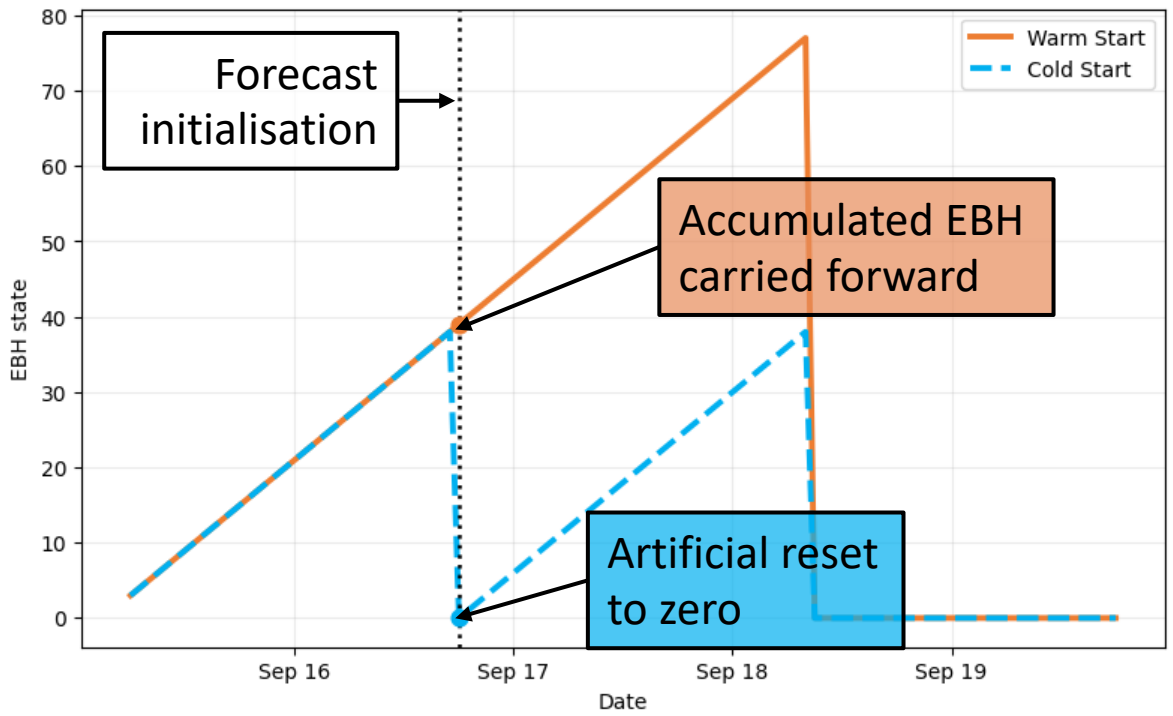
Interpolation Methods & Output

- **Temperature:** ordinary kriging (exponential)
- **Humidity:** ordinary kriging (exponential)
- **Rainfall:** inverse distance weighting



Warm-Start EBH Initialisation

EBH Initialisation Strategies



Cold-start limitation

Cold-start workflows reset EBH to zero at forecast initialisation.

Why problematic?

This introduces an artificial discontinuity in accumulated disease-favourable conditions.

Warm-start framework

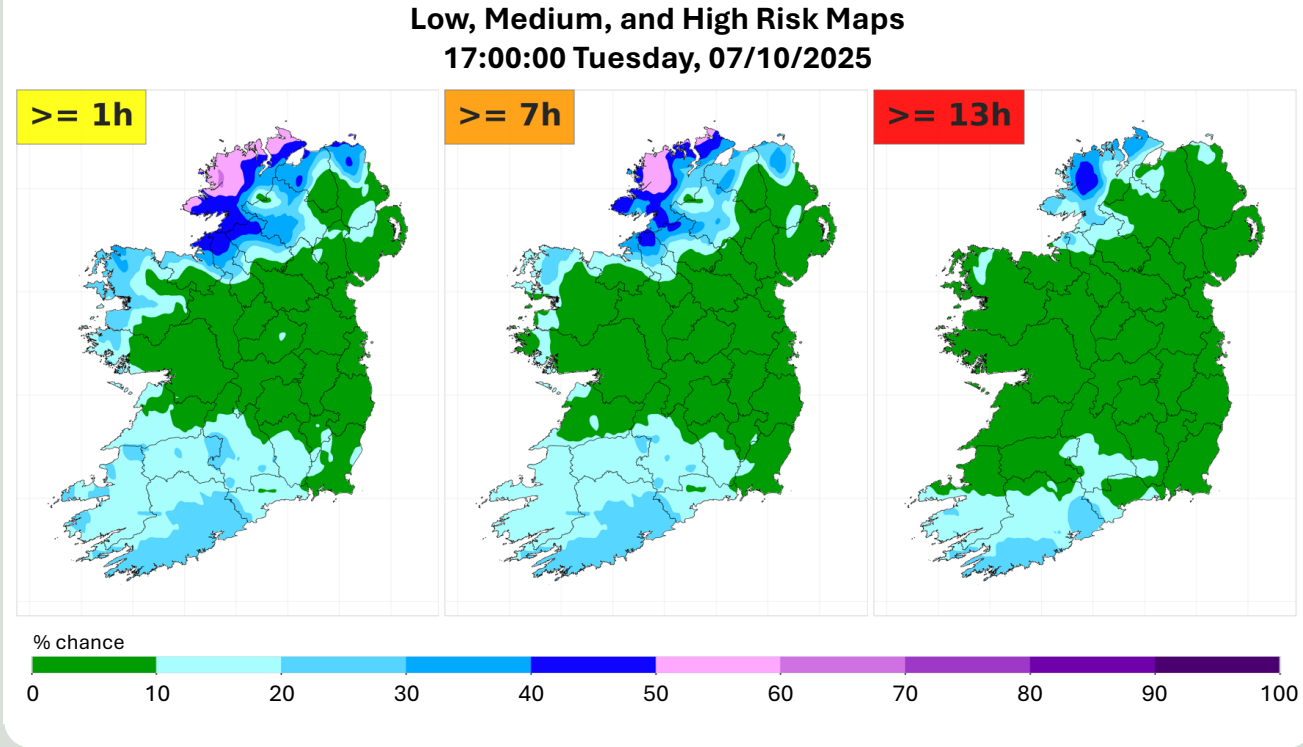
Warm-start initialisation carries the latest EBH state into the forecast period.

Probabilistic ECMWF Forecasting

51-member ECMWF ensemble forecasts

Ensemble-driven EBH calculation

Probabilistic EBH Risk Mapping



Conclusions & Future Work

Conclusions:

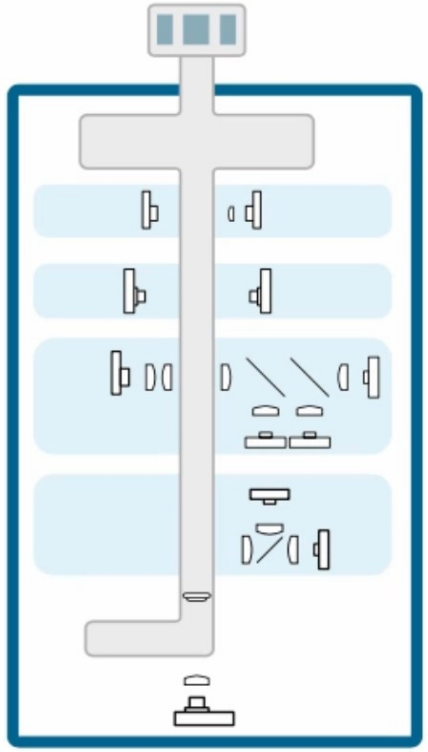
- Long-term EBH with clear **spatial** and **seasonal** patterns
- Best-performing **interpolation** methods for different met inputs
- **Warm-start initialisation** preserves accumulated disease risk
- ECMWF ensembles for **probabilistic** EBH risk mapping

Future Work:

- Integrate **Swisens Poleno** bioaerosol classification
- **Landcover** and in-field **microclimate** observations
- **Biologically informed**, **field-relevant** decision support

Swisens Poleno Jupiter – Intro & Integration

Particle Measurement Workflow



Multimodal particle information

Extracting optical, geometrical, and fluorescence features for particle characterisation.

Real-time bioaerosol measurements

Enabling continuous airborne particle monitoring and classification.

Relevance to EBH Assessment

Linked to microclimate observations and pathogen detection to improve EBH risk modelling.

THANK YOU

Any Questions?

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