Modeling the Spatio-Temporal Dynamics of Late Blight: Optimization, Validation, and Applications

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Potato late blight caused the Irish Potato Famine and still causes billions of dollars of annual crop damage. Tracking and predicting its spread remains problematic. Growers overspray potato fields with fungicide. Based on the model created last year to track the probabilistic spread of late blight, a new methodology for validation was developed and implemented for testing the accuracy of the model. This novel method models dealing with presence-only data -- when it is known where the disease is, but not where it is not. The model was tested using this original contrapositive ‘proof’ by comparing predicted to actual weather patterns to examine its accuracy. The model’s implementation was improved by replacing the old algorithm to combine probabilities with a more accurate and efficient version. The new algorithm is proven to run in linear time, rather than a polynomial heuristic, meaning it will always run incredibly quickly regardless of scale. The model was then used to create dynamic risk maps showing the likelihood of future infections in the region. Such risk maps can help growers optimize late blight suppression and fungicide use. It can be used to follow the spread of specific strains of the disease and what were to happen if it were to mutate. This model could be used to power an online decision support system (DSS) to crowd-source infection data from farmers and help them collectively control blight more cheaply and effectively. With knowledge of risk, farmers can spray targeted fungicide and regionally stop the disease.

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