

Forecasting Beach Safety in Iowa's Recreational Lakes Using Machine Learning Models

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Nutrient pollution from farm fields and agricultural operations has contributed to harmful algal blooms (HABs) in Iowa's lakes. HABs have been on the rise recently and can produce toxins that are harmful to human health and threaten the recreational use of Iowa lakes. The Iowa Department of Natural Resources conducts weekly monitoring of microcystin (an algae toxin) for 39 beaches in the summer. Swim advisories are issued when microcystin exceeds 8 microgram/L. However, this monitoring program only reflects past beach safety conditions and the lag time between sampling and results could expose beachgoers to unhealthy waters. To overcome these limitations, this study attempted to develop machine learning models to forecast whether microcystin levels at Iowa beaches are safe using 15 years of monitoring, meteorological, and watershed data. While all four models built had over 95% accuracy when predicting beach safety, the Random Forest and Decision Tree with Gradient Boosting models performed the best by four statistical metrics. These two models can be used to forecast daily beach safety, including beaches not currently being monitored. These forecasting results can empower communities that want to know if their beach is safe and aid beach managers in making beach warning and closure decisions.