Artificial Neural Network Modeling of Harmful Algal Blooms in Lake Okeechobee

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Harmful algal blooms (HABs) have been recognized as an increasingly severe threat to many communities with far-ranging consequences for environmental conditions, economic prosperity, and human health and well-being; yet much is still unknown regarding the specific alignment of environmental drivers over varied spatial and temporal scales of blooms. My research aims to predict HABs occurrence in Lake Okeechobee, the second-largest freshwater lake in the contiguous US, using Artificial Neural Networks (ANN). Water quality monitoring data collected from 1990 to 2019 in Lake Okeechobee were downloaded from a public domain database (www.sfmwd.gov). Statistical analyses were performed to examine the relationship between chlorophyll-a concentration, which is considered the surrogate parameter of algal blooms, and various environmental variables. Dissolved inorganic nitrogen, dissolved inorganic phosphorus, and temperature were identified as the most relevant variables related to HABs occurrence. Two sets of monthly time series data consisting of these input variables and the output variable (chlorophyll-a concentration) were developed for training and testing of ANN. The platform of Keras was used to code the ANN model. The result showed the optimal ANN had 2 hidden layers, consisting of 16 and 8 nodes successively, with a learning rate of 0.005 and momentum of 0.8. This ANN structure is robust in quantifying the non-linear relationships between environmental variables and chlorophyll-a concentration (MAE= 4.7, RMSE=6.7 and R2=0.7). With this ability to predict, the ANN model can be used as a management tool to mitigate HAB's adverse socio-economic, environmental and health effects in Lake Okeechobee and surrounding coastal communities.

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