Research on Algae Bloom

Algal Bloom is a rapid increase in the population of microscopic algae in water. Algal blooms may occur in fresh water as well as marine environments. Algal bloom events involving toxic or other harmful phytoplankton are called Harmful algal blooms (HAB's)

Algae bloom is a typical manifestation of eutrophication caused by extreme rise in nutrients such as nitrogen and phosphorus in lakes. Under the appropriate conditions of temperature, illumination, climate and hydrology, colored algae floaters are developed caused by explosive breeding in lakes.

Thus, there is no clarity about the critical factors and mechanism of algae blooms, and some effective technologies of prevention and treatment of algae blooms are still lacking in general.

Bright green blooms in freshwater systems are frequently a result of cyanobacteria (colloquially known as blue-green algae) such as Microcystis. Blooms may also consist of macroalgal (non-phytoplanktonic) species. These blooms are recognizable by large blades of algae that may wash up onto the shoreline.

A harmful algal bloom is an algal bloom that causes negative impacts to aquatic organisms via production of natural toxins, mechanical damage to aquatic organism.

HAB's are often associated with large-scale marine mortality events and have been associated with various types of shellfish poisonings and also fin fishes and other aquatic organisms.

Algal blooms maybe harmful to seagrass and coral reef ecosystems and the connected food webs.

- Reasons for increase in HAB's:
  1.Global climate changes producing wider ranges for some species.
  2.Human contributions of increased nutrients and pollution in coastal waters and also fresh waters.
  3. Changes in local ecosystems that may allow exotic species to thrive if introduced.

- Factors that contributes to HAB's:
  1.Excess nutrients (e.g phosphorus / nitrogen)
  2. Sunlight
  3. Low-water levels or low-flow conditions
  4.Warmers temperatures.

- Harmful effect of algal bloom:
  1.Changes in levels of chemicals such as nitrogen and phosphorus from fertilizers, in the water.

2. Algal blooms can deplete the oxygen and block the sunlight the other organisms need to live.
3.And some can produce toxins that are harmful to the health of the environment – plants, animals and people.
4.Aquaculture industries.

Improved Prediction of Harmful Algal Blooms in Four Major South Korea's Rivers Using Deep Learning Models

Harmful algal blooms are an annual phenomenon that cause environmental damage, economic losses, and disease outbreaks. A fundamental solution to this problem is still lacking, thus, the best option for counteracting the effects of algal blooms is to improve advance warnings (predictions).

In this paper [1] , deep learning model is used for prediction. They conducted short-term (one week) predictions by employing regression analysis and deep learning techniques on a newly constructed water quality and quantity dataset drawn from 16 dammed pools on the rivers. Three deep learning models are compared.

Multilayer perceptron (MLP); recurrent neural network (RNN); and long short-term memory, LSTM were used to predict chlorophyll-a, a recognized proxy for algal activity. The results were compared to those from OLS (ordinary least square) regression analysis and actual data based on the root mean square error (RSME). The LSTM model showed the highest prediction rate for harmful algal blooms and all deep learning models out-performed the OLS regression analysis. Our results reveal the potential for predicting algal blooms using LSTM and deep learning.

Machine learning (deep learning) can analyze and learn a vast amount of untapped big data, extracting important patterns from the datasets and providing insight into specific research questions or problems.

In this study, we aimed to identify the cause of harmful algal blooms and construct a suitable prediction model to facilitate preemptive action.

Here, we analyzed factors influencing the occurrence and prediction of harmful algal blooms using weekly water quality and quantity data of 16 dammed pools on four major rivers in South Korea. Based on the selected variables, we employed chlorophyll-a as a predictive factor.

The results using deep learning model showed the performance of the LSTM model was superior to the MLP and RNN models. In addition, the LSTM model predictions were closer to the actual data than those of the MLP model when variations in chlorophyll-a were large. This implies that the MLP model tended to fail to learn properly when the value of chlorophyll-a increased. Therefore, for water quality data collected daily with continuous data management, predictions could be made more accurate using such "big data."

Learning-Based Algal Bloom Event Recognition for Oceanographic Decision Support System Using Remote Sensing Data

This paper [2] describes the use of machine learning methods to build a decision support system for predicting the distribution of coastal ocean algal blooms based on remote sensing data in Monterey Bay. To solve this problem, we built a Random Forest model using MODIS and MERIS satellite data and applied a threshold filter to balance the training inputs and labels. After building the model, we compared our random forest model with previous trials based on a Support Vector Machine (SVM) using satellite data from 221 days.

SVM: The Support vector machine approach for classification is based on mapping training data and finding the optimal value.

Random forest: RF is an ensemble learning method for classification, which is performed by constructing multiple decision trees. Each tree is independent and identically distributed with the other trees in the forest.

From this paper we can conclude, several features (sst, cloud cover data, k490) were added to the chlorophyll-a features in our model that effectively increased the bloom event prediction performance.

Conclusion:

From the above research, we can say that there are many ways to predict using different models like deep learning models, SVM , RF. The accuracy (performance) depends on many factors like the data, number of factors and the training and testing data.

References:

1. Lee, S. and Lee, D., 2018. Improved Prediction of Harmful Algal Blooms in Four Major South Korea's Rivers Using Deep Learning Models. *International journal of environmental research and public health*, *15*(7), p.1322.

2. Song, W., Dolan, J.M., Cline, D. and Xiong, G., 2015. Learning-based algal bloom event recognition for oceanographic decision support system using remote sensing data. *Remote Sensing*, *7*(10), pp.13564-13585.