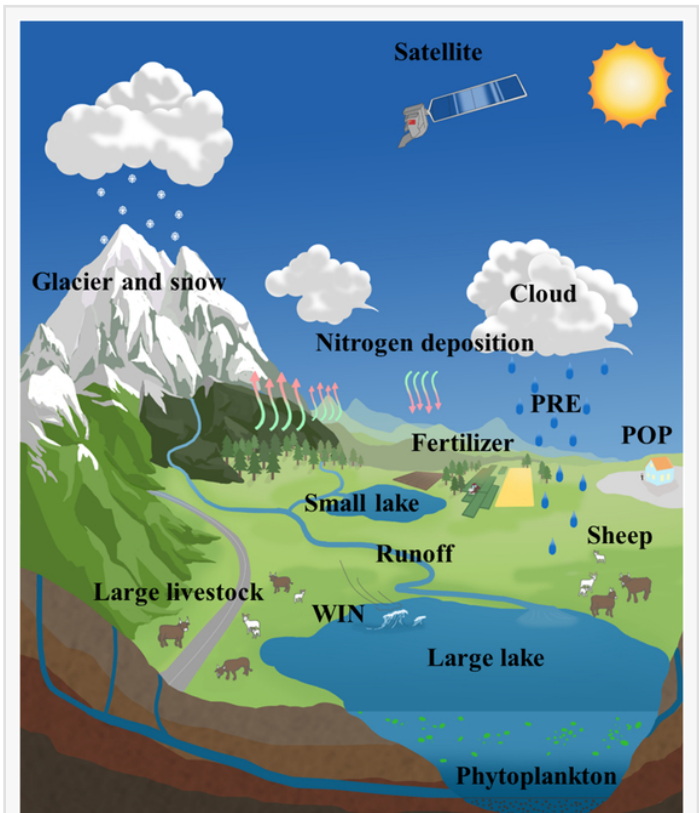


Satellite insights into eutrophication trends on the Qinghai-Tibet plateau

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/EINPresswire.com/ -- This research investigates chlorophyll-a (Chla) variations in lakes across the [Qinghai-Tibet Plateau](#) (QTP), a region facing rapid warming. Using Landsat satellite data from 1986 to 2023, the study explores how climate change and human activities, such as grazing and fertilizer use, affect lake water quality. The analysis of 1,069 lakes reveals significant changes in Chla concentrations, indicating increasing eutrophication, particularly in smaller and shallower lakes. The study forecasts future Chla trends until 2100, offering valuable insights for water management in this ecologically sensitive region.

The Qinghai-Tibet Plateau (QTP), known for its rapid warming, is experiencing significant impacts on its lakes due to both climate change and human activities. Chlorophyll-a (Chla), a key indicator of lake health, serves as a proxy for eutrophication. This study leverages long-term satellite data to assess Chla levels in over 1,000 lakes, analyzing the relationship between Chla and environmental factors like nitrogen deposition and livestock. The QTP's extreme conditions and limited field data make satellite imagery an essential tool for understanding lake changes, filling gaps in traditional monitoring methods.



Schematic diagram of key environmental factors driving changes in chlorophyll-a concentration in lakes, including large livestock, sheep, fertilizer, population, nitrogen deposition, wind speed, temperature, precipitation, and pressure.

A research team led by scientists from the Northeast Institute of Geography and Agroecology, Chinese Academy of Sciences, published a study on June 24, 2025, in *Journal of Remote Sensing* that investigates long-term changes in chlorophyll-a levels across 1,069 lakes on the Qinghai-Tibet Plateau. Using satellite images from the Landsat series processed through Google Earth Engine, the researchers reconstructed lake eutrophication trends from 1986 to 2023 and

predicted future changes through 2100. Their results provide a robust scientific foundation for managing alpine lake ecosystems under climate and land-use pressures.

The study analyzed 1,069 lakes on the QTP from 1986 to 2023 using Landsat data to estimate Chla concentrations. It found significant increases in Chla in 281 lakes and decreases in 166 lakes. Smaller and shallower lakes, which are more vulnerable to environmental changes, showed higher Chla concentrations, signaling worsening eutrophication. The study identified key environmental factors affecting Chla levels, including large livestock, sheep, fertilizer use, and nitrogen deposition. Using a general linear model, the researchers forecasted future Chla levels, predicting a rise in most lakes by 2100 due to increased human activities. However, some lakes with higher ecological resilience are expected to withstand these pressures better. These findings underscore the need for targeted water management strategies to mitigate eutrophication and preserve lake health.

Professor Kaishan Song, an expert in lake ecosystems, stated, "This study emphasizes the importance of satellite technology for monitoring the health of remote lakes. As climate change accelerates and human pressures mount, understanding how these factors influence lake ecosystems is critical. The projected increases in Chla concentrations highlight the need for sustainable practices and more effective water quality management to protect these vital water resources for the future."

The researchers used Landsat satellite data from 1986 to 2023, processed through the Google Earth Engine platform, to estimate Chla concentrations in 1,069 QTP lakes. Environmental factors like nitrogen deposition, livestock density, and weather conditions were integrated to examine their correlation with Chla. Variance decomposition and general linear model regression quantified each factor's contribution. Future Chla concentrations were predicted using data from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) for the years 2024 to 2100, accounting for anticipated environmental changes and human activities.

This study sets the stage for future water management strategies in the QTP. The findings stress the importance of reducing anthropogenic pressures, such as livestock grazing and fertilizer use, in lakes facing high environmental stress. By using improved satellite monitoring, researchers can refine predictions and enhance conservation efforts. The study's forecasts provide crucial information for developing sustainable water quality management practices, ensuring the resilience of lake ecosystems in the face of climate change and increasing human influence.

References

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