

Climate Variation Determine the Cyanobacterial Bloom Intensity via Influencing Nutrient Recycling in a Eutrophic Large System- A Study of Lake Taihu, China

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Lake Taihu is the third largest freshwater lake, located in the delta of the Yangtze River where is the most industrialized and urbanized area in China. This lake has long suffered from the eutrophication and harmful cyanobacterial blooms. Since the drinking water crisis in 2007, this lake has received intense effort for effluent diversion and restoration. However, a record-setting algal bloom occurred in 2017 after a ten-year extensive external loading reduction. This bloom resurgence persisted until 2020, followed by a sharp decline of cyanobacterial bloom intensity from 2021-2023. Detail analysis revealed that extreme warm winter between 2016/2017 sustained a high level of phytoplankton biomass overwinter, and initialized the earlier and more intense algal bloom in the spring of 2017. Strong cyanobacterial bloom triggered the massive phosphorus mobilization from the sediment to the overlying water, stimulating the bloom occurrence and persistence via increase the pH value of water column and hypoxia at the lake bottom. Algal bloom persistence coupled with the internal loading increase to form a positive loop to further promote the bloom occurrence. This loop was broken by a sharp decrease of PAR in the spring in 2021, when the PAR was about 18% lower than the normal level. Because the spring season is a critical period for phytoplankton growth and biomass accumulation for bloom formation in this subtropical system. Sharp decrease in PAR efficiently suppressed the algae growth, which further decoupled the algal growth with the phosphorus recycling from the sediment to overlying water and uptake by phytoplankton, through lowering pH value and hypoxic intensity. Our finding highlights that internal loading control is necessary to decouple algal proliferation and phosphorus recycling is necessary to mitigate the intensive harmful algal blooms in shallow eutrophic waters.