

# Basin scale surface water quality monitoring for the largest freshwater lake in China

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**Abstract.** As the largest freshwater lake in China, Poyang Lake is located in a globally important ecological area as designated by the World Wide Fund for Nature (WWF) and constitutes a major hydrological subsystem of the middle Yangtze basin. With the rapid economic development, it is currently suffering varying degrees of water pollution. This study presents an overview of the current state of water pollution and water quality monitoring for the whole basin of Poyang Lake. First, the spatial distribution and temporal trend of water pollution indicators in rivers and lake will be shown to view the current state of surface water pollution. The overall status and legal framework for point and non-point source pollution control will be examined. Then, the current system for monitoring rivers and lake water quality will be introduced, including remote sensing, real-time onsite monitor system, etc. The data uncertainty for the key hydrological variables of rainfall, river discharge and water quality (suspended solids, phosphorus and nitrogen) will be discussed considering how data uncertainties impact on the interpretation of catchment dynamics. In closing the review, we make recommendations for future research priorities in quantifying water pollution and highlight the need for an improved water quality monitoring in Poyang Lake. This synergistic exploitation of data derived from basin scale observation systems and in situ data will provide valuable information for the water resource management at the largest freshwater lake in China.

**Keywords:** Poyang Lake, Rivers, Water pollution, Water quality, Monitoring

## 1. INTRODUCTION

Poyang Lake is located in a globally important ecological area as designated by the World Wide Fund for Nature (WWF) and constitutes a major hydrological subsystem of the middle Yangtze basin (Fig. 1). With the rapid

**Figure 1** Location and stream network of Poyang Lake basin.

economic development, the water quality of the Poyang Lake shows a continuous downtrend in recent years. Water pollution has become a serious problem in Poyang Lake. Specifically, the concentrations of TN and TP have increased significantly because of agricultural irrigation drainage water injection. Therefore, the spatial and temporal distribution of water quality in the Poyang Lake is necessary to be investigated. The State Council formally approved the planning of Poyang Lake Eco-economic Zone on December 12, 2009. Basin scale surface water quality monitoring is also launched for this largest freshwater lake in China, including its five branches called as “Five River” basin.

The aim of this study is to present an overview of the current state of water pollution and water quality monitoring for the whole basin of Poyang Lake. Based on the water quality and human activity data, the spatial-temporal trend of water quality, pollution characteristics will be analyzed systematically. The corresponding prevention and control measures will be proposed according to various pollution factors.

## 2. DATA AND METHODS

Poyang Lake is located at the middle reaches and southern bank of the Yangtze River, which is the largest freshwater lake in China, with a basin area of  $1.6 \times 10^5 \text{ km}^2$ , accounting for 9% of the total area of the Yangtze

River Basin and nearly 96.85% of the land area of Jiangxi Province. In a normal year, the area of the lake averages  $3,500 \text{ km}^2$ . Poyang Lake connects five rivers (Xiushui, Ganjiang, Fuhe, Xingjiang, Raohe), which are all prone to

flood disaster (Fig. 2). In this study, the annual water quality data sources are obtained from the Jiangxi Environmental Aspect Bulletin and the Key Laboratory of Chinese Academy of Sciences. Statistical methods are used to present an overview of the current state of water pollution. Monthly water samples were also collected and analyzed to study the spatial and temporal water quality variation for both the rivers and lake.

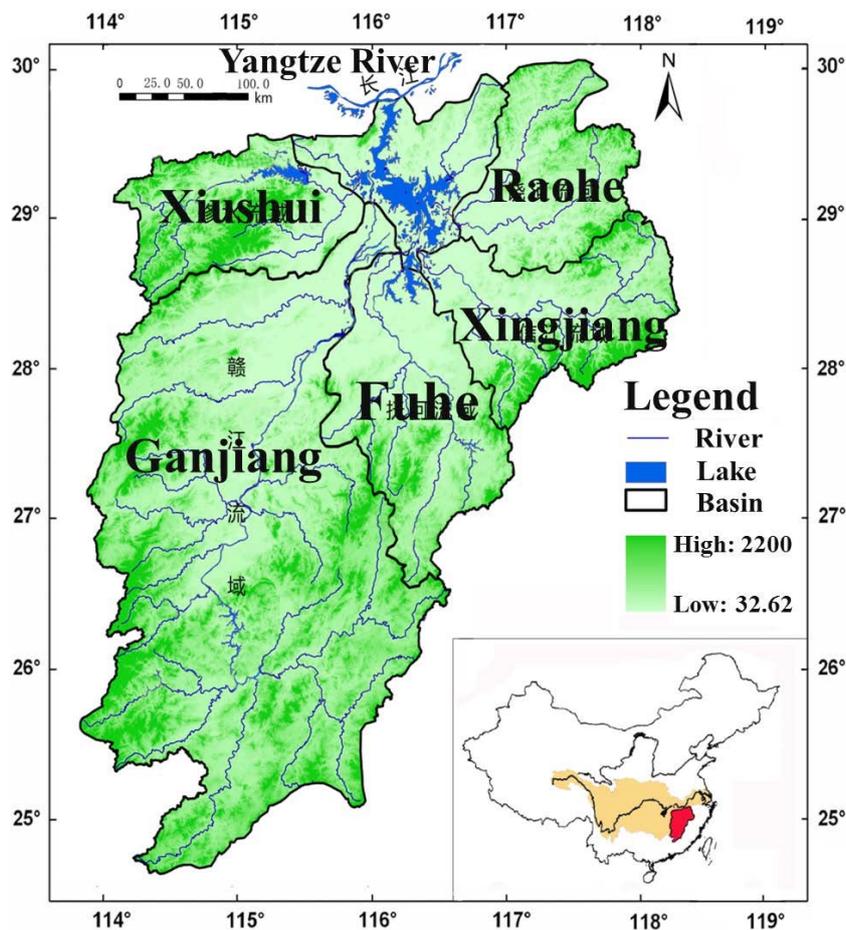
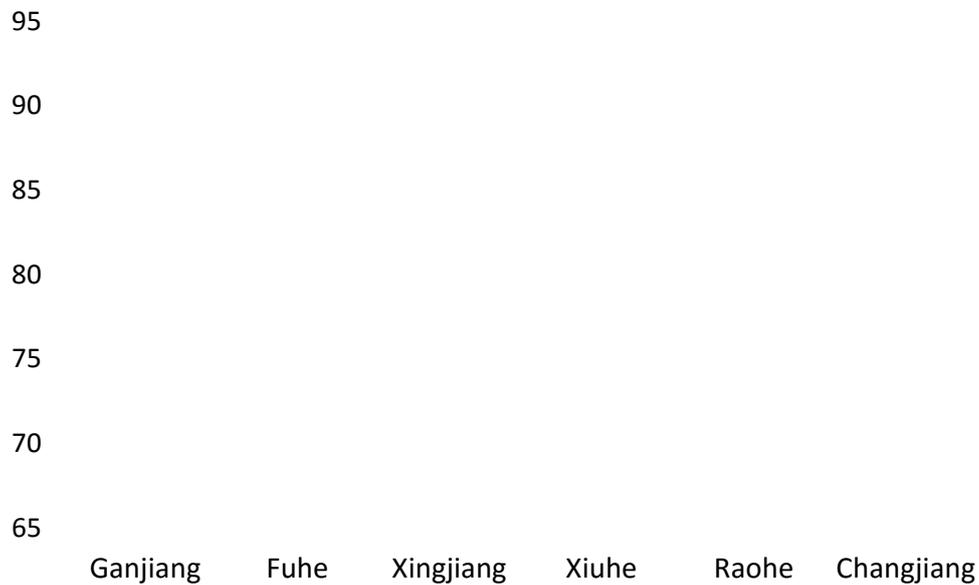


Figure 2 Digital elevation map of Poyang Lake basin and location of five rivers.

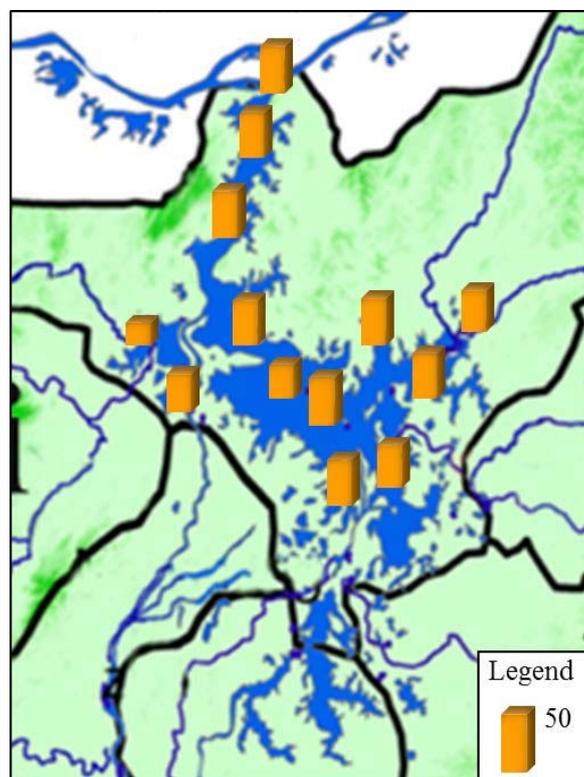
### 3. RESULTS AND DISCUSSIONS

Figure 3 shows the proportion of I~III class waters (I class is the best) in the main rivers of Poyang Lake basin, 2014, suggesting that worst situation happened in Raohe River. In Xingjiang River, the water quality is much better than others.

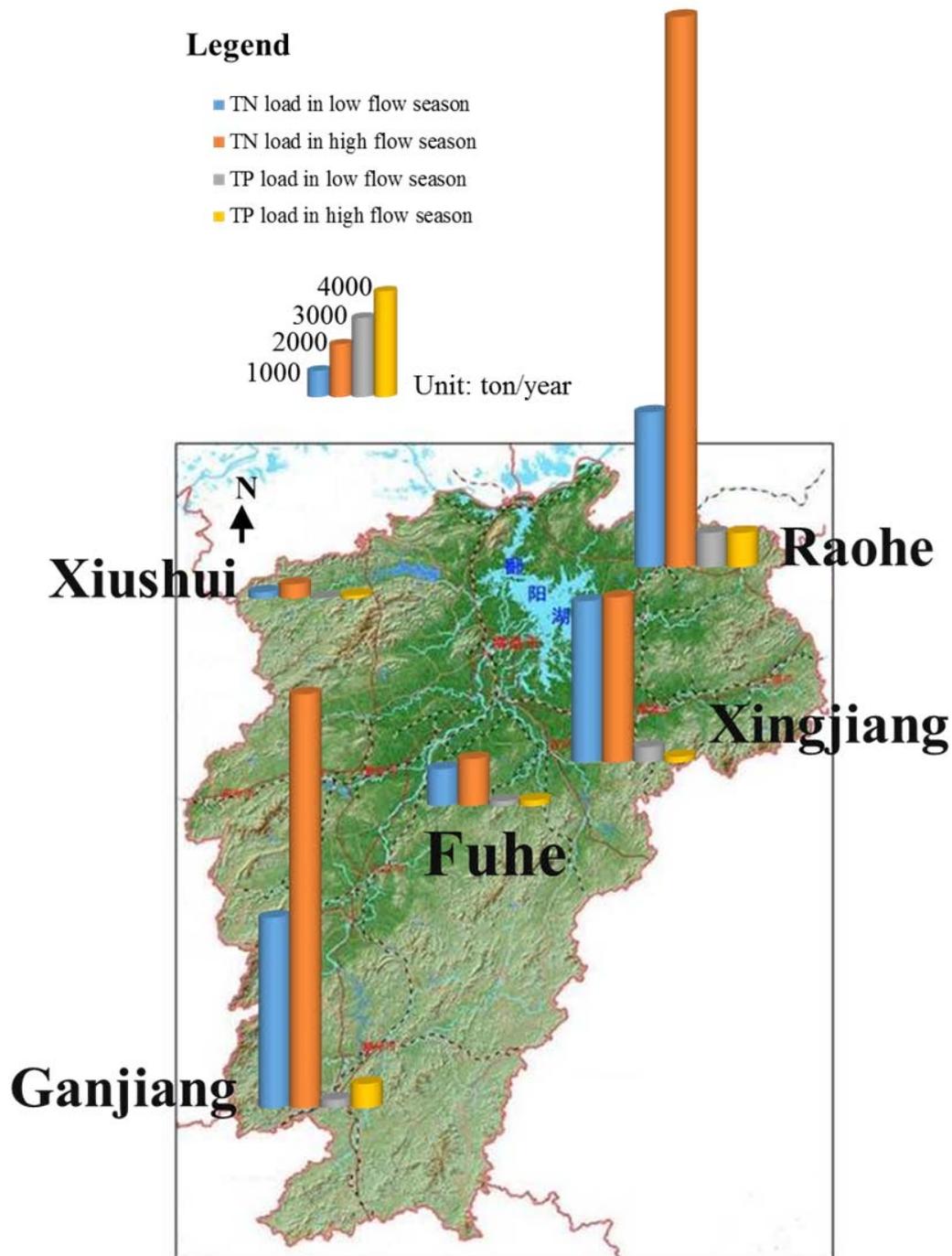


**Figure 3** The proportion of I~III class waters in the main rivers of Poyang Lake basin, 2014.

The results presented in Fig. 3 also show that the water pollution in south area of Poyang Lake is more serious than that in the north area. In terms of temporal distribution, the water quality in high water period is better than that in lower water period from the previous research.



**Figure 4** The eutrophication frequency level (0-100) in Poyang Lake.



**Figure 5** The amount of Nitrogen and Phosphorus into the lake from the five rivers of Poyang Lake.

The eutrophication frequency level was calculated based on the water quality monitoring data. Figure 4 shows the spatial distribution of the average eutrophication level in Poyang Lake for the year 2010. It indicated that in most of the monitoring site, the lake water has the middle level of eutrophication. In Raohe and Xingjiang rivers, the eutrophication levels are little bit higher than others.

The huge population pressure and the construction of ecological and economic zones have great potential threats to the water quality in Poyang Lake. Figure 5 shows the amount of Total Nitrogen (TN) and Total Phosphorus (TP) into the lake from the five rivers of Poyang Lake for the year of 2010. It indicates that the nitrogen load is much more than the phosphorus load in the whole Poyang Lake basin. All the TN loads in the low flow season are smaller than those in the high flow season. Most of the TP loads in the low flow season are smaller than those in the high flow season except those

of Raohe and Xingjiang river basins, in which the soil erosion is very serious. In the Xiushui River basin, both the TN and TP loads are the smallest. In the low flow season, Ganjiang River basin has the largest TN load and Raohe River basin has the largest TP load. In the high flow season, Raohe River basin has the largest TN load and TP load, which also leads to the worst water quality in Raohe River from the result in Fig. 3.

#### 4. CONCLUSIONS

In this study, an overview of the current state of water pollution and water quality monitoring for the whole basin of Poyang Lake was presented. It showed that the water quality of Poyang Lake was at the middle level of eutrophication in general and that the main factor determining the water quality was TN and TP. The water pollution from the rural domestic sewage will be the important factor causing the deterioration of water quality. In the future study, the countermeasures will be considered to link the regulating scheme in “Five Rivers” of Poyang Lake basin, water control projects, the Three Gorges Reservoir. Moreover, adjusting the industrial structure, reducing the pollutant discharge, and establishing basin-specific environmental access thresholds and pollutant discharge standards will be discussed with more details.

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