STICHTING
TOEGEPAST ONDERZOEK WATERBEHEER

RESEARCH PROJECT ENHANCING THE ECOLOGICAL MODELS PCLAKE AND PCDITCH

CLIENT: PEKING UNIVERSITY, CHINA

LAKE CHAOHU - PCLAKE

Characteristics Lake Chaohu

Water level management	Fixed with seasonal fluctuations
Average water level	7.5 m
Average water level	9.09 m
Surface	760 km^2
Fetch	15,000 m
Residence time	176 days
Soil type	Silty sand

Xiangzen Kong (Peking University): 'The model illustrates the need for reduction of nutrient loading in combination with hydrological regulation for the ecological restoration of Lake Chaohu. The model is a powerfull tool in determining effective and cost-benefit restoration measures.'

INTRODUCTION AND MANAGEMENT QUESTIONS

Lake Chaohu is a highly eutrophic lake in Eastern China and has been subject to considerable changes during the last decades. As an example a sluice was built in 1963 for flood prevention, changing the hydrological regime dramatically. Since 1980 cyanobacteria blooms have occurred annually with increasing frequency and coverage.

The aim of this study was to disentangle the key principles of the decline in water quality in Lake Chaohu. Furthermore management options such as reduction of nutrient loading and change in hydrological regime were investigated to restore the lake ecosystem.

RESULTS OF THE WATER SYSTEM ANALYSIS

Inflowing water of Lake Chaohu mainly originates from river inflow, runoff, rainfall and seepage. Nutrient loading mainly originates from municipal and industrial waste-water, livestock and poultry breeding, runoff and discharge from soil erosion. The nutrient loading is far above the critical threshold for a clear vegetation dominated lake. An analysis of the current state of the water quality shows a highly perturbated lake without vegetation. The conclusion of the water system analysis is that the high nutrient loading and the current hydrological regime are driving factors for the bad water quality.

SEE FIGURE 2

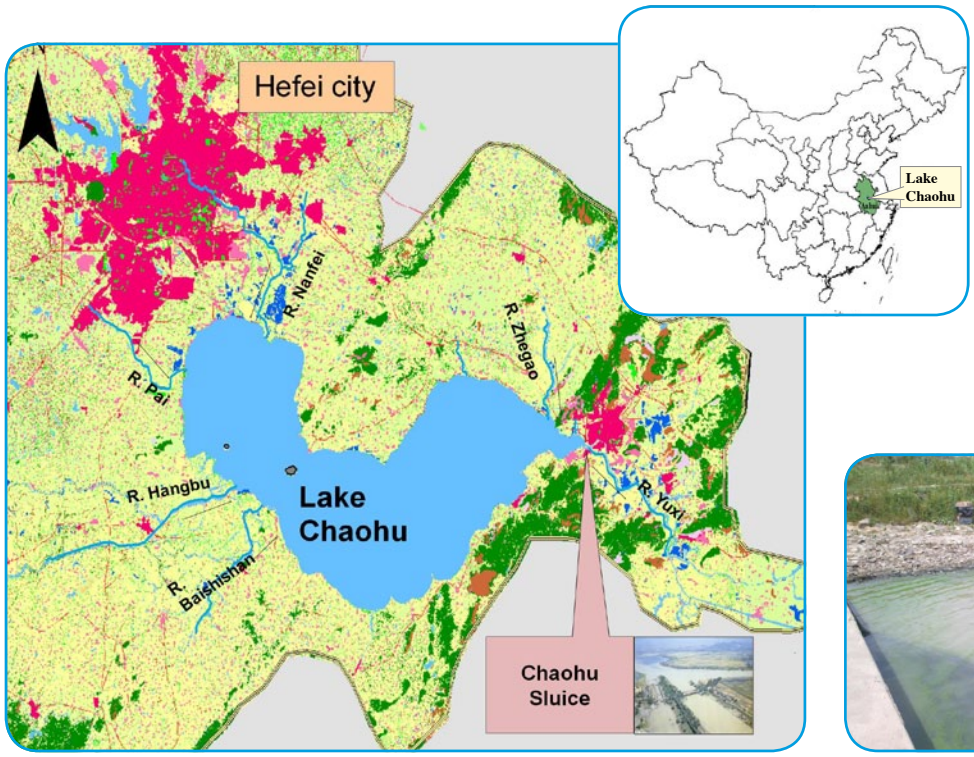
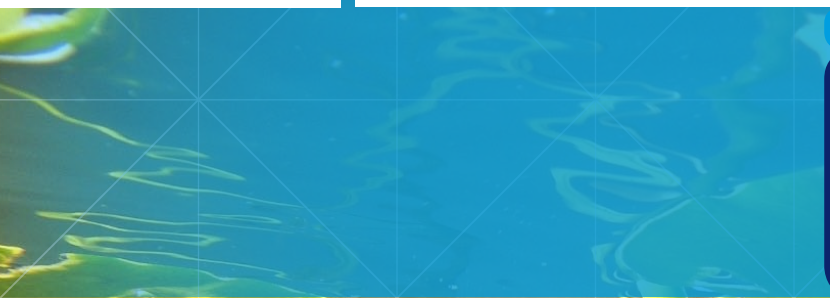


Figure 1: Hydrological schematisation of Lake Chaohu. Agricultural land use (light green/ yellow), urban area (pink), forest (dark green).

Photo: Lake Chaohu (X. Kong, Peking University).



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APPLICATION OF PCLAKE

PCLake was applied to simulate the long-term ecological dynamics of Lake Chaohu. Model predictions were compared with field measurements and showed a good correspondence. The model was able to simulate the interactions between phytoplankton and submerged macrophytes and to simulate the regime shift from clear to turbid in the 1960s. The results of the study reveal that the increasing nutrient loading and the onset of hydrological regulation are the key drivers of the ecosystem decline in Lake Chaohu. Hydrological regulation advanced the regime shift of the lake from clear to turbid state with a decade. The results highlight the major contribution of hydrological regulation in triggering unfavorable regime shifts in shallow lake ecosystems, which was largely underestimated before. Moreover, the results suggest that at least 80% of the current nutrient loading should be reduced to trigger a shift back to a clear state. In order to facilitate the recovery of macrophytes the water level should be reduced in spring to an average level of 7.5 m.

SEE FIGURE 3

BENEFITS OF THE MODEL

The application of the PCLake model was found to be a strong tool to disentangle the key driving forces of the decline in water quality in Lake Chaohu. Not only was PCLake able to reconstruct the long-term dynamics and reveal the dominant driving forces of Lake Chaohu it was also able to predict the development of the lake in different future scenarios. The outcomes of the study can directly be used for the support of management decisions. The lake managers are currently planning to reduce the water level to 7.5 m from March to May by the control of the sluice, in parallel to nutrient loading reduction.

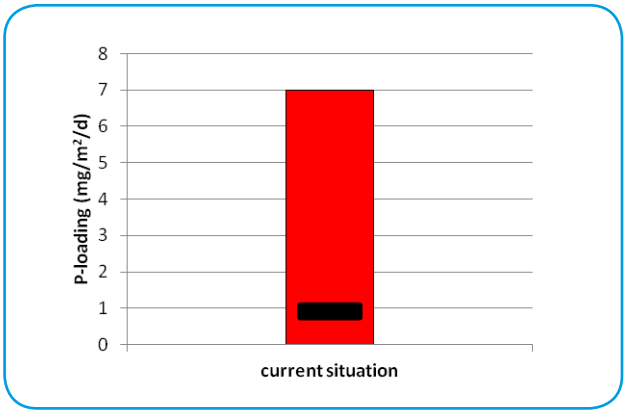

Figure 2: Phosphorus loading (red column) and critical threshold of Lake Chaohu (black line).

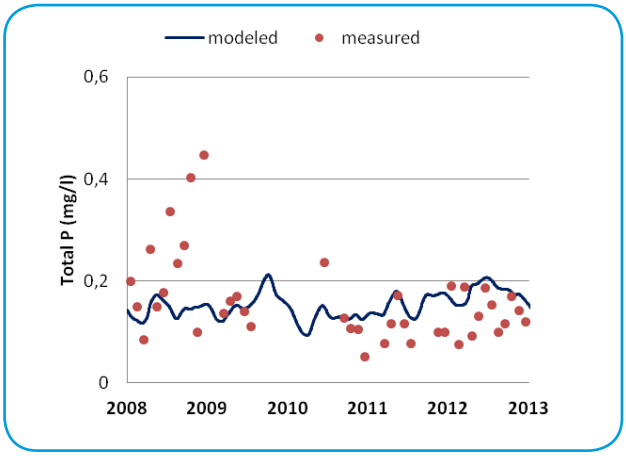

Figure 3: Measured and modelled Phosphorus concentrations in Lake Chaohu.