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Long-term trophication evolutions responding to changes in climate and ecosystem in Poyang Lake, China

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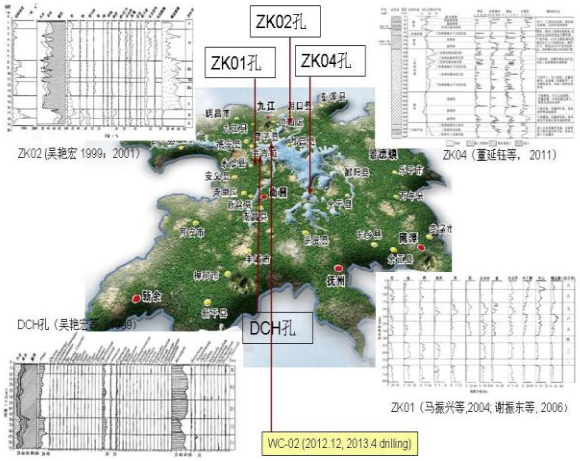
Lake eutrophication had serious effects on water resources and has become a hot issue in limnology and sedimentology studies. However, eutrophication is not yet fully understood because of the water-biomass-sediment complexity in lakes and because the use only decades of data makes it difficult to see the entire process of nutrient evolution. Poyang Lake is the largest freshwater lake in China, existing in a mesotrophic state and a trend toward eutrophication since the 19th century, while sediment core provide a record back to the past 300 years. Aiming at understanding long-term lake trophic evolution, we used lake sediment records [1] and climate-hydrology-forced ecosystem model [2] to do data-modelling comparisons to understand the mechanisms of climate-aquatic biomass-nutrient interaction during the last 300 years in the lake.



Diatom-based Total Phosphorous (TP) was reconstructed based on lake sediments from WC-02 core, Poyang Lake and the age-model of last 300 years was used by $^{210}Pb/^{137}Cs$ dating. Other proxies of total organic carbon (TOC) and aquatic pollen were complied by other cores (Fig. 1). The nutrient change history was synthesis from the proxy-records. The simulations of aquatic biomass and nutrient TP were run for last 300 years and revealed nutrient changed differentially in response to changes in climatic-hydrology and lake ecosystem.

Figure 1: Poyang Lake & sediment cores, China

The simulation results were compared with sediment records: changes in TOC, aquatic pollen and diatoms can be inferred to changes in total biomass, aquatic plant biomass, and nutirnt TP. Time series analysis of the modeled TP was consistent with changes in the Diotom-based TP series and revealed 64.6% of the same variances. Comparison of simulated aquatic plant biomass and aquatic pollen concentration revealed 60.6% of the same variance. Similarly, comparisons of modeled primary biomass and TOC showed 61.9% of the same variance. The comparisons suggested reliable simulations.

The simulations revealed different processes in nutrient change of the past 300 years. Contribution partitions from hydrology and aquatic biomass accounted for 79.1% and 20.9% of this time, respectively. The synchronous changes between hydrology-forced and ecosystem-feedback nutrient during the past

300 yrs occupied 62.5% of the time, suggesting climatic-hydrological factors played a major role in the process of nutrient evolution. Although the asynchronous period only accounted for 12.5% of the past 300 years, it also had a critical effect on nutrient changes in the lake.

References:

[1] Guo Y et al. (2015) Journal of Freshwater Ecology 30(1): 25-40
[2] Yu G et al. (2013) Quaternary Science 33 (6): 1148-1159