



Research Article

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Water level change of Poyang lake and exploring of its formation

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ABSTRACT

Poyang Lake is China's biggest freshwater lake, its water level changes, which will have a very important and far-reaching influence to the social, economic, and environmental of the area. Meanwhile, we analyzed the water change factors from five aspects of Poyang Lake, the five rivers of Poyang Lake basin precipitation, jacking of Yangtze River main stream flowing effect, Poyang Lake itself for the carrying capacity of water and artificial sand mining. We find Nanchang rainfall and water level of Poyang Lake has evident consistency, and this consistency is becoming more and more obvious after 2000. Yangtze River jacking flowing makes the water level of Poyang Lake appears certain rise, and the height of the water level depends on the middle and lower reaches of the Yangtze River and Poyang Lake exports out of the water level, flow and etc. In addition, we also found that the lake itself on the bearing capacity of the water.

**Key words:** Poyang Lake; Water level; cause

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INTRODUCTION

2006 drought in Poyang Lake there is a clear, dry season ahead of more than 70 days, in 2007, Poyang Lake suffered a drought once in fifty years, in 2011, Poyang Lake experienced drought once every hundred years, Surface area less than 400 square kilometers[1].

For this reason, "Mother Lake "cause droughts or floods, the degree of influence of various factors and future Poyang Lake water regime, climatic characteristics have become the focus of attention and explore these aspects of the analysis, the Poyang Lake to play its ecological functions and achieve sustainable socio-economic development of the basin has important significance.

**Poyang Lake's Water Situation**

The water level of Xinzi station of Poyang Lake is relatively stable, less affected by the area and the middle and lower reaches of the Yangtze River water, so we will take the Xinzi hydrological station for mark, and take the Xinzi station measured data in the past years for the source, and then to summarizes the Poyang Lake water situation.

**Seasonal of Poyang Lake**

Poyang Lake water level appears to be strong periodicity, the deepest level appears in the June and July, and the lowest water level appears in January and February. According to statistical standards of the hydrographic office in Jiangxi province, Poyang Lake Xinzi standing water breakthrough 13.39 m for the same period is the wet period, and 10.22 m below for water is the dry season. In order to facilitate calculation here, we consider the Poyang Lake water level period in between 10.22 m to 10.22 m. As can be seen from figure 1, 2007-2011 in May, June, July, August, September's monthly average water level were greater than 13.9 m, then the five months are the wet period;

And in November, December, January, February, average water level are less than 10.22 m, then the four months are the dry season. Overall, Poyang Lake water has more water in summer, and less water in winter, spring and autumn season somewhere is between to them[2].

### Year changes in the Poyang Lake water

In order to facilitate the year of the Poyang Lake water, according to the actual impact of the different levels of effectiveness, this paper divided the annual water roughly into four levels: flood years (water level  $\geq 15$  m), in high water level; Wet year ( $13.5\text{m} \leq \text{water level} < 15\text{m}$ ), water is relatively abundant, the water level relative median water year slightly higher; median water year ( $12\text{ m} \leq \text{water level} \leq 13.5\text{ m}$ ), hovering water after years of average level; Drought years, low water level serious (water level  $< 12\text{m}$ ).

By looking at table 1, we can find that 1983 and 1998 are apparently in a flood, and 1973,1975 could also belongs to flood years for their water levels are close to 15 m; the wet years are 1962,1964, a total of 15 years; the drought years are 1963, 1978, 2006, 2011; The rest of the year we will them into median water year.

Table 1. Hydrologic partitioning of Poyang Lake (the Xinzi station) in 1956-2011

division	The year	total	The proportion %
Flooding year	1973、1975、1983、1998	4	7.14
Wet year	1962、1964、1970、1980、1981、1982、1984、1989、1990、1991、1993、1994、1995、1999、2002	15	26.79
median water year	Remaining years	33	58.93
The drought years	1963、1978、2006、2011	4	7.14

**Month changes of Poyang Lake water :** We can find that in recent years (2007-2011), the monthly water level of Poyang Lake is 6.95% higher than that in many years (1956-2000), in addition of march. The other in the water level is below 1956-2000 levels, which in January, February, April, October and November to reduce the size of the more obvious, fell 11.6%, 14.88%, 14.64%, 15.68%, 14.64%. During 2007-2011, the average water level is 7.6% lower than in the average water level during 1956-2000 every month. Therefore, from the change of Poyang Lake water, the water level of Poyang Lake has a declining trend almost every month. One of the most obvious months is focused on the February, April and October.

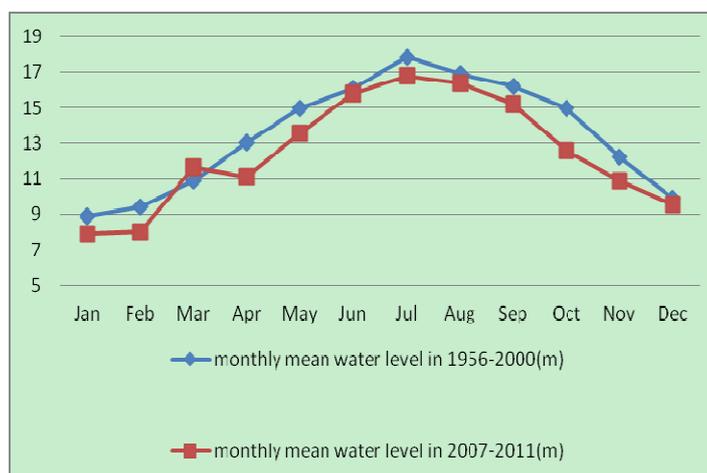


Figure 1. In Poyang Lake water level of the comparison chart for years

### The flood and the drought of Poyang Lake

#### The flood of Poyang Lake

Poyang Lake is a flood prone area, mainly are happening flood disasters in 1954, 1983, 1995, 1998, 1999, 2010, etc. The causes of the Poyang Lake flood disasters mainly includes: Lake basin sediment deposition; reclaiming land reduces the storage volume of Poyang Lake; the Yangtze river channel sedimentation, which decreases lead to water flow backward; rainfall increase, etc[3].

### The drought of Poyang Lake

According to the annual drought index, the Poyang Lake is divided into light drought year, the drought year, heavy drought year and dry year. During the year of 1950 to 2000, there are five dry year, 6 heavy drought year and 14 drought year, the drought frequency as high as 50%.

According to the introduction of the expert in relevant provincial water resources bureau, since 2000, the Poyang Lake has been in drought for many years, there had been the dry year in the year of 2003, 2007, 2007, and in the year of 2011, the average water level even reaches the lowest level in history.

People used to consider the levels below 10m<sup>①</sup> as the low water level, and less than 9m is called the very low water level. From the Poyang Lake in table 2, the table of dry time and continued day and can be seen that: (1) the mutagenicity of longer duration, before 2006, low water level (here refers to the level less than 10 m) last about 30 days or so, and the duration of the 10m below the water level after 2006 lasts for more than 60 years, and presents delay trend year by year. At the same time from the duration of the water level that blow the 9m, 8m, water shortage drought period of delay time is also very obvious. (2) After go into the low water level period, the dry period come 1 to 2 months in advance. From the perspective of the time that appears the water level below 10m, they mostly happened in December before 2006, 2006 years later in October or so, the Poyang Lake into the water for 1 to 2 months ahead of time[4].

**Table 2. Poyang Lake partial onset of low water year and lasting days**

year	u10/d	The time	u9/d	The time	u8/d	The time
1963	24	12-17	6	12-25	0	--
1978	28	12-3	20	12-11	11	12-2
2003	52	11-9	20	12-2	2	12-3
2004	26	12-5	14	12-17	0	--
2005	26	12-5	12	12-19	0	--
2006	94	9-28	27	12-14	3	12-29
2007	60	11-1	46	12-15	27	12-4
2008	104	10-31	96	11-15	44	12-4
2009	142	10-11	123	--	55	--

Note: u10/d means the number of years that under 10m, and it is similar to u9/d, u8/d.

### Influence factors and the method of poyang lake water

#### Precipitation near Poyang Lake

Poyang Lake is belong to the subtropical humid monsoon climate zone, the annual average temperature at 16.5 to 17.8 degrees Celsius, are relatively abundant rainfall, the annual precipitation in 1300-2150mm, years of average rainfall is 1,660mm. Precipitation uneven distribution of space and time, has obvious seasonal and regional, April and May are the concentrated period of rain, there is about 800 mm rainfall during the 3 months, it is about 40% to 50% of annual precipitation, from April to September, the rainfall is about 70% of total rainfall in this year.

#### The five rivers runoff

Poyang Lake has brought together the Ganjnag, Fuhe, Xinjiang, RaoHe, Xiushui, the five major river water. This more than 5 river into the lake for an average of 12.66 billion m<sup>3</sup>, accounted for 86.8% of Poyang Lake by men for many years into the Yangtze River water on average[5].

Through the statistics of five rivers in 2003-2011, we can find that in the years 2003-2011, most years are less than the average for many years, the other are relatively small, the year Ganjiang runoff exceeds the average years the is 3 years, Fuhe river, Xinjiang is only 1 year and 2 years Raohe has 2 years, Xiushui is 2 years. And the years beyond average were 2003, 2005, 2006, and 2010.

**The jacking of river water flow backward:** Poyang Lake and the Yangtze River main road (Jiujiang and Hukou area) exist relatively close relationship: on the one hand, a certain period of time, the Poyang Lake water pour into the main road of Yangtze River; on the other hand, a certain period of time, the Yangtze River jacking flow backward[6].

Jacking (backward) refers to the tributary water resistance by the trunk stream of high water level, forming the harmony of water phenomenon. Difference of Lake Basin and the Yangtze River shelter-forest water effect, providing the conditions for a specific period of river flow backward. Or, it should look both of the relative water

<sup>①</sup> The mutagenicity of authority written is into less than 10.22 m, but most of the time people habitually approximation to levels below 10 m as a sign of close into the water.

level and water flow rate that whether main influence of the Yangtze River to Poyang Lake is jacking or the Yangtze River perused by Poyang Lake[7].

**Table 3 .Average annual runoff from 2003 to 2011 in Poyang Lake water system ( $10^8\text{m}^3$ )**

Name of the river	Ganjiang	Fuhe	Xinjiang	Raohe	Xiushui	stream outlet
Hydrological control station	Waizhou	Lijiadu	Meigang	Hushan	wanjiapu	Hukou
Perennial average	683**	127*	179*	71.19*	34.9**	1500*
2003	546.1	77.86	149	79.5	39.95	1404
2004	428.9	61.09	94.74	45.28	20.38	927.9
2005	718.3	122.1	164.5	45.16	39.23	1465
2006	771.1	138.6	198	57.16	27.88	1564
2007	531.6	53.35	111.5	32.78	20.37	1013
2008	603.1	87.19	147.2	62.95	19.97	1292
2009	437.9	65.55	143.9	53.86	21.1	1060
2010	931.1	211.8	305.5	102.5	42.84	2217
2011	389.2	46.85	129.7	53.06	22.83	969.5
Higher than Perennial average(year)	3	2	1	2	3	2

Note: the data selected in the Yangtze River sediment communiqué of calendar year; \* count from 1953-2010 annual average; \*\* say from 1950-2010 annual average number.

### Water carrying capacity of the lake itself

Poyang Lake itself to carrying capacity of the water, is one of the factors influencing the water level of Poyang Lake, reflecting the Poyang Lake flood control and storage capacity. Soil erosion is one of the important factors that affect the Poyang Lake flood control storage capacity[8]. Ganjiang, Fuhe, Xinjiang, Raohe, Xiushui, Hukou waterway of the annual average sediment concentration were 0.127, 0.112, 0.116, 0.081, 0.104, 0.069  $\text{kg}/\text{m}^3$ , sediment concentration of Ganjiang and Xiushui from 2004 to 2011 is less than the average sediment concentration of many years, Fuhe, Xinjiang, Raohe except 2010 annual average sediment concentration is greater than the average for many years, the rest of the year are below average[9]. It suggests that 2004-2011 the Soil and water erosion phenomenon of the five rivers has greatly improved, and the influence of the area of Poyang Lake sediment concentration is in the flagging. Seen from the output of the Poyang Lake sediment situation, Hukou channel for many years the average sand content is 0.069  $\text{kg}/\text{m}^3$ [10]. And 2001, 2005, 2007, 2005, 2010, the five years are all more than average, and year 2005 and 2007 are more than 50% above the average. Therefore, Poyang Lake sediment deposition growth is weakening, this means that the factors such as soil and water loss impact on the bearing capacity of the Poyang Lake water is also gradually reduced.

**Table 4. Poyang Lake water system for the sediment concentration in 2004-2011**

Name of the river	Ganjiang	Fuhe	Xinjiang	Raohe	Xiushui	stream outlet
control station	Waizhou	Lijiadu	Meigang	Hushan	wanjiapu	Hukou
Annual sediment concentration ( $\text{kg}/\text{m}^3$ )	0.127 (1956-2010)	0.112 (1956-2011)	0.116 (1955-2010)	0.081 (1956-2010)	0.104 (1957-2010)	0.069 (1952-2010)
2004	0.06	0.071	0.066	0.052	0.036	0.09
2005	0.06	0.079	0.047	0.029	0.089	0.123
2006	0.06	0.071	0.066	0.052	0.036	0.09
2007	0.04	0.051	0.024	0.013	0.033	0.128
2008	0.04	0.057	0.04	0.081	0.032	0.06
2009	0.04	0.062	0.04	0.035	0.039	0.054
2010	0.05	0.131	0.114	0.136	0.079	0.072
2011	0.03	0.077	0.065	0.295	0.063	0.079

### CONCLUSION

We use the measured water level data of Xinzi station as a reflection of the water level of Poyang Lake, and summarize the years of Poyang Lake water level changes, thus finding out the characteristics about the water level of the Poyang Lake, the change rule and the trend of the change. we can find that water level of Poyang Lake has evident seasonal and interannual characteristics. From May to September is the plentiful, March, April and October as level period, and November to February for mutagenicity, that is more water in summer, less in winter ,and spring and fall is in between. Annual Poyang Lake water level tend to be more volatile, the width of fluctuation in the expanding trend; Nearly ten years water level decline significantly, from the moving average as we can see, the moving average after 2000 appeared a downward trend, and reached a historical low.

We analyzed the water change factors from four aspects of Poyang Lake, the five rivers of Poyang Lake basin

precipitation, jacking of Yangtze River main stream flowing effect, water flow backward and Poyang Lake itself for the carrying capacity of water . The water level is positively related to precipitation and Poyang Lake. The five rivers are the main water sources of the Poyang Lake, and the area of traffic flow is basically consistent with Poyang Lake. Yangtze River jacking flowing makes the water level of Poyang Lake appears certain rise, and the height of the water level depends on the middle and lower reaches of the Yangtze River and Poyang Lake exports out of the water level, flow and etc. In addition, we also found that the lake itself on the bearing capacity of the water .

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