

Change analysis of lake environment for efficient management of water resource in drought damage region

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Abstract- In the case of Chinese major granary of the northeastern region due to global warming it has been a recurring droughts and floods. Northeast is more than 30% for the grain producing area that is highly sensitive areas to climate change. Thus, in this research, Landsat satellite images about Songhua lake were acquired where is the largest lake in the northeastern region. Area changes to different land cover of time series were analyzed. As the result, it was able to confirm that the reduction. 2014 area of the lake has decreased than before the drought in 2011. In the future, if an analysis is made of based on high resolution satellite images maybe the more accurate the results obtained are considered to be possible.

Keywords- lake environment, drought damage region, management of water resource

1. Introduction

Northeast China is the Chinese granary where the annual grain production is more than 30% of the total fall grain production. However, recent global warming and climate change cause the frequent droughts and floods [1-2]. Especially, because of the flood during ten days in August, 2010, over a hundred people died and had been missing. And 162,000 houses were damaged by stream flooding, and about 592,000 residents were evacuated due to this food. Also, 3740,000 persons were damaged by the flood in August, 2013 [3-4]. On the other hands, in September, 2014, the severe drought was occurred in 60 years and people suffered from the shortage of drinking water and damaged the grain harvest which had reduced 5 million tons from the previous year. [5].

As above, despite the important role of the grain producing area in China, the northeastern region has been affected by the impact of climate. It has been a victim of frequent floods and droughts [6]. Thus, in this research, we targeted the large areas around the Songhua Lake where affected easily by the floods and droughts and conducted monitoring the environmental exchange in this area. For this purpose, we performed image classification using satellite images and calculated the surface temperature for managing the temperature change and time-series change effectively.

2. Data Acquisition and Processing

In this research, we selected the Songhua Lake as research area in order to analyze environmental changes in the lake about floods and droughts in accordance with the time series.

The Songhua Lake is the man-made lake where is in the upstream of Songhua river of Jilin in China. This lake is the large scale lake that the area is 425km², maximum water depth is 77.5m, and the volume of water kept in store is 10.8 billion m³. As above, since the large scale of this lake, we used and acquired the Landsat satellite images to analyze economically. The period of satellite images are taken by October due to the time constraints of the orbital period and the acquisition circumstance. And we acquired the Landsat satellite images in 2009, 2011, 2013, 2014. Fig. 1 shows the research area.

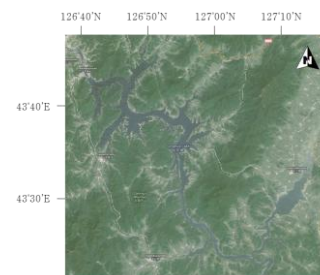


Fig. 1. Research area

2.1. Land Cover Classification

We decided the classification items to three sorts (lake, mountain, bare soil) and confirmed the classification to calculate the time-series change of area quantitatively [7]. We used the maximum likelihood as supervised classification method which is most commonly utilized. Fig. 2 shows the land cover classification results of each period.

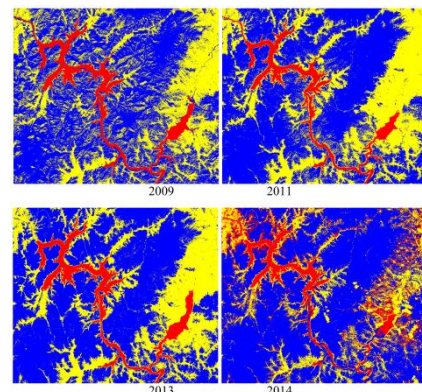


Fig. 2. Land cover classification results of each period

2.2. Calculation of Land Surface Temperature

We calculated land surface temperature about surrounding area of the lake to detect the environmental change of lake with the area. 6th thermal band of Landsat 5 TM satellite image and 10th and 11th thermal band of Landsat 8 OLI satellite image were utilized to calculate the land surface temperature. We used the NASA equation as calculation equation of land surface temperature [8]. Fig. 3 shows the results of land surface temperature of each period.

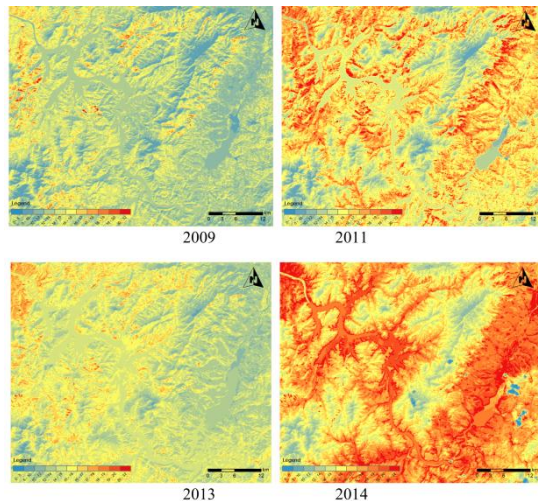


Fig. 3. Results of land surface temperature of each period

3. Analysis of Results

3.1. Analysis of Land Cover Classification

As a results of land cover classification, area of the lake were calculated 19,718.280km² in 2009, 17,634.780km² in 2011, 21,790.890km² in 2013, and 19,092.150km² in 2014. Table 1 shows the change of area according to land cover classification.

Table 1. Change of area according to land cover classification (unit: km²)

	2009	Δ	2011	Δ	2013	Δ	2014
River	19,718.280	-2,083.500	17,634.780	4,156.10	21,790.890	-2,698.740	19,092.150
Mountain	162,430.290	2685.420	165,115.710	6,433.290	171,549.000	52.110	171,496.890
Bare Soil	107,986.230	-601.920	107,384.310	-96,794.400	96,794.910	2,750.850	99,545.760

3.2. Analysis of Land Surface Temperature

In order to calculate the temperature change in the lake by the time-series, only masked the lake region from the result of surface temperature extraction using the result of each time determined by the lake in the land cover classification.

From the result of extraction, temperatures of the lake were 0.87°C in 2009, 0.89 °C in 2011, 1.17 °C in 2013, and 2.80 °C in 2014 on average. Lake temperature of 2014

that caused the most extreme drought was the most high. Fig. 3 shows the results of temperature in the region of lake.

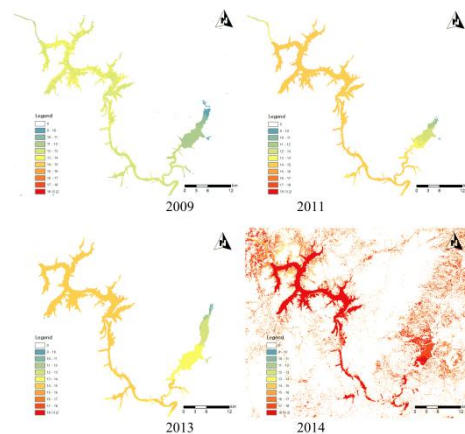


Fig. 3. Results of temperature in the region of lake

4. Conclusions

In this research, we propose an efficient management of water resources in the target area where occurred floods and droughts frequently in northeast China. For this purpose, we confirmed the land cover classification about the surrounding area of Songhua lake and calculated land surface temperature using NASA equation and Landsat thermal band. Also, we analyzed the time series change of land surface temperature about the region of lake.

As a results, we could grasp the quantitative changes of land coverage and the surface temperature in the large areas quantitatively. Especially, we could understand the characteristics about drought and flood in this lake by comparing the time series results.

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