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Dynamic Changes of Lakes in Tibet Plateau and the Climate Interaction in the Past Forty Years

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Lake change, as a mirror of climate change, has obvious indication and warning effect on climate. By extracting information of all lakes in Tibet Plateau from Landsat of the 1970's, the 1990's, around 2000 and 2010 based on RS and GIS, and, in combination with on-the-spot investigations to a few representative lakes, the authors have developed the spatial database of lakes in four periods. There were 858 lakes in Tibet Plateau whose area was larger than 1 km² (exclusive of dry lakes and dry saline lakes), and their total area was 30338.17 km² according to the remote sensing interpretation of 2010.

On the one hand, through a statistic analysis of lake spatial data using ArcGIS, the authors detected the dynamic changes of lakes in Tibet Plateau from the 1970's to 2010 or so in the light of time and space (Table 1). Taking around 2010 as an example, there were 1246 lakes whose area was larger than 0.5 km², and their total area was 30613.58 km². The number and total area of lakes in Tibet Plateau keep increasing in the past forty years. In around 2010, lakes expanded significantly and there were 64 lakes area of which was larger than 100 km² (their names were shown in Figure 1). On the other hand, some representative lakes whose area was larger than 10 km² were selected to analyze the dynamic changes one by one, and division of these lakes into expansion area and atrophy area was made according to the dynamic changes (Figure 1C). From the

1970's to the 1990's, lakes in north and middle Tibet Plateau were shrunk whereas lakes in other places tended to expand. From the 1990's to 2000, most lakes in Tibet Plateau were expanded and the expansion rate of most lakes was less than 20 percent. From 2000 to 2010, lakes continued to expand and there were 302 lakes area of which was larger than 10 km² with area of 239 lakes increased and 111 lakes increased by 20 percent.

Additionally, the authors analyzed annual mean temperature, annual rainfall and annual evaporation combining with the results of previous studies, and reached some conclusions based on the data obtained: annual mean temperature and annual rainfall were trend to increased; annual evaporation were trend to decrease. Dynamic changes of lakes in Tibet Plateau were consistent with the variation tendency of climate. With the Bangor Lake of Tibet as an example, the authors finally analyzed the factors responsible for the lake changes, i.e., climatic environment and human activity.

Lake is a recorder of climate environment. For one thing, under the background of the global climate warming, lake changes can mirror climate changes quite well, which have important reality significance to predict the climate change. For another, we analyzed dynamic changes of lakes in Tibet Plateau accurately based on the spatial databases in four different periods, which can help to inform about the

Table 1 Statistical data of lakes in Tibet Plateau.

Area/ km ²	the 1970's		the 1990's		around 2000		around 2010	
	number	Total area /km ²	number	Total area /km ²	number	Total area /km ²	number	Total area /km ²
≥500 km ²	7	6555.75	6	6605.09	5	6204.66	7	8327.74
≥100 km ²	42	14455.70	50	16225.30	54	16985.03	64	20161.16
≥50 km ²	90	17868.18	101	19891.40	113	21080.93	124	24382.76
≥10 km ²	215	20880.14	259	23656.05	293	25228.59	302	28503.42
≥1 km ²	551	22006.75	704	25094.01	869	27124.94	858	30338.17
≥0.5 km ²	678	22097.36	928	25254.17	1166	27338.34	1246	30613.58

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situation of water resources in the study area and establish an early-warning system.

Key words: Tibet Plateau; lake; dynamic changes; remote sensing; climate changes

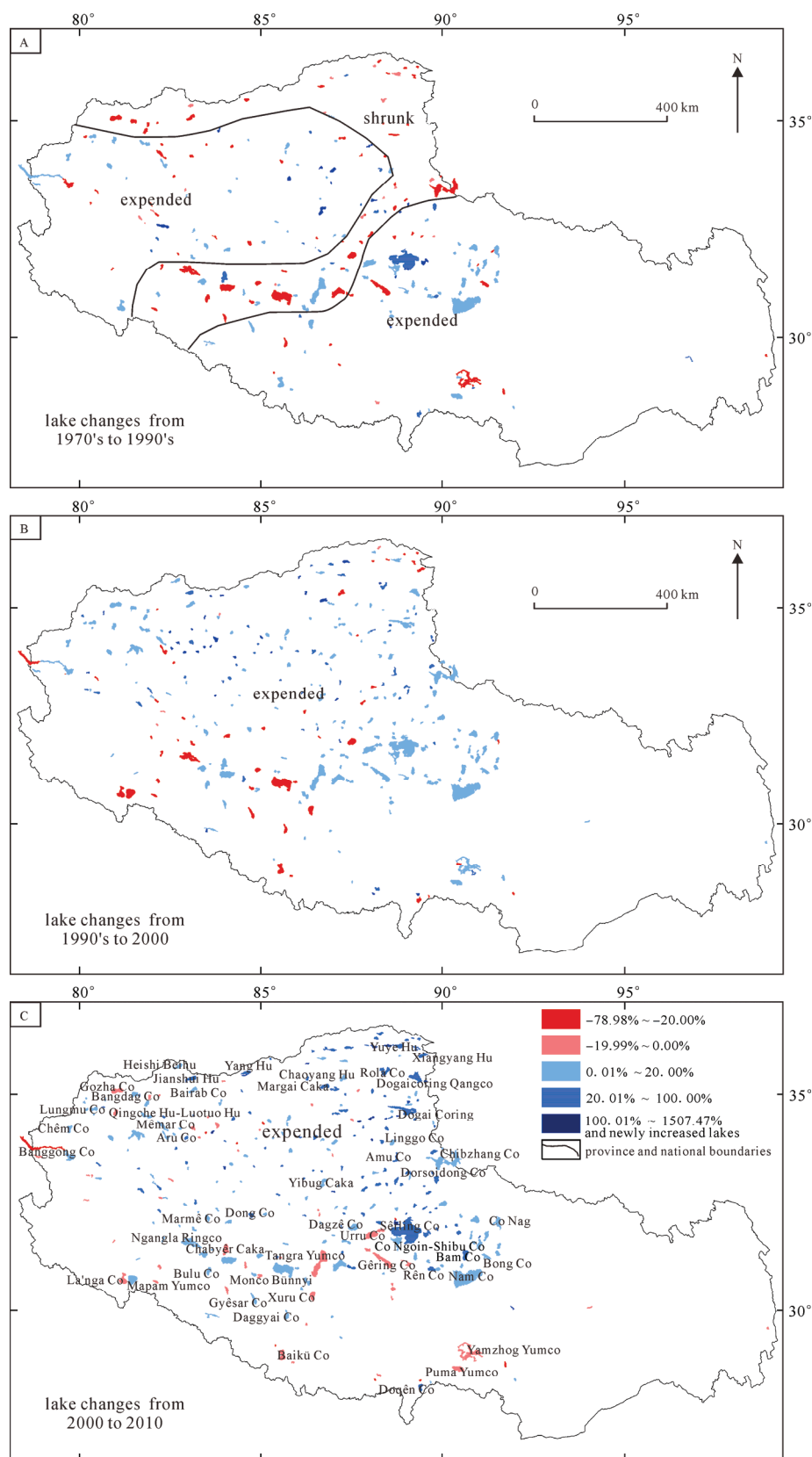


Fig. 1. Dynamic changes of lakes in Tibet Plateau in the past forty years