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Spatiotemporal variations in the water storage of closed lakes on the Tibetan Plateau and their climatic responses

Liping Zhu (1,2) and Ruimin Yang (1)

(1) Institute of Tibetan Plateau Research CAS, China (lpzhu@itpcas.ac.cn), (2) CAS Center for Excellence in Tibetan Plateau Earth System

The water storage of lakes responds sensitively to variations in climate.At the same time, lakes have an important influence on climate by altering the energy exchange between the land surface and the atmosphere. In the present study, water storage changes in 114 closed lakes with areas greater than 50 km2 on the Tibetan Plateau (TP) were estimated by integrating SRTM DEM (Shuttle Radar Topography Mission, Digital Elevation Model) and LandSat images. The results reveal that the total water storage increased by 102.64Gt from 1976-2013, a rate of 2.77Gt•yr-1. Specifically, thestorage changes between 2000 and 2013 account for 97% of the changes during the entire study period, resulting in an overall positive water balance of 7.67 Gt•yr-1. However, the pattern of water balance changes of the studied lakes exhibit significant differences from 1976-2013. Three main regions were distinguished according to the differences: the southeastern part of the inner TP (a slight increase followed by a sharp increase); large parts of the inner TP, except for the southeast (initially decreasing and then increasing); and large river valleys of the southern TP (mainly decreasing). Precipitation changes were identified as the dominant influencing the changes in lake water balances on the inner TP during the study period. Specifically, a large amount of precipitation resulted in the dramatic increase of lake water storage from 2000-2013. The influence of temperature on the lake water balance was changeable in different period. It made more significant contribution on the changes in lake water balance when the precipitation was low before 2000 than after as the steep rising precipitation. However, the different sensitivity of TP lakes to climate change confirmed in the present study is an important implications for the interpretation of past lake level records and for the understanding lakes change, even the land process in the future climate change.