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Towards the water level fluctuations of Lake Nam Co with a lumped watershed-lake model

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Hydrologic cycles of most inland lake watersheds on the Tibetan Plateau are not closely monitored due to lack of observation abilities in the harsh environment. Understanding the hydrologic processes of lake watersheds in the Tibetan Plateau could provide insights into the responses of Tibetan lake dynamics to climate change. An efficient approach for this purpose is to represent complex hydrologic behaviors of such Tibetan lake watersheds with simple and plausible hydrologic models. In this study, water level fluctuations of an inland saline lake in the central Tibetan Plateau, Nam Co, were investigated using a lumped watershed-lake model. This terminal lake is fed by both precipitation and glacier melt water from west slopes of Nyainqentanglha Ranges. The degree-day factor method was introduced to improve the model applicability in the glacier-covered basins. The model simulated the hydrologic processes as well as lake water budget of the Nam Co watershed. Remote sensing images (Landsat MSS, TM and ETM) from 1972 to 2008 were used to identify the boundaries of glacier and lake. Multi-source climate data (e.g., ground point observation, 0.25^o gridded APHRODITE and TRMM 3B42 v7) were used to drive the hydrologic model at a monthly time step. It was found that both precipitation and air temperature experienced increasing trends with rates of 2.2 mm/year and 0.04 ^{o}C/year, respectively, for the period of 1963-2012. As a response to climate change, in the study basin, glaciers decreased by 51 km^2 (-23%) while lakes expanded by 98 km^2 (+5%) from 1972 to 2007. Results also showed that, during the period of 1961-2013, precipitation on lake, surface and subsurface runoff productions contributed 33%, 39% and 28%, respectively, to the total water mass gain of Lake Nam Co. As for its water sinks, lake water evaporation and groundwater outflow contributions were 63% and 23%, respectively. Consequently, a 14% of incoming water remained in the lake, producing an increase of the lake level. The hydrologic analysis of this study echoes the point that there exists groundwater outflow in the Lake Nam Co, which has been deemed to be a closed inland lake for a long time.