

Title: Changes monitoring in Hongjiannao Lake from 1987 to 2023 using Google Earth Engine and analysis of climatic and anthropogenic forces

Author Names: Md. Enamul Huq , Xijun Wu , Akib Javed , Ying Dong , Bingbing Li , David Lopez-Carr , Jiang Wu , Jing Liu , Yaning Zhang , Fanping Zhang , Muhammad Riaz , Md. Nazirul Islam Sarker , Walid Soufan , Khalid F. Almutairi, Aqil Tariq

Abstract: The research aimed to quantify the lake area dynamics, evaluate the changes in distance and rate of lake shorelines quantitatively and spatially and investigate the key factors influencing the Hongjiannao Lake (HL) area shrinkage. The study used [remote sensing](#) (RS) data from Landsat TM/ETM+ and OLI images and [Google Earth Engine](#) (GEE), a cloud platform for obtaining the lake surface area and island information from 1987 to 2023. A modified normalized difference water index (MNDWI) was applied to water area extraction. Digital Shoreline Analysis System (DSAS) was employed to assess net shoreline movement (NSM) and depict the lake shoreline length and rate changes. Furthermore, the water level was derived by ASTER GDEM V2 using the [waterline](#) method and lake boundaries. Six climatic features (temperature, precipitation, potential and actual evaporation, aridity index, and actual water difference) were investigated to find the driving factors of lake area shrinkage by correlation and factor analysis. The results reveal that during 1987–2023, the HL area has undergone four separate phases: stable (1987–1997), shrinkage (1998–2015), growth (2016–2019), and reduction (2020–2023). The most substantial negative change (–7.45%) in the HL area was observed in 1998. NSM analysis demonstrates that the lake has experienced both expansion and shrinkage at various times and locations. According to Water Balance Method, the water volume of HL exhibited variations, ranging from –0.1895 to –0.009 km³. The average yearly change in lake volume, water level, and area displayed similar characteristics with high inconstancy. Correlation and factor analysis of lake area and [climatic factors](#) demonstrate that higher precipitation, low temperatures, less potential evaporation level, lower actual [evaporation rates](#), and more minor differences in water levels are associated with an increase in lake area. In contrast, the opposite conditions lead to a reduction in lake size.

Key words: Hongjiannao Lake (HL) Lake area dynamics Remote sensing (RS) Google Earth Engine (GEE) Modified Normalized Difference Water Index (MNDWI)

<https://doi.org/10.1016/j.pce.2024.103756>

<https://www.sciencedirect.com/science/article/abs/pii/S1474706524002146>