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Assessing the Influence of Global Climate and Anthropogenic Activities on the Water Balance of an Andean Lake

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ABSTRACT

Tropical regions along the Andean Cordillera face an uncertain future as mountain lakes and snow peaks exhibit receding trends associated with factors such as climatic precursors and local anthropogenic activities. Tota, the largest mountain lake in the Colombian Andes, exemplifies the role played by these factors on the lake's hydrologic evolution. A monthly water balance in Tota Lake was performed using available hydrological information from 1958 to 2007 to address interannual and multiannual level fluctuations associated with human activities and climatic precursors. The balance shows that net water uses fluctuated around 2 m^3/s during this period with a pattern that, although constrained during years of severe decline in lake levels, is able to explain most of the multiannual decaying trend of 1.5 cm/year in the last 50 years. The lake ' s naturalized levels were used to determine the influence of climate precursors on the lake evolution. Using Multichannel Singular Spectrum Analysis (M-SSA), significant five-year ENSO and 20-year PDO related quasi-oscillations were detected, explaining 54% of the variance associated with mean annual naturalized level fluctuations. ENSO is markedly in-phase with lake levels, with critical declines associated with low precipitation and high evaporation rates during El Niño years, whereas the PDO signal exhibits a phase opposition with lake levels, with low naturalized levels during a positive PDO phase and high levels during a negative PDO phase (an important result to consider given the current cooling trend of the PDO signal).

KEYWORDS

Water Balance, Andean Lakes, Climate Teleconnections

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