Abstract

The South American monsoon is central to the continent's water and energy cycles, however, the relationships between the monsoon, regional water balance, and global climate change is poorly understood. Sediment records at Lake Junín (11°S, 76°W) provide an opportunity to explore these connections over the last 650 ka. Here, we focus on two interglacials, the Holocene (11.7–0 ka) and MIS 15 (621–563 ka), when sediment proxies suggest rapid regional hydroclimate fluctuations occurred. Clumped isotope distributions of lake carbonates reveal that interglacial water temperatures were similar to present, though analytical limitations preclude detecting the small temperature differences expected in the tropics (<2 °C). Combining the reconstructed water temperatures with carbonate oxygen ($\delta^{18}O$) and triple oxygen ($\Delta'^{17}O$) isotope values, we reconstruct precipitation $\delta^{18}O$ values and lake water $\Delta'^{17}O$ values. Precipitation $\delta^{18}O$ values, a proxy of monsoon strength, range from -18.6 to -12.3 ‰ with lower values reflecting a stronger monsoon. Lake water $\Delta'^{17}O$ values are -14 to 43 per meg and indicate the extent of lake water evaporation; lower values reflect a higher proportion of evaporation to inputs (i.e., more negative P-E). The precipitation $\delta^{18}O$ and lake water $\Delta'^{17}O$ values from both interglacials vary with the pacing of local summertime insolation, which follows an orbital pacing. These data document the close connection between Andean water balance, the South American monsoon, and global climate. Further, we analyze the relationship between precipitation $\delta^{18}O$ and insolation, and we find that the relationship is consistent among interglacials, suggesting a similar response of the monsoon to orbital forcings over time. In contrast, while lake water $\Delta'^{17}O$ and insolation are also correlated during both interglacials, water balance was overall more positive during MIS 15 than the Holocene. This suggests that either other global forcings or local basin dynamics can also contribute to water balance at Lake Junín. Together, these data provide new evidence of the connections between global climate, monsoon strength, and regional water balance.