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Climate variability over the Holocene in the Atacama Desert of Chile as reconstructed from tree ring isotope series

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A high temporal resolution record of Holocene climate variations is reconstructed from δ^{18}O and δ^{13}C isotopes of *Prosopis sp*. tree rings. These deciduous tropical hardwoods live up to 200 years and are sensitive to local climate and environmental conditions in the modern period. El Niño Southern Oscillation (ENSO) and the location of the Bolivian high over South America control local climate and water availability in the region. Rainfall in the Andean highlands consistently recharges local groundwater to the lower altitude Pampa del Tamarugal (PdT) basin where the trees occur naturally. The PdT basin is one of the direst places on Earth, and receives on average less than 4 mm of rainfall annually. Sub decadal ENSO variability causes anomalous episodes of increased basin moisture than is recorded in the tree-ring isotope archive. A modern high-resolution tree ring series demonstrates seasonal sensitivity to increased soil and air moisture during the 2015/2016 El Niño event. Ancient trees are well preserved and radiocarbon dated to provide a floating record over the Holocene. Intervals of high-resolution tree-ring isotope data document the increase in ENSO frequency and intensity over the last 9.5 ky, as well as, the previously documented Mid-Holocene decrease in ENSO. Compared to modern (avg. δ^{18}O = 31.97, σ = 1.63) the lowest variation is observed in the interval between 7.8 – 7.7 (avg. δ^{18}O = 32.40, σ = 0.47), while the earlier period is also low at 9.5 – 8.8 kya (avg. δ^{18}O = 31.80, σ = 1.0). Oxygen isotope values are highest over the $\sim$ 4.9 kya segment (avg. δ^{18}O = 36.80, σ = 1.6). While the period between 2.5-2.4 kya (avg. δ^{18}O = 36.60, σ = 1.9) and 1.9-1.8 kya (avg. δ^{18}O = 34.75, σ = 2.9) show the greatest variation indicating dramatic shifts between wet and dry conditions which are attributed to ENSO events. These records are in agreement with other eastern Pacific paleoclimate records and provide some of the highest resolution data for Holocene ENSO variability in the Western Hemisphere. This study demonstrates the utility of desert tree-ring isotope series in expanding climate records to areas lacking other high-resolution paleoarchives.