Assessing bias in the representation of ENSO in precipitation stable isotope values

JESSICA L. CONROY,*[1,2] D. ALLIE WYMAN[1], LORI J. BELL[3]

[1]Department of Geology, University of Illinois Urbana-Champaign, Urbana, IL 61801, USA *correspondence: [jconro@illinois.edu]

[2] Department of Plant Biology, University of Illinois Urbana-Champaign, Urbana, IL 61801, USA

[3] Coral Reef Research Foundation, Koror, PW 96940, Palau

Sedimentologic paleo-El Niño Southern/Oscillation (ENSO) proxies often record only one end of the ENSO spectrum, for example, archiving erosion and deposition events associated with strong El Niño storms in the eastern tropical Pacific. Tropical Pacific paleoclimate records that archive the stable isotopic composition of precipitation may offer a better opportuninty to evaulate the full ENSO spectrum in a range of different paleoclimate archives, given that dry periods should be reflected as high stable isotope ratios and periods of intense convection should drive stable isotope ratios lower, due to the 'amount effect'. Here we present a new, daily-resolved precipitation stable isotope dataset spanning from Palau (7.3°N, 134.4°E), in the western equatorial Pacific. We find a significant and meaningful amount effect at both the daily and monthly timescales from February 2013 to July 2017, although the monthly relationship between precipitation amount and $\delta^{18}O$ is stronger than the daily relationship. Coupled with 4 years of previously published, monthly precipitation $\delta^{18}O$ data from Palau (spanning December 2002 to December 2006), we investigate how different phases of ENSO are manifested in the isotopic composition of monthly precipitation and compare our results to a previous study from the Galápagos, in the eastern tropical Pacific. In the Galápagos, only very strong El Niño events in the NIÑO1+2 (0°-10°S, 80°-90°W) region produced significantly lower median monthly $\delta^{18}O$ values as the sea surface tempreature (SST) threshold for deep convection (28°C) was only surpassed during these strongest El Niño months. In Palau, median monthly precipitation $\delta^{18}O$ values were also only signifcantly higher in strong to very strong El Niño months, as expressed in the NIÑO6 region (140°-160°E, 8°-16°N), due to anomalously dry conditions. Thus precipitation $\delta^{18}O$ values in both the eastern and western tropical Pacific are biased toward strong to very strong El Niño events, which has implications for understanding of the full range of ENSO variability in isotope-based paleoclimate records.