The effect of varying Holocene insolation on ENSO, as recorded by individual foraminifera at the Line Islands, central tropical Pacific

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El Niño-Southern Oscillation (ENSO) is the strongest mode of interannual variability in the modern climate; however, its sensitivity to external forcing (such as insolation or pCO_2) is still debated. We examine ENSO's response to varying summer insolation during the Holocene, using a marine sediment core from the Line Islands, central equatorial Pacific, where ENSO outweighs seasonality as a driver of temperature variability. The site is well situated to test contrasting hypotheses of ENSO behavior. Model studies predict a decrease in ENSO during the mid-Holocene, when equatorial summer insolation was at a maximum, due to negative feedbacks from upwelling [*Clement et al., 1999*]. This prediction is borne out by coral- and foraminiferal-based paleoclimate records from the Line Islands and eastern equatorial Pacific [*McGregor et al., 2013; Koutavas and Joanides, 2012*]. However, a recent compilation of coral records (also from the Line Islands) show no overall Holocene trend, and argue instead that ENSO is dominated by unforced internal dynamics with little response to external insolation forcing [*Cobb et al., 2013*].

Here we present Mg/Ca-derived temperature data from individual planktonic foraminifera analyzed by laser ablation ICP-MS, from seven time intervals throughout the mid- and early Holocene. Both mixed-layer dwelling *G. sacculifer* and subsurface-dwelling *G. tumida* are analyzed to constrain upper water column structure. For each ~400 year-long sample, we generated a population of 75-85 individual temperatures from each species. By analyzing the distribution of these temperatures, the dominant modes of temperature variability (including ENSO) can be identified, and the paleo-distribution can be quantitatively compared to the modern distribution. El Niño/La Niña events most strongly affect the warm and cool "tails" of the distribution, whereas a shift in mean temperature is shown by a constant offset from the modern distribution; changes in seasonality have a small effect on the middle of the distribution, and are readily distinguished from ENSO. Coretop *G. sacculifer* and *G. tumida* temperatures show a similar distribution to modern temperatures near the site [*Carton and Geise, 2008*], indicating that our method captures modern ENSO variability well. Downcore data collected thus far show muted El Niño amplitude relative to the coretop in four mid-Holocene intervals (4680-8345 years before present).