Abstract: The dynamic response of the El Niño Southern Oscillation (ENSO) to varying solar and volcanic forcing is thought to be an important influence on climate during the Medieval Climate Anomaly (MCA), but proxy evidence of ENSO variability during the MCA is sparse. Here we analyze δ¹⁸O from individual mixed-layer dwelling foraminifera (Globigerinids) from a high-resolution (>100 km²) multi-core (MC42) from the Eastern Tropical Pacific (Figure 1) to test the hypothesis that ENSO variability was different in the MCA compared to the 20th Century. We found that δ¹⁸O from instrumental-era samples captured the variability and full range of oceanographic conditions predicted by δ¹⁸O calculated from oceanographic reanalysis data, including peak El Niño and La Niña conditions (Figure 3) and that multi-decadal scale variability in calculated δ¹⁸O is reflected in foraminiferal δ¹⁸O from instrumental-era populations (Figure 2). We also found that δ¹⁸O from individual foraminifera from <1100-1300CE display variability reductions from 27% to 33% compared to late 20th Century values, as well as reduced range and fewer δ¹⁸O outliers (Figure 4), suggesting weaker ENSO activity during the MCA. This reduction is consistent with existing paleo-climate reconstructions and the modeled response of the tropical Pacific to increased solar forcing during the MCA.

Conclusions

1. Do core-top distributions of individual foraminifera δ¹⁸O reflect modern oceanographic conditions at the sample site?
   - **YES** – we find that δ¹⁸O distribution of modern G. ruber is statistically identical to calculated values from reanalysis data at various time intervals in the instrumental era (Figure 3).

2. Is there evidence for multi-decadal resolution?
   - **YES** – G. ruber δ¹⁸O data appear to capture a distinct period of cooler SSTs and decreased ENSO variance in the early 20th Century.

3. Is there evidence for changes in the δ¹⁸O characteristics between modern and MCA samples?
   - **YES** – δ¹⁸O standard deviation and variance are significantly reduced in samples from <1100-1300 as compared to 20th Century intervals (Figure 5).

4. Is there evidence of reduced ENSO activity during the MCA?
   - **YES** – foraminiferal δ¹⁸O from peak MCA intervals display reduced variance, smaller range and fewer statistical outliers compared to late 19th-20th Century foraminifera populations. This reduction of δ¹⁸O variability is on the scale of removal of ENSO from late 19th-20th Century δ¹⁸O values. 5°C variance reduction in the MCA may indicate reduced upwelling. It is likely the changes in total oceanographic variability are due to reductions in both seasonality and ENSO variability during the MCA.