ENSO record in mid-late Holocene fossil corals from Line Islands – Forced response or internal variability?

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A major unresolved issue in climate dynamics is the extent to which the El Niño/Southern Oscillation (ENSO) phenomenon responds to external forcing or is sensitive to global mean climate state. The Holocene represents a natural case study for this issue, given the orbitally-induced changes in radiation and the changes in global climate. Records from the tropical Pacific provide hints that ENSO characteristics may have evolved over the Holocene, but definitive evidence has been lacking.

Here we present fossil coral (genus Porites) derived high resolution oxygen isotopic ($\delta^{18}O$) records spanning the mid-late Holocene. The coral cores were recovered from the Line Island chain near centre of ENSO activity in the central tropical Pacific. These annually banded fossil corals preserve multidecadal windows on climate variability (each segment 50 to 70 years long), and U/Th dates show that the ages of these corals are relatively evenly distributed throughout the last 7ka. The mean growth rates of the corals allow monthly resolution records with 10 to 15 samples/a. El Niño (La Niña) events in the study area are accompanied with positive (negative) sea surface temperature and rainfall anomalies, which in turn are expressed in negative (positive) anomalies in coral $\delta^{18}O$ records. We address the question of whether there were systematic changes in ENSO characteristics, including the possible evidence for a ‘turn on’ after 6 ka.