320 years of modern sea surface pH and SST variability in the South Pacific from coral proxy records

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Marine calcifying organisms are under threat from global climate change, i.e. ocean acidification (OA) and warming sea surface temperature (SST) that result from increasing anthropogenic CO_2 emissions. It is thus important to better understand how marine ecosystems and reef-building corals have responded to climate change relative to historical pH and SST variability. To constrain the natural variability of pH and provide baseline reconstruction and quantification for OA, we measured $\delta^{11}B$ composition in an annually banded modern massive coral, *Diploastrea heliopora*, from New Caledonia in the southwestern Pacific. This coral displays uninterrupted growth between 1690-2012 CE covering historical periods from the termination of the Maunder Minimum (ca. 1690-1715 CE) through the beginning of the Industrial Revolution (ca. 1760-1830 CE) and into the modern era (1900 CE to present). The most striking feature from our pH reconstruction is the evidence of OA (decrease in sea surface pH) based on the depleting $\delta^{11}B$ ratio in the most recent portion of the record. The distinct trend of decreasing $\delta^{13}C$ ratio in this coral documents and confirms the oceanic Suess Effect due to increase in anthropogenic atmospheric CO_2 concentration. This modern decrease in reconstructed pH is concurrent to the significant warming trend of at least 1 ºC as revealed by our coral-based SST proxies (i.e., Sr/Ca and $\delta^{18}O$). The interannual and longer-term decadal to interdecadal variability of our proxy records indicates a coupled anti-phase relationship between pH and SST reflecting similar climatic drivers related to the El Niño/Southern Oscillation (ENSO) and Pacific Decadal Oscillation. Our results support the potential of this coral genus as an archive to study global climate change where the lower frequency variability of South Pacific pH and SST are strongly modulated by ENSO and are coherent with records across the greater Pacific basin.