Paleoceanography

Supporting Information for

Characterizing Seawater Oxygen Isotopic Variability in a Regional Ocean Modeling Framework: Implications for Coral Proxy Records

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Contents of this file

Introduction

Figures S1 to S3 illustrate temporal variability in Equatorial Undercurrent (EUC) in the context of cross-island temperature gradients at Christmas Island. EUC variability in isoROMS is consistent with previous observational studies, with substantial EUC weakening during strong El Nino events and a pronounced seasonal cycle. During time periods when the differences in temperature across Christmas Island are large (i.e. fall/winter 1988/89, 1998/99, 1999/2000, and 2007/08; Figure S2), the EUC tends to be at a seasonal minimum and to lie 0.5 degrees or more south of Christmas (Figure S1, bottom). Additionally, little upwelling is observed at the surface during these time periods (Figure S3). This indicates that EUC-driven upwelling is not the primary cause of these cross-island temperature gradients.

Figure S4 provides an indication of the efficacy of multi-coral averaging in eliminating mesoscale effects, by averaging together temperature time series from the isoROMS LI downscaling experiment. Little change is observed as a function of number of sites combined, owing to the fact that the islands tend to be smaller than the mesoscale.

A complete copy of the isoROMS 20th century dataset can be found on the Earth System Grid: www.earthsystemgrid.org

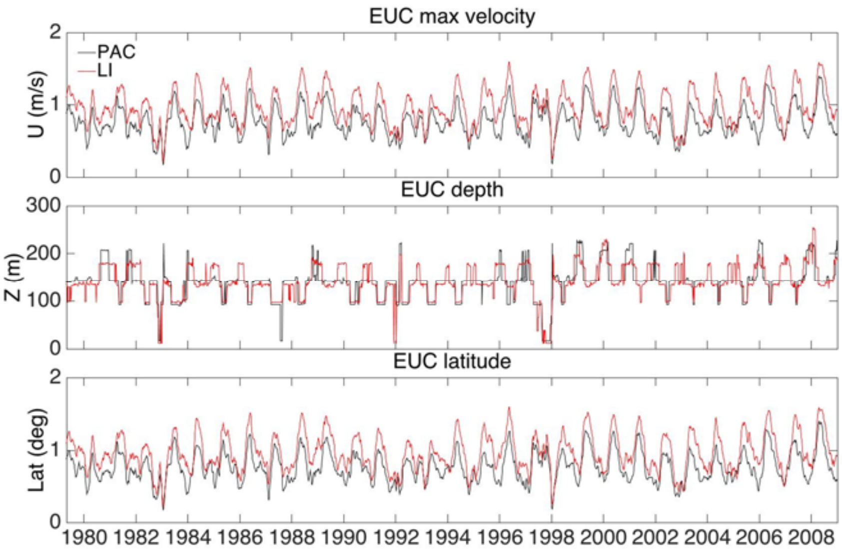

Figure S1. Metrics for the Equatorial Undercurrent, following a slightly modified version of the methodology of Drenkard & Karnauskas (2014). The core of the EUC is defined as the location of maximum 30-day running mean zonal velocity, over the domain 2S-2N, 175-145W, from 10-300m depth. a) Maximum velocity (m/s); b) EUC depth (m); c) EUC latitude (degrees N). In all panels, the PAC simulation is plotted in black and the LI simulation in red.

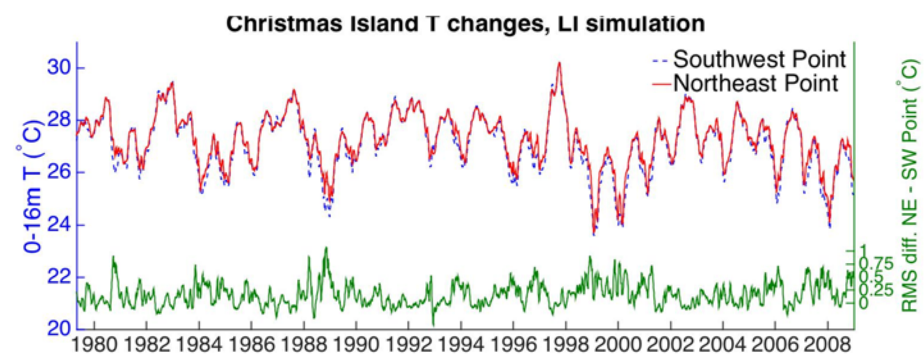

Figure S2. Reproduction of Figure 11a from the main text, illustrating the lack of relation between the EUC and cross-island temperature differences at Christmas Island. Left-hand axis plots gridpoint 0-16m temperatures at Northeast Point (red) and Southwest Point (blue); the RMS difference between the two is plotted in green, along the right-hand axis.

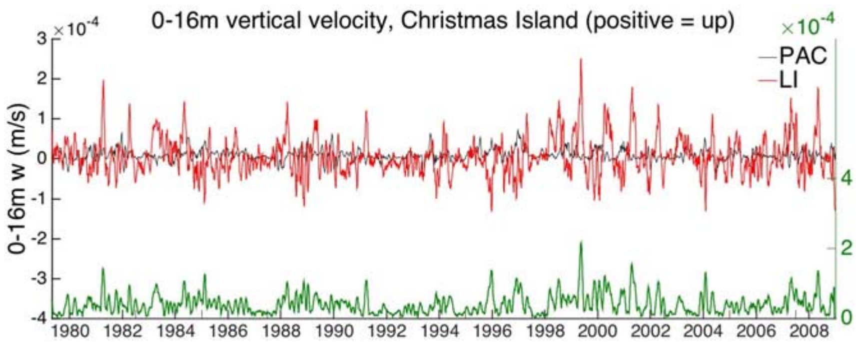

Figure S3. Illustration of the association between surface upwelling and cross-island temperature differences at Christmas Island. Left-hand axis plots gridpoint 0-16m vertical velocity for the nearest PAC gridpoint to Christmas (black) and the LI gridpoint nearest Southwest Point in LI (red). Positive values indicate upwelling. The RMS difference in vertical velocity between the PAC and LI simulations is plotted in green.

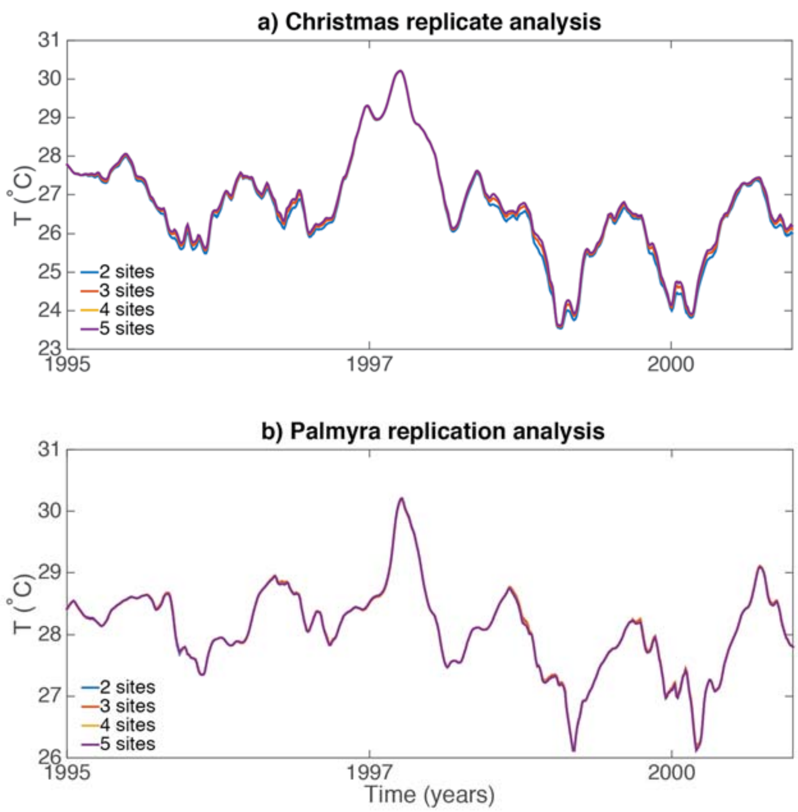

Figure S4. Replicate analysis for a) Christmas and b) Palmyra 0-16m temperature in the LI simulation. Colored lines indicate the number of gridpoints used in the average, selected according to their Euclidean distance from the island.

References

Drenkard, E. & Karnauskas, K. 2014, "Strengthening of the Pacific Equatorial Undercurrent in the SODA Reanalysis: Mechanisms, Ocean Dynamics, and Implications", *Journal of Climate,* 27, 2405-2416