Four centuries of tropical Pacific sea-surface temperature from coral archives

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Our ability to judge the significance of recent climate change is fundamentally limited by the shortness and sparsity of the instrumental record. It is crucial to extend the latter, particularly in the tropical Pacific where powerful air/sea interactions orchestrate global-scale low-frequency climate variability. Multiproxy reconstructions of tropical sea-surface temperature (SST) variability have traditionally relied heavily on extratropical proxy records, particular dendrochronological ones. Such dependence hampers a rigorous examination of the links between tropical SST and continental hydroclimate in the pre-instrumental era. Here we use an expanded network of high-resolution coral proxies and a novel statistical methodology (GraphEM, *Guillot et al.*, submitted) to reconstruct tropical Pacific SST back to 1600 C.E solely from annually-banded coral archives.

The network and method prove able to capture $\sim 30\%$ of interannual SST variability in the NINO3.4 region, but systematically under-represents El Niño events, especially strong ones, which negatively affect coral physiology at some sites. La Niña events, however, are more faithfully captured.

The reconstructed NINO3.4 displays no long-term trend since 1600 C.E, contradicting claims that the twentieth century is anomalous with respect to a long-term baseline (*McGregor et al.*, 2010). Changes in the preponderance of ENSO 'flavors' (Eastern Pacific vs Central Pacific El Niño events) are assessed using the methodology of (*Yeh et al.*, 2009), and suggests that the late twentieth century trend towards increased CP El Niño occurrences is within historic norms, consistent with results employing a multivariate red noise model (*Newman et al.*, 2011).

The link to North American droughts is assessed by comparison to the Palmer Drought Severity Index from the North American Drought Atlas v2a (*Cook et al.*, 2004; *Cook*, 2008): the pattern corresponding to notable droughts in the US southwest is a cool tropical Pacific, both during the instrumental and pre-instrumental period. In detail, SST patterns associated with individual drought episodes may deviate from the canonical La Niña (*Cook et al.*, 2007). Finally, superposed epoch analysis confirms the results of *Adams et al.* (2003) that El Niño events tend to follow large tropical explosive eruptions. A formal analysis of uncertainties will put these findings in a probabilistic context.

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