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Signature of ENSO in a coral record from the southern Red Sea

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We investigate the large-scale climatic patterns associated with interannual variability in a coral 18O record from the southern Red Sea during the Northern Hemisphere winter season. The coral 18O record, which reflects a combined signal of temperature and salinity variations in the surface waters, covers the period 1931-1992 and has a seasonal resolution. A correlation analysis reveals that the winter coral 18O record is associated with coherent patterns of temperature and sea level pressure on a near global scale, which reflect ENSO variability on interannual time scales and PDO variability on decadal time scales.

Multi-taper method (MTM), Singular Spectrum Analysis (SSA), wavelet and cross spectra techniques are used to identify the coherent cyclic and non-stationary modes in the winter coral 18O record. MTM analysis reveals strong periodicities in the 2.5 to 7.5 year band, possibly associated with the ENSO phenomenon of tropical Pacific origin. Wavelet spectral analysis also reveals a strong signal in the 2.5 – 7.5 year band. Furthermore, the MTM spectrum of the winter coral 18O record shows significant peaks at 15 to 20 years, which could be indicative of a PDO influence on southern Red Sea climate during the last century.

A running correlation analysis reveals that the connection between the winter coral 18O record from the southern Red Sea and indices of ENSO and PDO is non-stationary over the last century. We identified periods when ENSO and PDO, ENSO only, PDO only or neither ENSO nor PDO influence southern Red Sea climate. The structure of the associated global teleconnections during these periods is discussed based on statistical analysis of instrumental data sets of the ocean and the atmosphere.