224

A 2,000 YEAR RECORD OF THE ENSO – ANTARCTIC OSCILLATION BATTLE IN COASTAL VICTORIA LAND

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On interannual to decadal time scales tropospheric Antarctic circulation is dominated by three forces: ENSO (El Niño Southern Oscillation), AAO (Antarctic Oscillation or Southern Annular Mode), and potentially ACW (Antarctic Circumpolar Wave) but there is disagreement on their relative influences and temporal robustness.

We present high resolution records from six snow pits from the McMurdo Sound region (Victoria Lower Glacier, Wilson Piedmont Glacier, Baldwin Valley Glacier, Shapeless Mountain, Evans Piedmont Glacier and Mt Erebus Saddle, and a 180m deep core from Victoria Lower Glacier. The snow pits are dated using annual layer counting and represent up to ~50 years. The core is dated using annual layer count, tritium dating of the ice, and volcanic horizons. Water chemistry (major ion – Ca, K, Mg, Na & Cl, NO_3, SO_4, trace elements – Al, Fe, Mn, P, S, Si, Sr), oxygen isotopic ratios, dust concentration, and density fluctuations are presented. The ice core proxies were calibrated to meteorological (AWS) data using transfer functions.

We employ empirical function analysis to correlate snow pit and ice core proxies with meteorological and re-analysis data. We find strong correlations between temperature and oxygen isotope data; and zonal and meridional wind direction and sea salt aerosols, respectively. We also use airmass trajectory calculations to reconstruct paleoclimate circulation pattern and snow precipitation history at our study sites.

Our data support the concept of a double-sided ENSO effect in the Ross Sea Region, but show that the ENSO forcing is non-linear and non-stationary. We argue that the interplay between katabatic winds and cyclonic activity in coastal Antarctica has caused interference between ENSO and AAO for at least the last 2,000 years. The ACW appears to be of lesser importance in the southern Ross Sea Region.