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A 2000 year reconstruction of Southern Ocean sea surface temperature from the Law Dome ice core.

Content

The lack of reliable observational records of sea surface temperature (SST) from the Southern Ocean spanning more than a few decades remains a key factor in limiting our attempts to understand climate variability in the Southern Hemisphere on inter-annual to centennial scales. The ice core from the Dome Summit South (DSS) site at Law Dome, East Antarctica, has very high temporal resolution due to the high snow accumulation rate. The annually resolved climate records provided by this ice core capture atmospheric and ocean processes from the Pacific and Indian sectors of the Southern Ocean. Here, we present a 2000 year reconstruction of SST using a combination of snow accumulation rate and sea salt records from the DSS ice core which shows skill in these sectors of the Southern Ocean.

Back trajectory analysis of ERA-Interim reanalyses data shows that the moisture falling as snow Law Dome originates from a broad region of the Southern Ocean, but predominately from a region to the west of Law Dome (between approximately 80 °E to 140 °E longitude). The seasonal cycle of the estimated concentration of sea salts carried with this moisture and deposited at Law Dome is in good agreement with the measured ice core record. Through the relationship between atmospheric-ocean heat exchange and wind speed, we find the Law Dome ice core sea salt aerosol record to be a proxy for SST which we use to reconstruct the past 2000 years of SSTs. Examination of the time series of the dominant temporal modes of this reconstruction shows a break point in the time series at 1259 CE. This shift is coincident with a series of volcanic eruptions also recorded in the same ice core archive, thus eliminating timing uncertainties between the two events, suggesting that the end of Medieval Warm Period may have been a result of a climate response to the eruptions.

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