Reconstructing Climate Variability Since 1880 Through Paleoclimate Proxies

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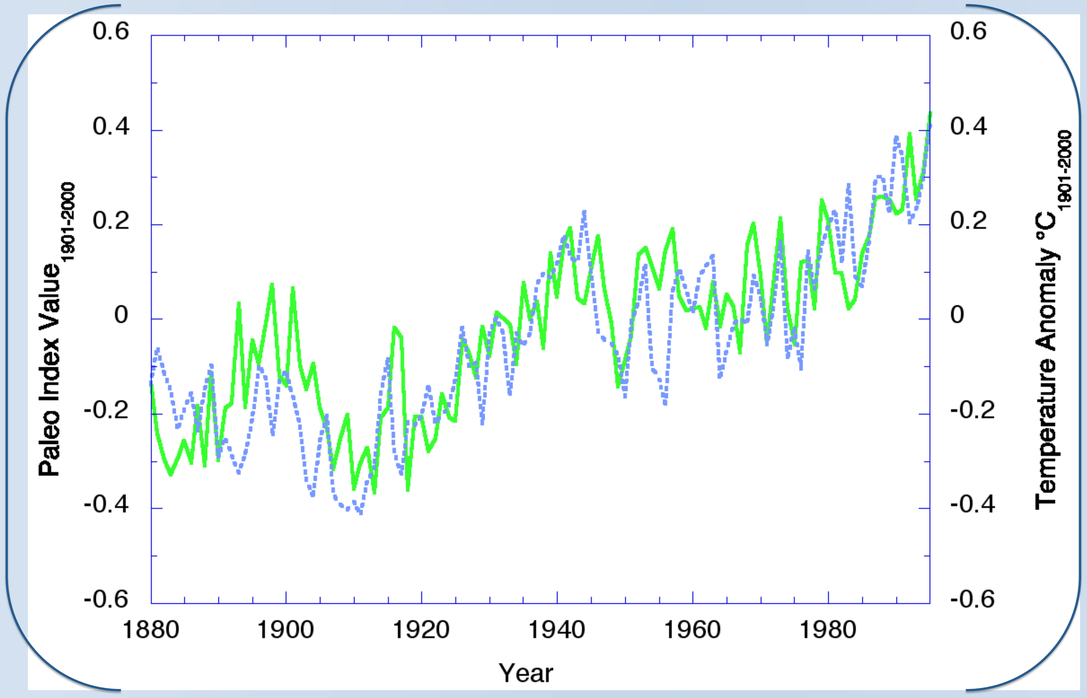
Method

Select paleo proxy time series that contain at least 10 samples between 1880-2000 (decadal resolution). Include only proxies for which sensitivity to temperature is attributable to a physical link (see table below). Tree rings were not included.

Each series was normalized by subtracting the mean (1901-2000) and then dividing by the standard deviation of that period. Yearly values were calculated for each of the 117 series (less-than-annually resolved series have years with missing values), proxy series whose values decrease with warming (Sr/Ca, $d^{18}O_{carbonate}$) were multiplied by -1, and averages of the annualized data were calculated to form an index.

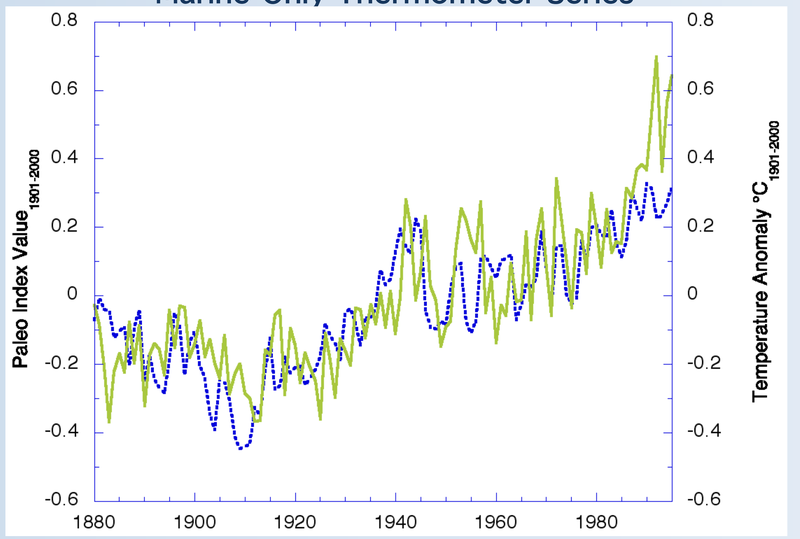
We performed an additional evaluation in which the instrumental data were strongly truncated to have common spatial coverage with the PI sites. We used a four step process for this comparison: 1) we calculated the annual mean of the four MLOST grid cells nearest to each PI site, for each year in which at least two grid cells had data; 2) we removed from analysis those PI sites for which the MLOST time series calculated in step (1) contain mostly or all missing values (all in high latitudes), leaving 95 sites for comparison; 3) we calculated the annual means across the 95 remaining MLOST and PI time series; and 4) we converted the mean MLOST anomalies calculated in step (3) to have the same 1901-2000 reference period as the PI data.

Paleo Index is Similar to Global Surface Temperature Series Derived from Thermometers (NOAA MLOST series)

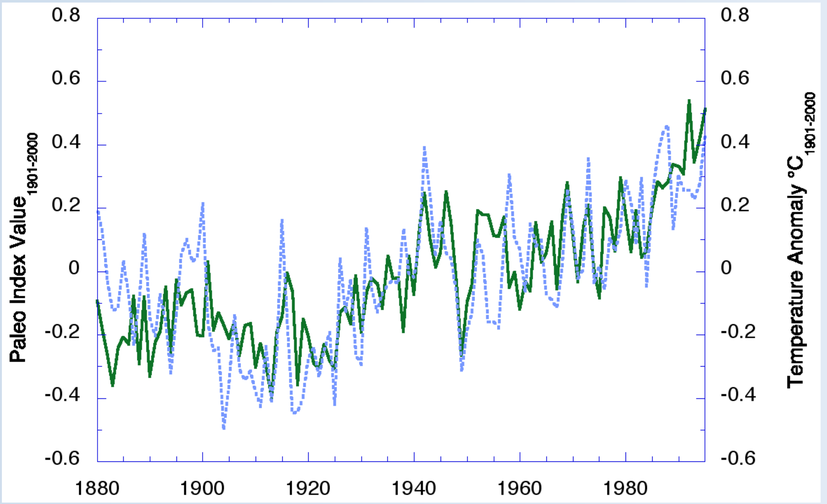


Paleo index (solid red line) and the merged land-ocean surface temperature anomalies (dashed blue line), both relative to 1901-2000. Paleo index derived from 117 time series of standardized index values binned into annual values and then averaged to create the global time series. The series have the same mean (0). The range of the paleo trends index is coincidentally nearly the same as the GST although the quantities are different (index values versus temperature anomalies °C).

Marine-Only Paleo Index (n=67) Has Trend Similar to Marine-Only Thermometer Series

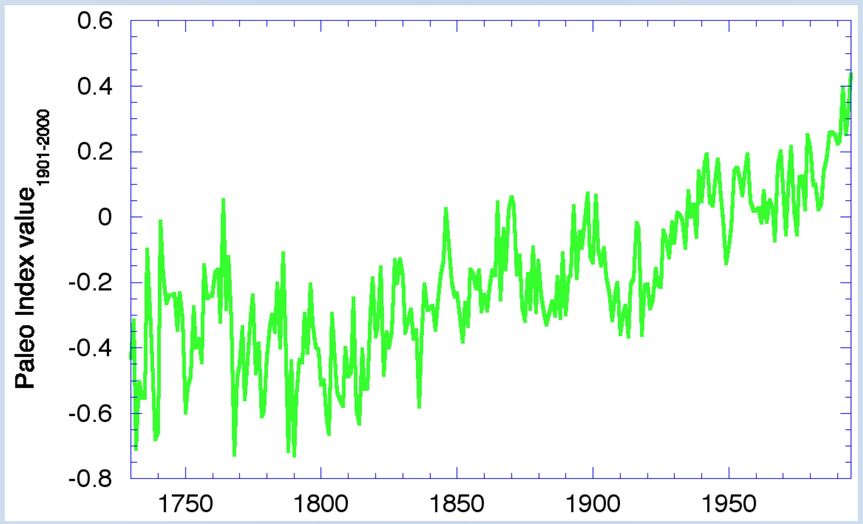


Common-Spatial Coverage Comparison (see method) Confirms Paleo Index and Temperature Series Have Similar Trend



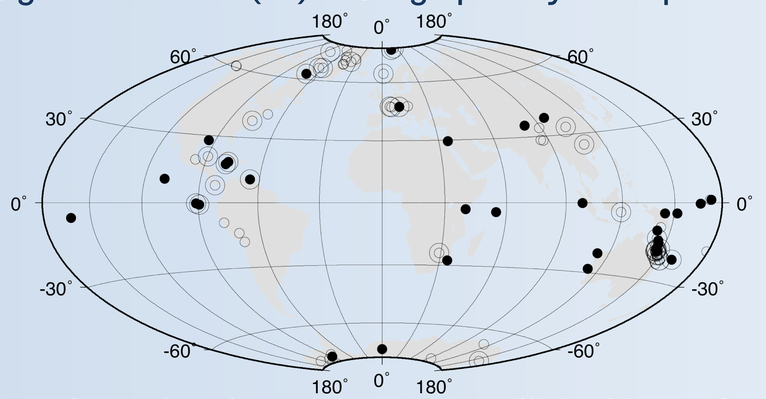
Recent Trend (1980-1995) Exceeds the Overall Trend (1880-1995) at many locations for many proxies. Number of series (N) Compiled by Proxy Type, and the Number of Series Where the Recent Trend (1980-1995) Exceeds the Overall Trend (1880-1995).

PROXY TYPES	MEASUREMENTS	N	TREND INCREASING
Coral	Mg/Ca, Sr/Ca, $\delta^{18}O$	26	8
Coral	Extension Rate	35	2
Ice Core	δD, $\delta^{18}O$	37	1
Marine/Lake Sediment	Mg/Ca, $\delta^{18}O$, Sediment	8	1
Phenology	Event Date, Growth Extent	3	1
Sclerosponge, Mollusk	Sr/Ca, $\delta^{18}O$	5	1
Speleothem	$\delta^{18}O$	3	1
TOTAL		117	15



Paleo index extending back to 1730. Many of the 117 time series contain more than one observation per year, including some corals sampled at near-monthly resolution.

Significant Trend (•) is Geographically Widespread



Map of sites with significant trend over 1880-1995 (filled circle), no significant trend (open circle), and sites extending back to 1730 (n=45) (double circle).

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