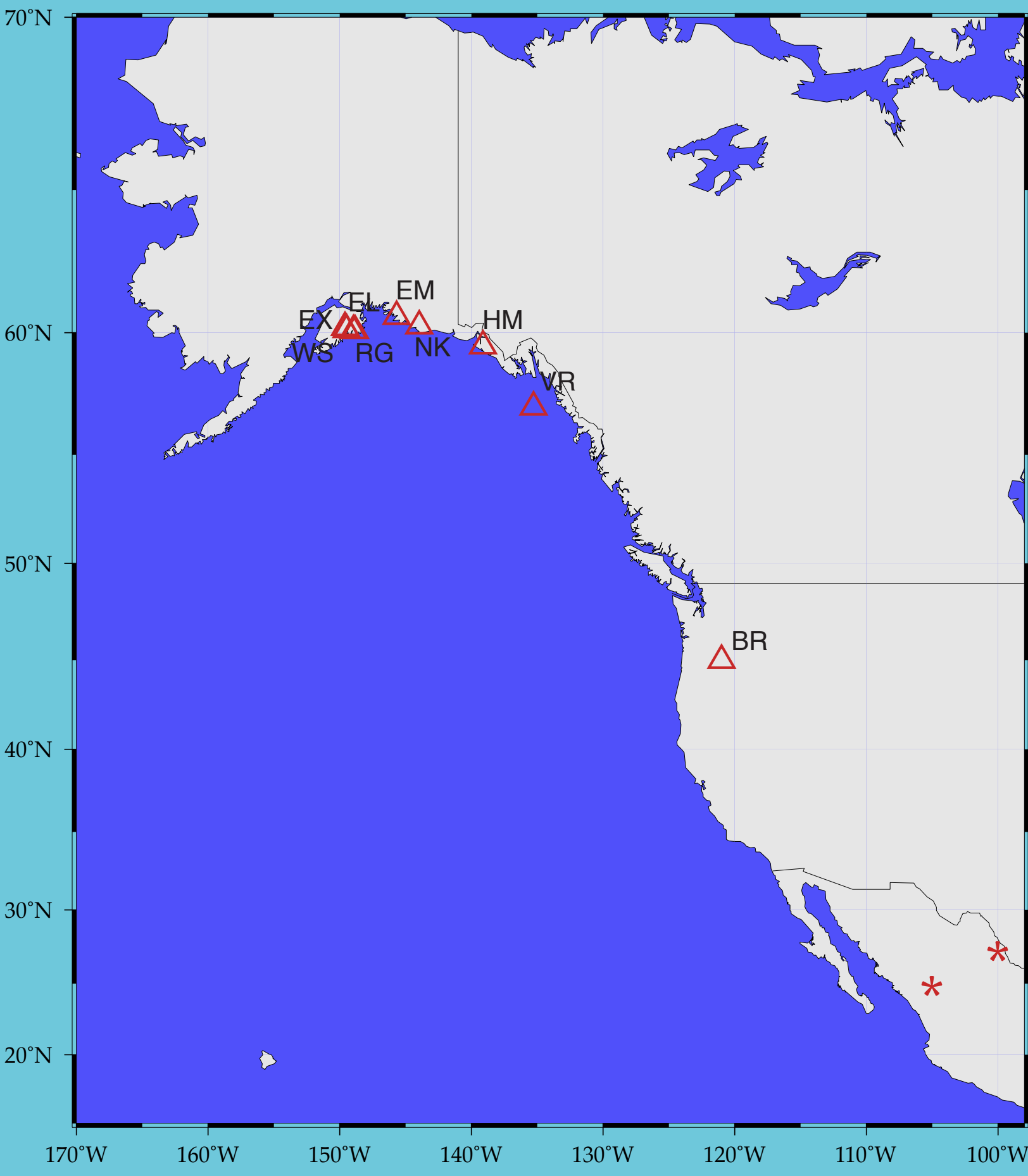
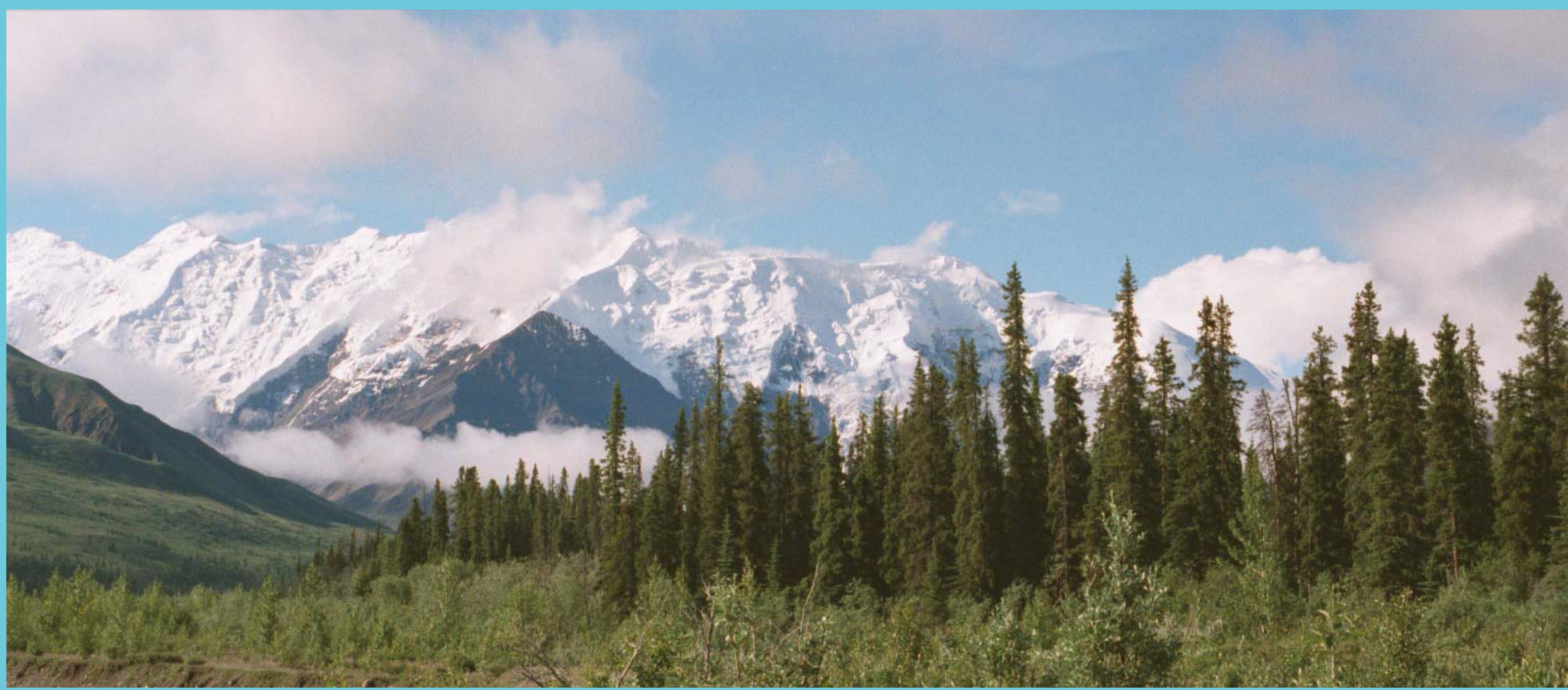


TREE-RING ESTIMATES OF PACIFIC DECADAL CLIMATE VARIABILITY

Rosanne D'Arrigo¹, Ricardo Villalba² and Gregory Wiles³

1. TRL-LDEO, Palisades, NY (druidrd@ldeo.columbia.edu)
2. IANIGLA-CRICYT, Mendoza, Argentina
3. College of Wooster, Wooster, Ohio

ABSTRACT: Decadal-scale oscillatory modes of atmosphere-ocean variability have recently been identified in instrumental studies of the Pacific sector. The regime shift around 1976 is one noteworthy example of a Pacific decadal climatic fluctuation, which has been shown to have significantly impacted climate and the environment along the western Americas. The length of meteorological data for the Pacific and western Americas critically limits such analyses of decadal-scale climate variability. Here we discuss recent studies of decadal-scale oscillations using temperature and precipitation-sensitive tree-ring series from the circum-Pacific spanning the past several centuries. Evaluation of these tree-ring records, from the western coasts of the two Americas, as well as Hokkaido and Kamchatka, reveals a shift towards less pronounced interdecadal variability in the instrumental period, after about the middle 1800s. We also describe reconstructions of the annual Pacific Decadal Oscillation (PDO) Index based on western North American tree-ring records, which extend as far back as AD 1700. Our analyses suggest that both coastal Alaska and vicinity, as well as the subtropical Americas need to be represented in proxy data sets used to reconstruct the PDO.



Map of western North America showing locations of tree-ring chronologies used in PDO reconstruction. Stars indicate two PDSI (Cook et al., in press) gridded reconstructions used in PDO model.

Temperature-sensitive tree-ring chronologies used to model the annual Pacific Decadal Oscillation index. AK = Alaska, OR = Oregon. DEN = Density, RW = Ring width. Barlow Pass data from K. Briffa and F. Schweingruber. Hemlock Knob series from D. Frank. TSME= mountain hemlock, PISI = Sitka spruce, PSME = Douglas Fir. Shorter NK, WS and HM series deleted from longer reconstruction.

Site		Lat. N	Long. W	Years	Elev. M	Species
Eyak Mt.,AK	(EM) RW	60 36	145 40	1191-1992	430	TSME
Nichawak Mt	(NK) RW	60 15	143 58	1762-1992	310	PISI
Exit Glacier,AK	(EX) RW	60 12	149 35	1650-1988	300	PISI
Water Supply,AK	(WS) RW	60 07	149 28	1729-1989	305	TSME
Ellsworth, AK	(EL) RW	60 05	148 58	1543-1991	480	TSME
Rock Glacier,AK	(RG) RW	60 04	148 50	1599-1991	420	TSME
Hemlock Knob,AK	(HM) DEN	59 29	139 08	1742-1991	30	TSME
Verstovia, AK	(VR) RW	57 03	135 16	1387-1996	675-765	TSME
Barlow Pass,OR	(BP) DEN	45 00	121 00	1504-1983	1300	PSME

Calibration and verification statistics for PDO reconstruction models. ar² is variance explained accounting for degrees of freedom, RE is reduction of error statistic (positive values signify predictive skill), ST is sign test (plus values indicate correct sign of tree-ring estimates), P is Pearson coefficient. Significance levels given in parentheses.

1790 VERSION

Calibration Period	ar ²	RE	ST	T Test	P
1900-1939 early	34%	.17	27+ 12- (.012)	1.84 (.035)	.42 (.004)
1940-1979 late	42%	.10	28+ 11- (.012)	2.31 (.013)	.55 (.000)
1900-1979 full	53%				

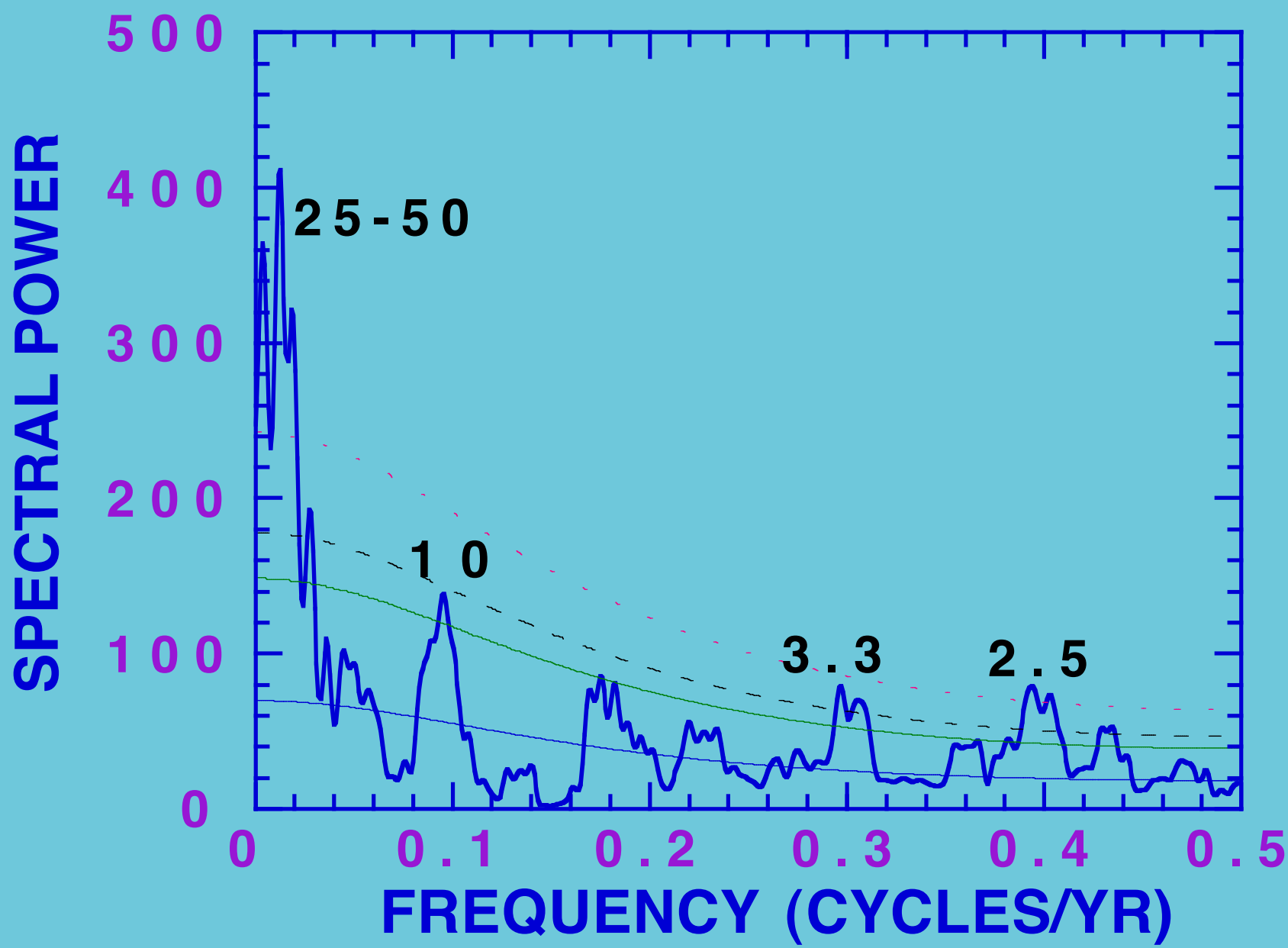
1700 VERSION

Calibration Period	ar ²	RE	ST	T Test	P
1900-1939 early	23%	.19	28+ 11- (.005)	1.86 (.034)	.44 (.002)
1940-1979 late	33%	.08	28+ 11- (.005)	2.86 (.003)	.54 (.000)
1900-1979 full	44%				

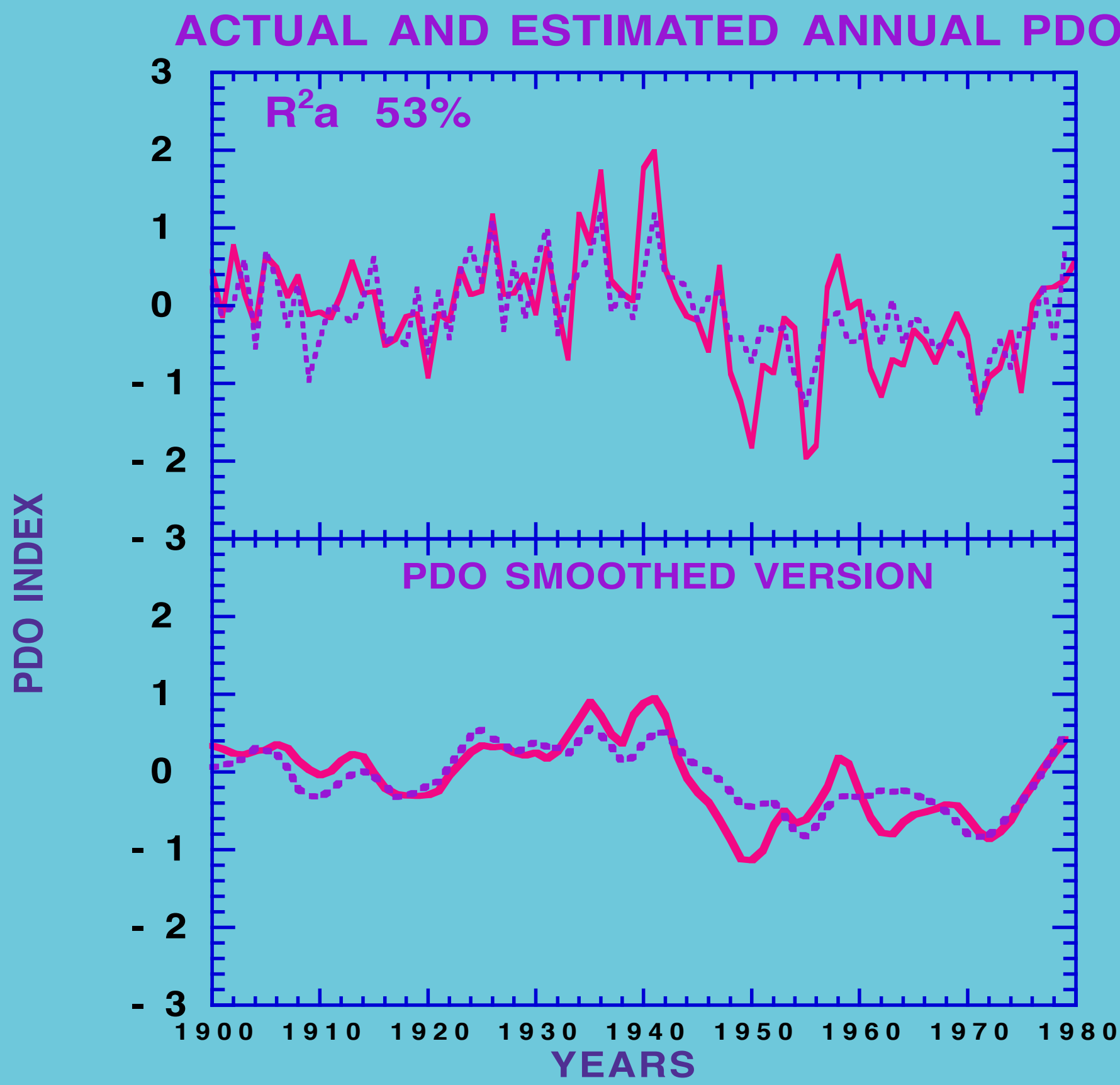
Correlations between tree-ring series and PDO.

Site	1900-39	1940-79	1900-79
Eyak Mt.	.40	.22	.30
Nichawak Mt	.23	.24	.32
Exit	.21	.27	.24
Water Supply	.12	.48	.33
Ellsworth	.18	.39	.25
Rock Glacier	.18	.50	.40
Hemlock Knob	.48	.50	.43
Verstovia	.38	.35	.47
Barlow Pass	.20	.33	.26
—			
PDSI Grid Point 26.2°N 100.0°W	.51	.60	.60
PDSI Grid Point 23.8°N 105.0°W	.16	.28	.19

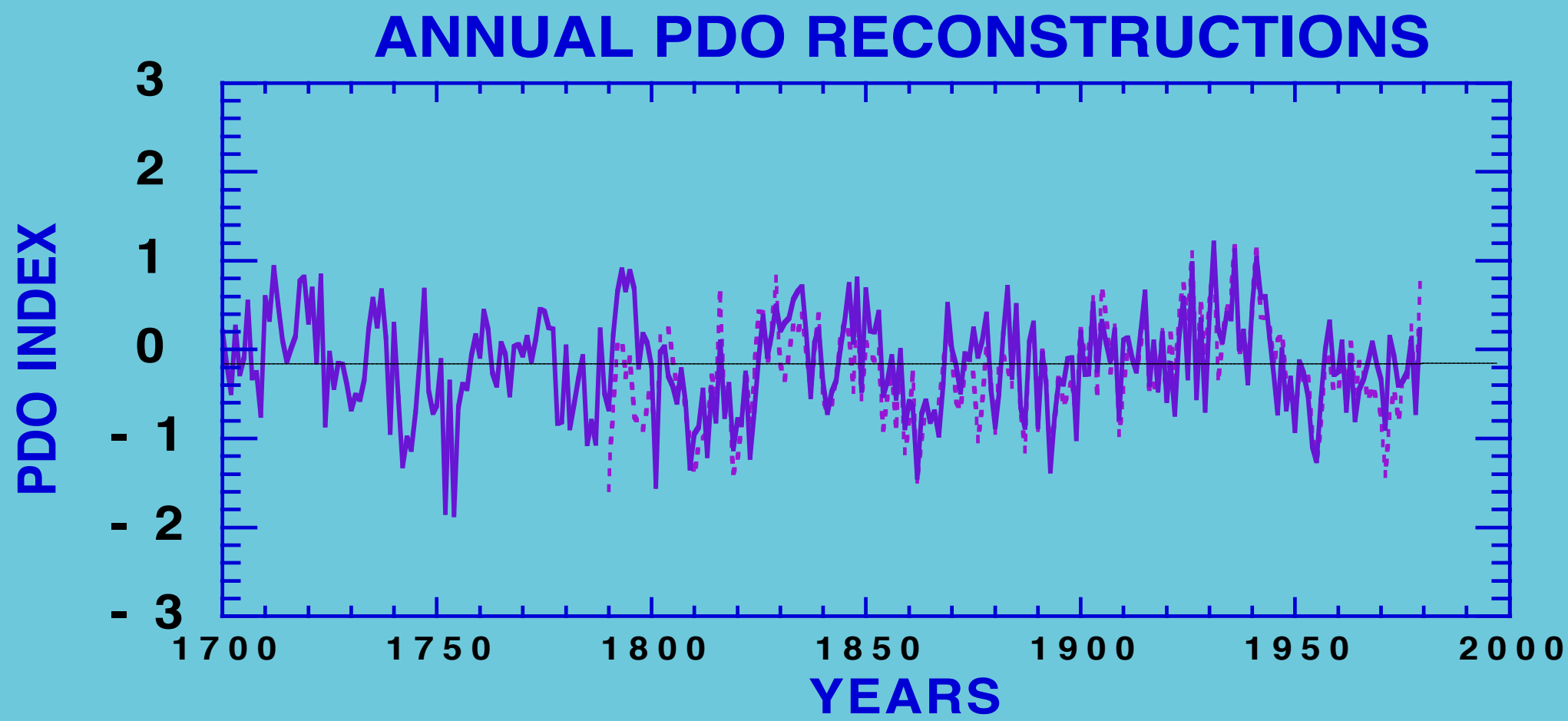
PDO RECONSTRUCTION 1790-1979



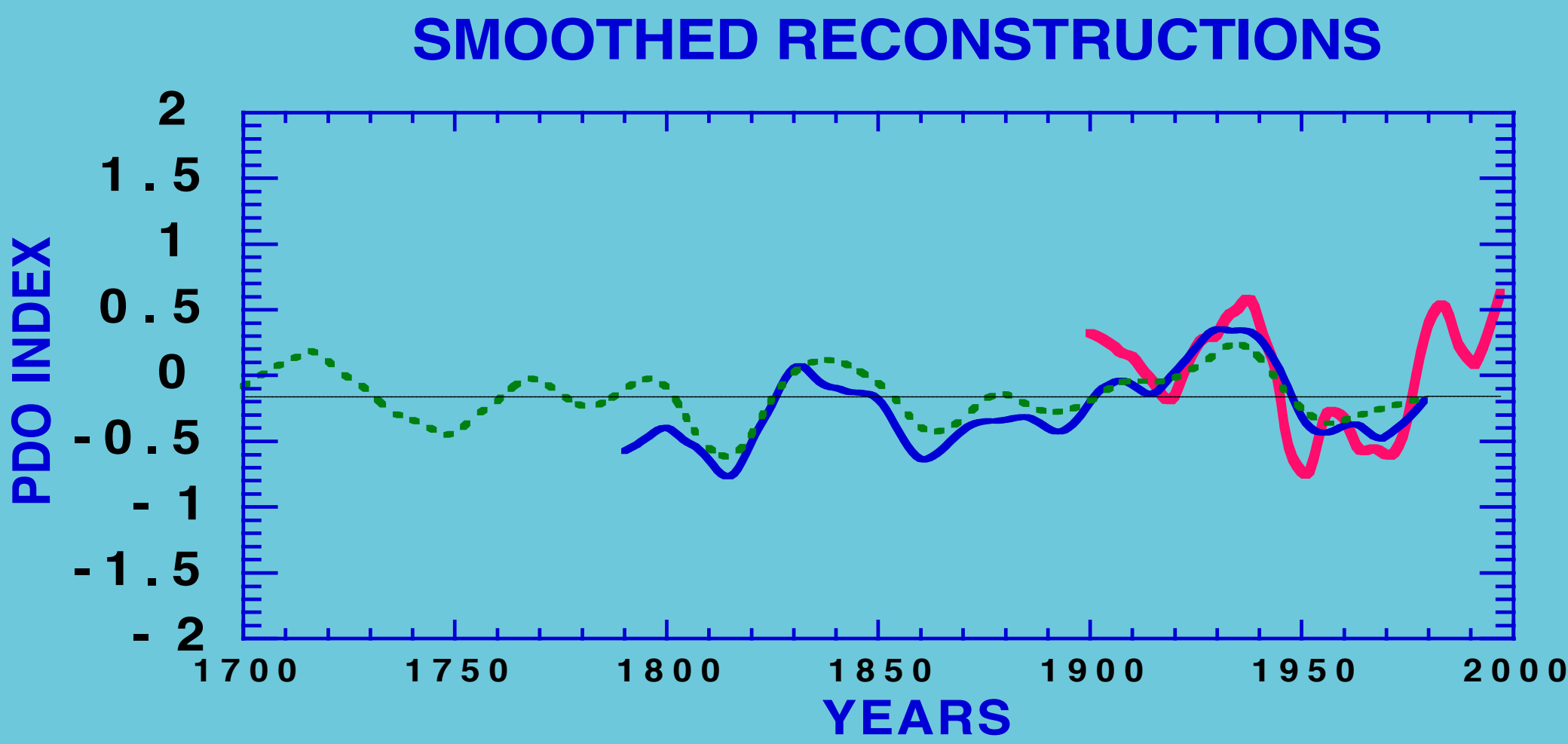
Multi-taper spectral analysis of PDO reconstruction from 1790-1979. Note significant spectral modes at interannual to decadal time scales. 50, 90, 95 and 99% confidence levels indicated.



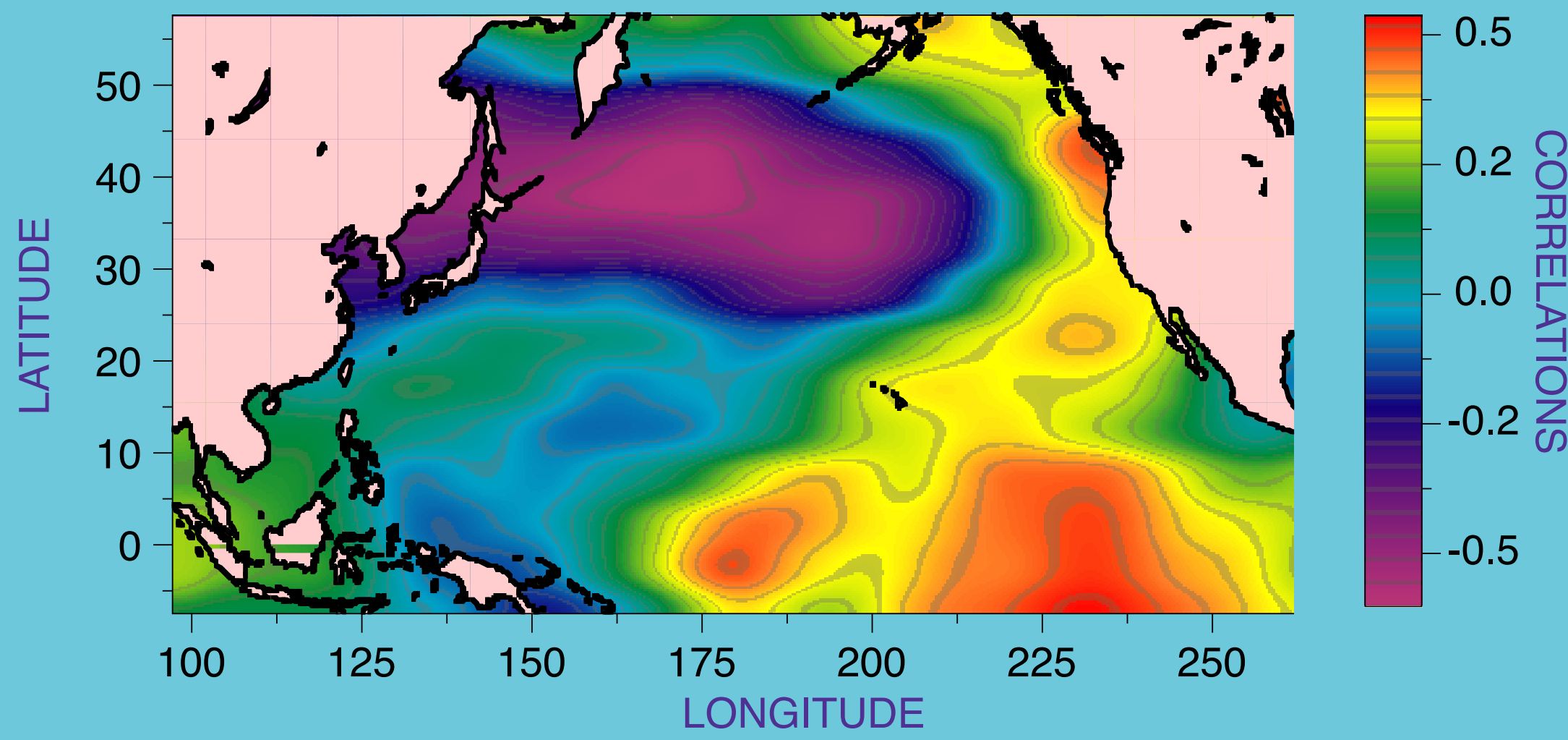
Actual and estimated PDO for 1900-1979 calibration period. Tree-ring climate model based on principal components regression analysis using tree-ring series from both coastal Alaska and the Pacific Northwest, as well as Mexico as predictors in the reconstruction. Lower plot: smoothed version emphasizes decadal variations.



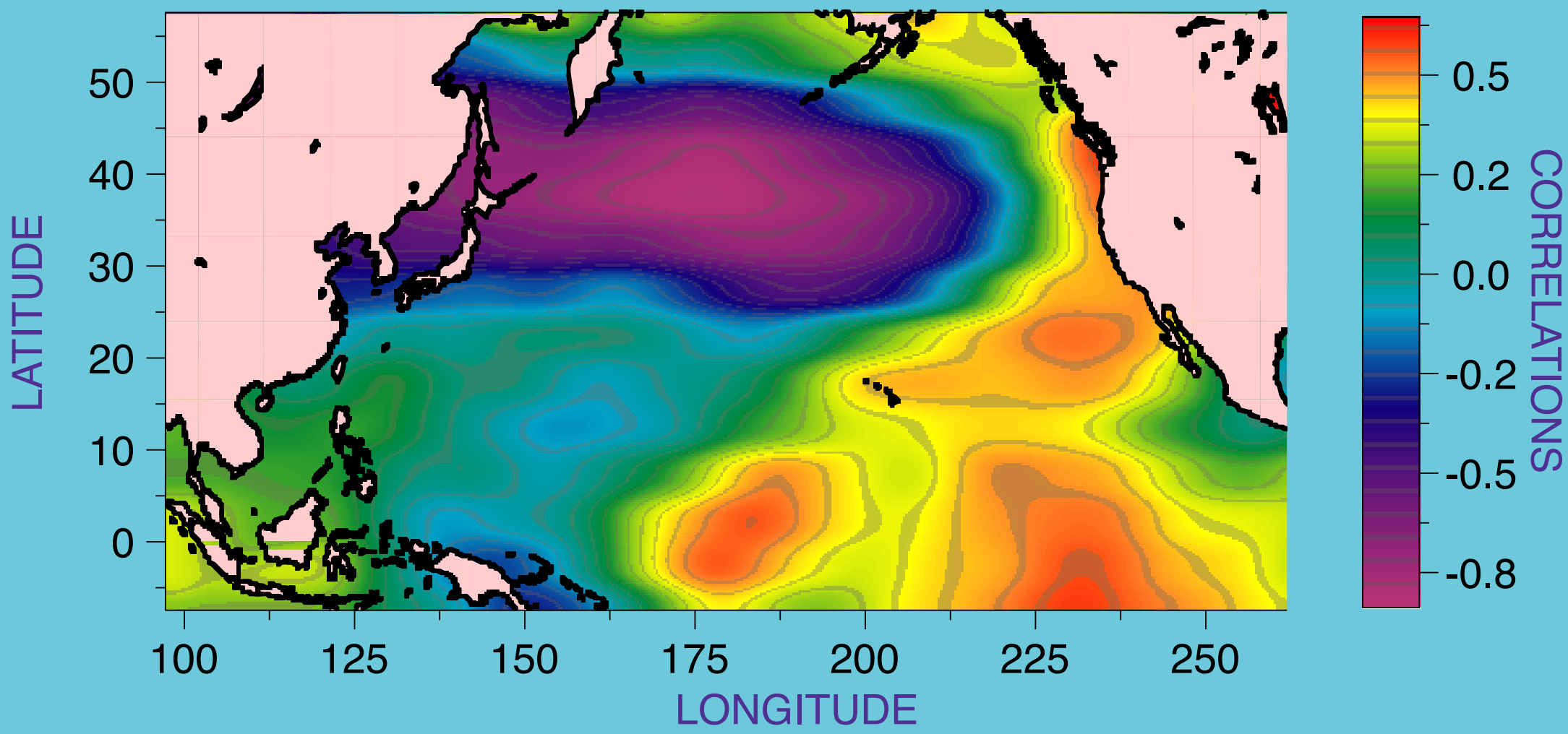
PDO reconstruction (dashed line) from 1790-1979 based on 11 tree-ring series. Alternative model (solid line) from 1700-1979 based on 8 series. Smoothed versions are shown in plot below. Red line below shows instrumental data, blue line is short reconstruction and green dashed line is longer version.



PDO RECONSTRUCTION AND PACIFIC SST



ANNUAL PDO AND PACIFIC SST



Spatial maps showing correlations fields between Pacific SST and PDO indices. Top map, instrumental annual PDO and SST. Bottom map, reconstructed annual PDO and SST.

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