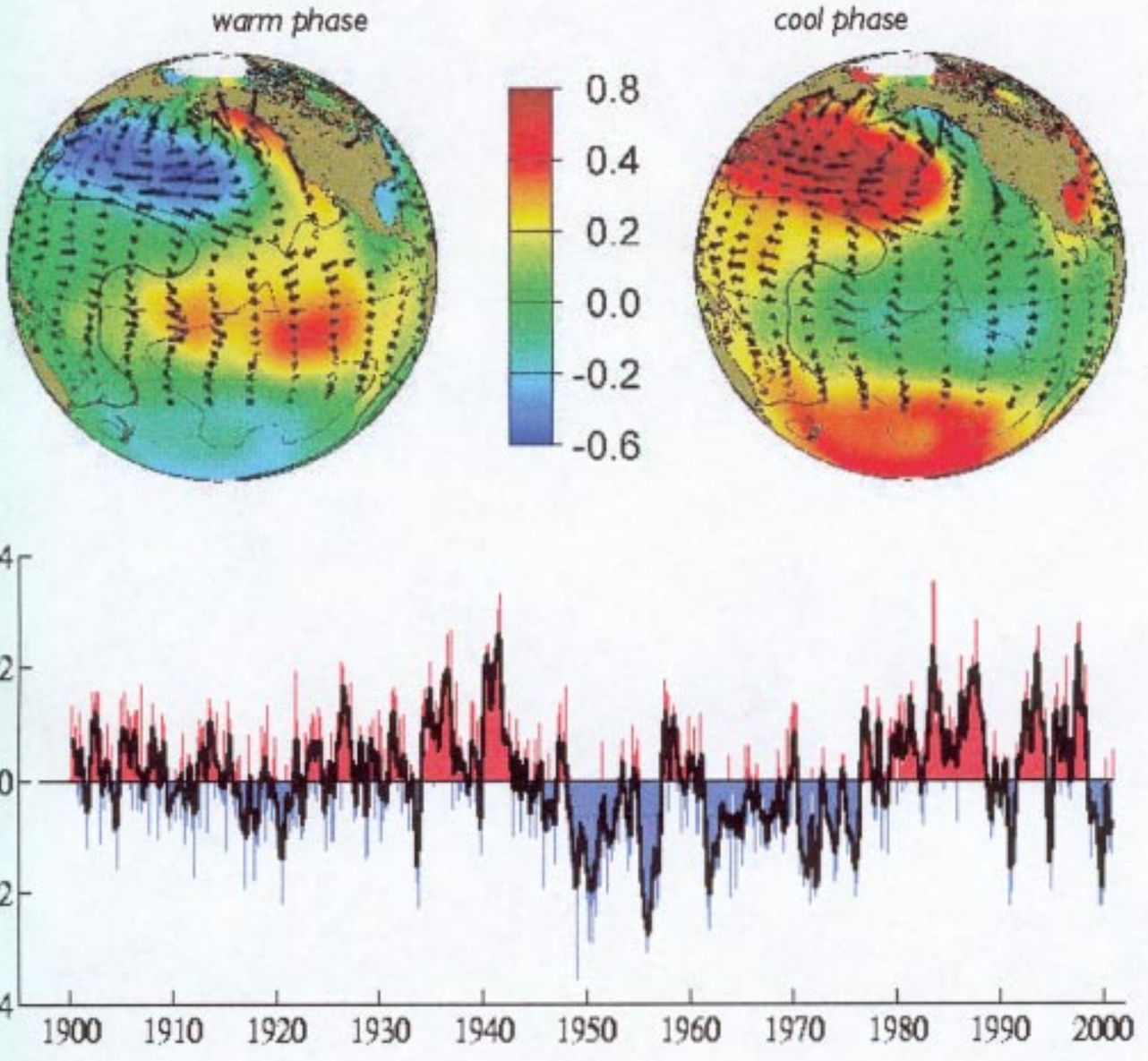
The Pacific Decadal Oscillation (PDO)

Typical wintertime Sea Surface Temperature (colors), Sea Level Pressure (contours) and surface windstress (arrows) anomaly patterns during warm and cool phases of PDO



The "Pacific Decadal Oscillation" (PDO) is a long-lived El Niño-like pattern of Pacific climate variability. While the two climate oscillations have similar spatial climate fingerprints, they have very different behavior in time. Fisheries scientist Steven Hare coined the term "Pacific Decadal Oscillation" (PDO) in 1996 while researching connections between Alaska salmon production cycles and Pacific climate (his dissertation topic with advisor Robert Francis). Two main

characteristics distinguish PDO from El Niño/Southern Oscillation (ENSO): first, 20th century PDO "events" persisted for 20-to-30 years, while typical ENSO events persisted for 6 to 18 months; second, the climatic fingerprints of the PDO are most visible in the North Pacific/North American sector, while secondary signatures exist in the tropics - the opposite is true for ENSO. Several independent studies find evidence for just two full PDO cycles in the past century: "cool" PDO regimes prevailed from 1890-1924 and again from 1947-1976, while "warm" PDO regimes dominated from 1925-1946 and from 1977 through (at least) the mid-1990's. Shoshiro Minobe has shown that 20th century PDO fluctuations were most energetic in two general periodicities, one from 15-to-25 years, and the other from 50-to-70 years.
http://ingrid.ldeo.columbia.edu/%28/home/alexeyk/mydata/TSsvd.in%29readfile/.SST/.PDO/

Major changes in northeast Pacific marine ecosystems have been correlated with phase changes in the PDO; warm eras have seen enhanced coastal ocean biological productivity in Alaska and inhibited productivity off the west coast of the contiguous United States, while cold PDO eras have seen the opposite north-south pattern of marine ecosystem productivity.

Causes for the PDO are not currently known. Likewise, the potential predictability for this climate oscillation are not known. Some climate simulation models produce PDO-like oscillations, although often for different reasons. The mechanisms giving rise to PDO will determine whether skillful decades-long PDO climate predictions are possible. For example, if PDO arises from air-sea interactions that require 10 year ocean adjustment times, then aspects of the phenomenon will (in theory) be predictable at lead times of up to 10 years. Even in the absence of a theoretical understanding, PDO climate information improves season-to-season and year-to-year climate forecasts for North America because of its strong tendency for multi-season and multi-year persistence. From a societal impacts perspective, recognition of PDO is important because it shows that "normal" climate conditions can vary over time periods comparable to the length of a human's lifetime .

Data

The Pacific Decadal Oscillation (PDO) Index is defined as the leading principal component of North Pacific monthly sea surface temperature variability (poleward of 20N for the 1900-93 period). Digital values of our PDO index are available from Nate Mantua's anonymous ftp directory (linked here). Please send email to Nate (mantua@atmos.washington.edu) or Steven Hare (hare@iphc.washington.edu) to let them know that you have obtained this data. Nate updates the PDO index every two or three months.

Alexey Kaplan's PDO reconstructions for 1856-1991: SST and SLP

A link to Trenberth and Hurrell's "North Pacific Index" for North Pacific area-weighted sea level pressure (a good index for the intensity of the Aleutian Low pressure cell). More information on this index and its importance to North Pacific and North American climate is detailed in Trenberth and Hurrell (1994): Decadal atmosphere-ocean variations in the Pacific. *Climate Dynamics*, Vol. 9, p 303-319.

Steven Hare's collection of links to Pacific fishery and climate time series.

NOAA's Climate Diagnostics Center interactive correlation maps, with links to many other climate indices (like the SOI, AO, NAO, etc.)

The Aleutian Low Pressure Index (ALPI) from Canada's Pacific Biological Station.

Key References to PDO research

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PDO review articles

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Mantua, N.J. 1999: The Pacific Decadal Oscillation and Climate Forecasting for North America. To appear in premiere issue of "Climate Risk Solutions" newsletter.

Francis, R. C., S. R. Hare, A. B. Hollowed, and W. S. Wooster. 1998. Effects of interdecadal climate variability on the oceanic ecosystems of the NE Pacific. Fish. Oceanogr. 7: 1-21.

Leetma, A., 1999: El Niño/La Niña and Hurricanes: was 1999 a preview of the future? An extended abstract from a seminar Dr. Leetma gave for the US Global Change Research Program. December 16, 1999, Washington D.C.

More Climate Links

http://jisao.washington.edu/ao
JISAO's Arctic Oscillation website

http://www.arctic.noaa.gov
NOAA's Arctic website (sponsored by NOAA's Arctic Research Program)

http://www.cpc.ncep.noaa.gov/
NOAA's Climate Prediction Center