The state of the eastern North Pacific from September 1997 to February 1998

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Dr. Howard Freeland is Head of the Ocean Science and Productivity Division at the Institute of Ocean Sciences (Department of Fisheries and Oceans, Canada) and a member of PICES' Physical Oceanography and Climate Committee. His research interests include the climatic state of the ocean and low frequency variability. Dr. Freeland was the scientist primarily responsible for the Canadian contribution to the WOCE lines P15 and P1. Presently he is accountable for the maintenance of Line P, a line of CTD stations that has been monitored for over 40 years between the mouth of the Juan de Fuca Strait and Ocean Station Papa at 50˚N and 145˚W (also known as WOCE Repeat Hydrography Line P6). At the present time Howard is coordinating Canadian projects to monitor the 1997/98 El Niño and its impact on the west coast of British Columbia.

Figure 1 shows the monthly mean sea-surface temperature (SST) anomalies in the eastern North Pacific from September 1997 through February 1998. The North Pacific remains dominated by the 1997/98 El Niño and is likely to stay under that influence for several more seasons.

The anomalies vary somewhat in intensity, but the pattern of the anomalies is remarkably consistent through all of the elements of *Fig. 1*. Throughout the months shown, sea surface temperature is high along the coast of North America and lower than normal in the Central Pacific. This distribution is a typical response of the northern North Pacific to El Niño forcing. The most intense anomalies occurred in September, 1997. In support of that, we found that at the British Columbia lighthouses (where sea surface temperatures have been registrated daily for 65 years) the highest monthly mean surface temperatures ever recorded were observed at the west coast stations also in September. Though anomalies off western Canada remain high, the tongue of high SST that previously extended along the Aleutians past the dateline indicates evidence of its retreat to Kodiak Island.

Figure 2 below demonstrates a plot of the subsurface temperature anomaly field observed on the outbound trip along Line-P during February 1998. Line-P extends from the mouth of the Juan de Fuca Strait (southern Vancouver Island) to Ocean Station Papa at 50°N and 145°W and is marked by a bold line on the February 1998 panel on *Figure 1*.

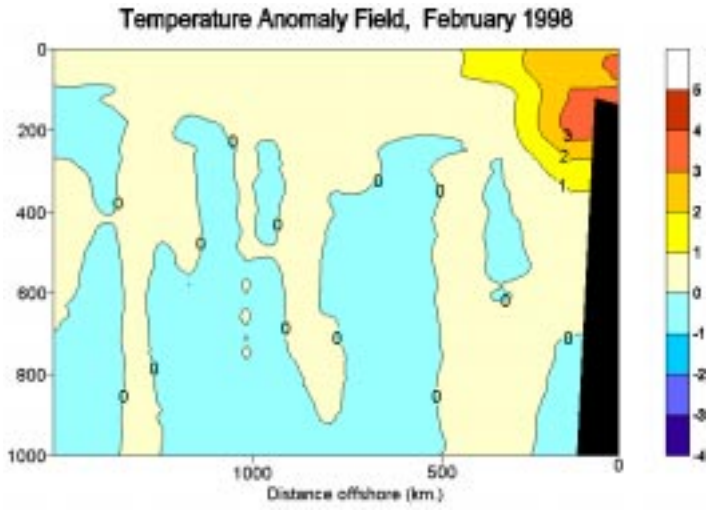

Fig. 2 Temperature anomaly field along Line-P, courtesy of Frank Whitney and Marie Robert.

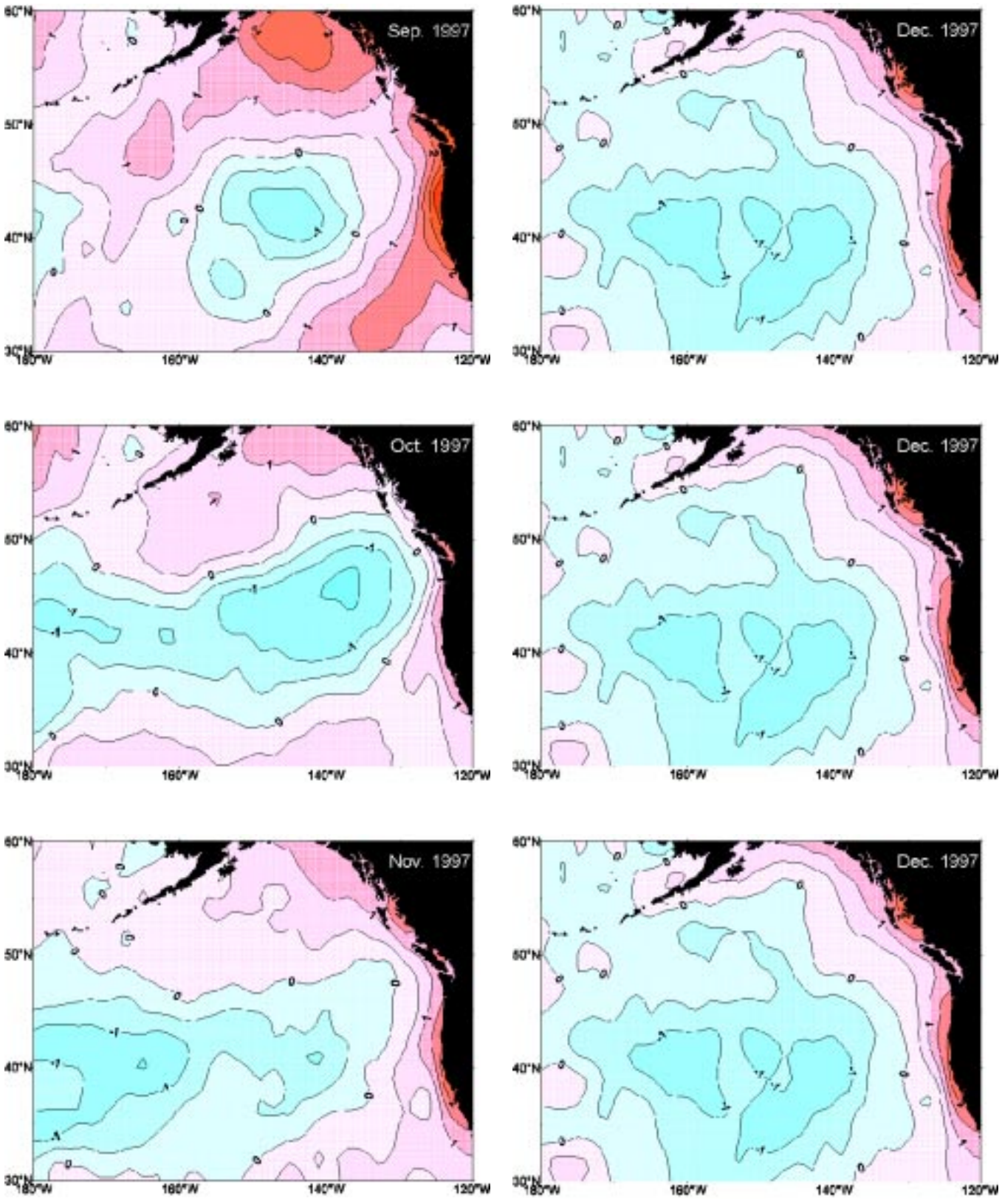

Fig. 1 Monthly mean sea-surface temperature anomalies for the eastern North Pacific Ocean, from September 1997 through February 1998. The labeled contours are at intervals of 1ºC with intermediate contours at intervals of 0.5ºC. Red tones indicate warm anomalies and blue tones cold anomalies.

The section is in general agreement with the sea surface temperature chart for February indicating near-normal conditions along most of Line-P. Also in agreement with the surface maps, we see the largest anomalies close to the coast of Vancouver Island. However, the surface chart is striking in that it shows the largest subsurface anomalies between depths of 100 m and 200 m. In this respect the anomaly pattern is very similar to the anomalies observed along Line-P in March 1983, during the largest El Niño event of the century.

Figure 3 demonstrates the variations in sea level at Prince Rupert. The purple line shows the variation in the long-term average sea level, and the blue line displays the 28-day averaged sea level from January 1997 to the present time. This illustrates the magnitude of the impact of the 1997/98 El Niño on the coast of British Columbia. Sea level is standing, as of early March 1998, about 35 cm above normal. This anomaly is larger than what occurred in 1983 and indeed has set new record anomalies around the coast of British Columbia.

Finally, no discussion of the state of the Pacific Ocean would be complete without some speculation about what the future holds. *Figure 4* shows a plot of the southern oscillation index (SOI) observed daily by Queensland Department of Natural Resources and the Department of Primary Industries in Australia. By mid December, 1997, the southern oscillation index had returned close to normal. However, through January there was a slow trend towards increasingly negative values culminating at the end of January and beginning of February in a large "westerly wind burst". This burst of El Niño-like activity on the equator was also clearly visible in the wind field observed on the equator by the TAO array. Since then the index has fluctuated but remained persistently negative.

Figure 5 presents monthly mean values of the SOI and the 5-month running mean. This demonstrates once again that the El Niño forcing on the equator remains substantial and we stay under the influence of a strong event.

Thus it is too early to claim that the 1997/98 El Niño is over, even on the equator. At higher latitudes we saw earlier that SSTs remain high over large regions of the North Pacific. Furthermore, the positive anomalies are distributed well down in the water column. The excess heat cannot be removed from the ocean in short order, thus the 1998 fishing seasons in the northeast Pacific will be influenced by the 1997/98 El Niño.

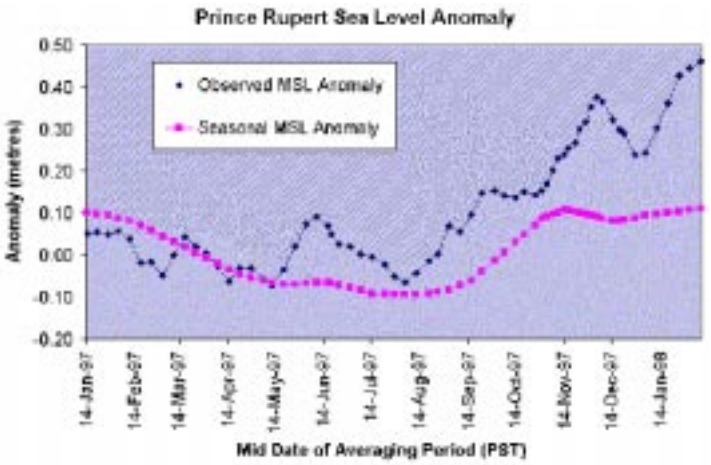

Fig. 3 Sea level anomalies at Prince Rupert, British Columbia, courtesy of Bill Crawford, Canadian Hydrographic Service.

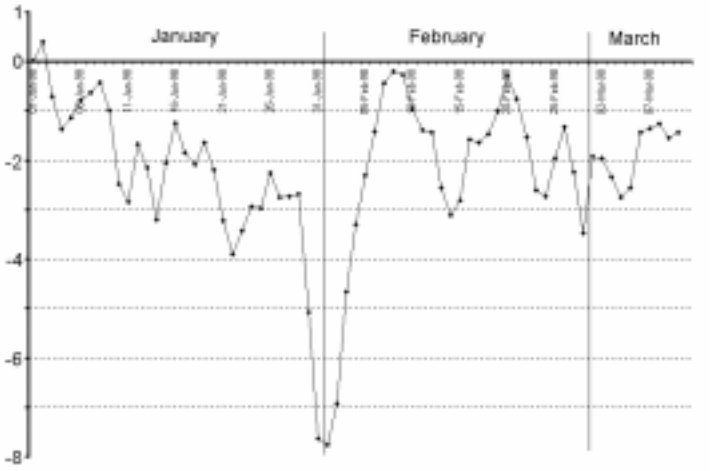

Fig. 4 Daily values of the southern oscillation index from January 1st to March 10th,1998.

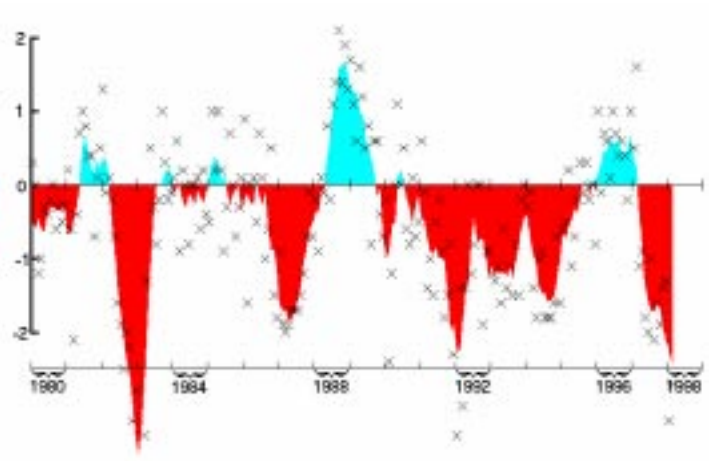

Fig. 5 Monthly values (X) of the southern oscillation index from 1980 to present. Colored fill areas show the 5-month running mean.