EL NINO AND SEA LEVEL CHANGES

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WHAT IS EL NINO

El Nino is a Spanish word for Jesus, the Christ Child, given by fishermen in South American countries to a warm coastal current which flows south along Ecuador and Peru during Christmas time. The phenomenon has been known in these places since ancient times and occurs at intervals of three to seven years. El Nino events last from a few months to more than one year and have caused significant changes in oceanic and climatic conditions all over the world, resulting in heavy losses in fishing, agriculture, housing and human lives.

Four major physical manifestations of the El Nino event (Sotelo 1986) are :

(a) The upwelling of masses of warm water with low nutrient content towards the southeast Pacific coasts causes the death of marine organisms, the emigration of fish and as a result mortality of sea birds due to starvation.

(b) The development of heavy rainfall affects agriculture, communications, transport, industry, housing and health.

(c) Severe droughts cause damage to the agricultural, livestock, energy and health sectors.

(d) Storms change course as a result of changes in the atmospheric conditions.

OCEAN RESPONSE

The equatorial ocean consists of a warm, shallow upper layer and a cold, deep layer. The southeast trade winds in the Pacific blow the warm water to the west, raising the water level in the western Pacific. Under normal trade wind conditions, sea level is about 40 cm higher in the western Pacific than over the eastern Pacific coast line (World Meteorological Organization 1985). When the trade winds increase, sea level will rise in the western Pacific and when the winds weaken, the water accumulated in the western Pacific surges eastward.

SEA LEVEL CHANGES DURING THE 1982/83 EVENT

The 1982/83 El Nino event started in June 1982 and ended in December 1983. This is the strongest event experienced during the era of instrumental records. The devastation to people, villages and economy in some countries was unprecedented. A summary of the type of abnormal weather and damage in some countries is given in Table 1 (Rasmussan 1984, Le Comte 1984, Sotelo 1986).

Table 1 Abnormal weather and damage in different countries during the 1982/83 El Nino event

Country	Abnormal Weather	Economic costs of damage (in millions of US$)
Peru	Rainfall 340 times normal in north drought in south	1997
Ecuador	Floods, rainfall 30 times normal	641
Bolivia	Drought	837
Calif., USA	High winds, excess rains	200 in 2/83
Hawaii, USA	Prolonged dry spell, rare hurricane in November	200 due to hurricane
Australia	Extreme drought 4/82 -2/83 (worst since 1960's), flood 3/83 - 6/83	400
French Polynesia	Six typhoons in five months (none in previous 75 years)	50
Africa	Drought	?
India, Sri Lanka	Drought	?
Indonesia	Drought	?

As far as sea levels are concerned, sea level anomalies over most of the equatorial Pacific are relatively small from January to June 1982 (Figure 1(a) - (h), Wyrtki 1985). Negative anomalies that developed in April 1982 near the Caroline Islands and intensified by July together with positive anomalies near the equator signal the start of the 1982/83 El Nino. The anomaly pattern further intensified in the next few months with a sea level of 272 mm above normal at Christmas Island in September and 288 above normal on the coast of South America in October. The sea level disturbance also spreads polewards resulting in a positive anomaly of 173 mm in San Diego in November. By December the anomaly reached +400 mm over the eastern Pacific but -250 mm in the west.

The negative anomaly in the western Pacific to the north of the equator began to decrease in strength in January 1983 but south of the equator, the negative anomaly continued to deepen reaching -414 mm at Funafuti near 9°S 179°E. In May and June the first signs of a positive anomaly appeared near 7°N. A second peak of +443 mm was however observed again on the coast of South America. During July and August, the anomaly patterns decreased in strength and extent, slowly recovering to the normal situation. By December the very strong anomalies have disappeared.

Sea levels at North Point, Hong Kong behaved in a similar way (Figure 2). A negative anomaly developed in July 1982 and reached a peak value of -21 cm in November 1982. The anomaly decreased in value thereafter and sea levels resumed normal by October 1983.

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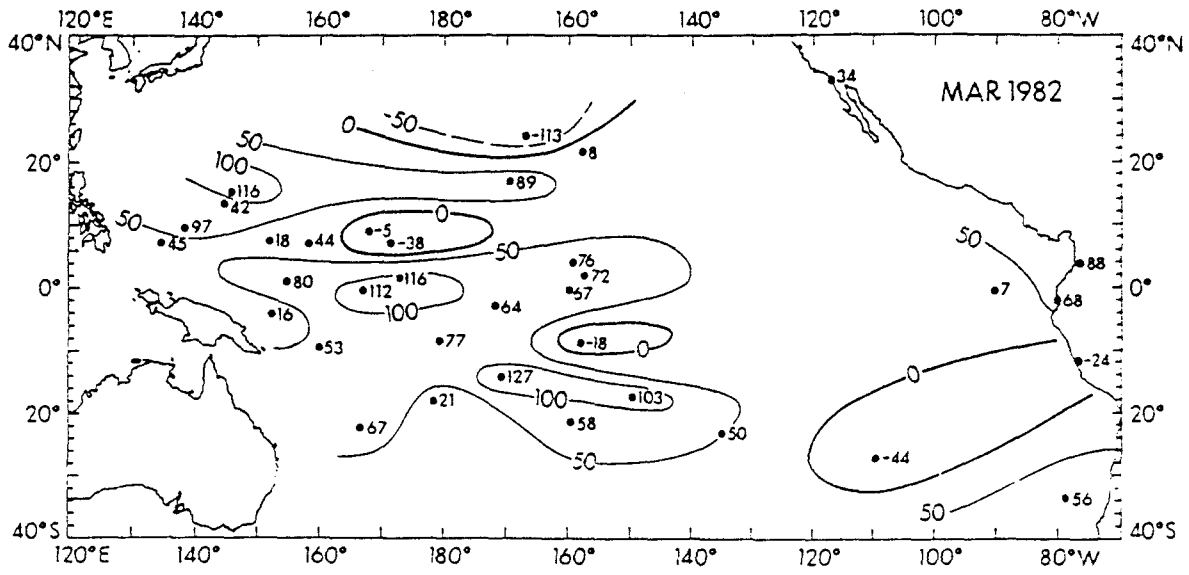
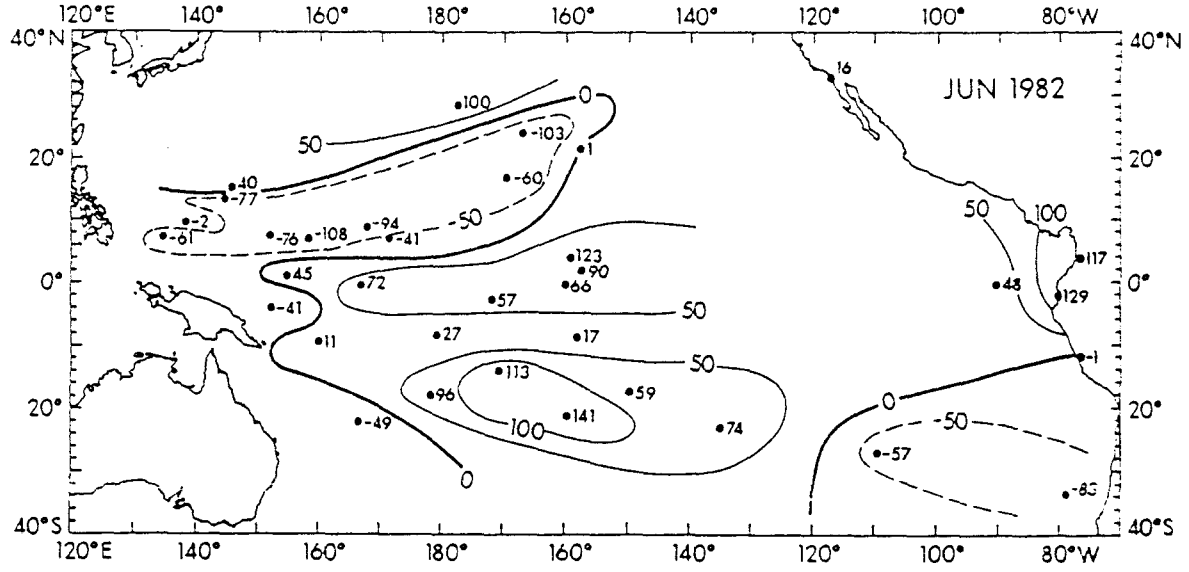


(a)



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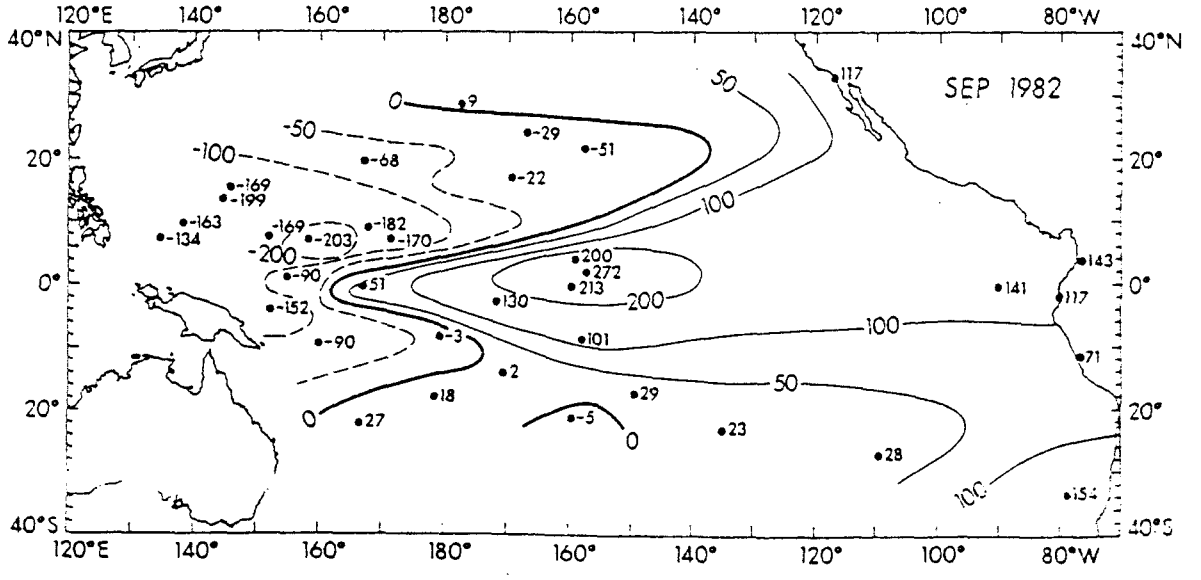
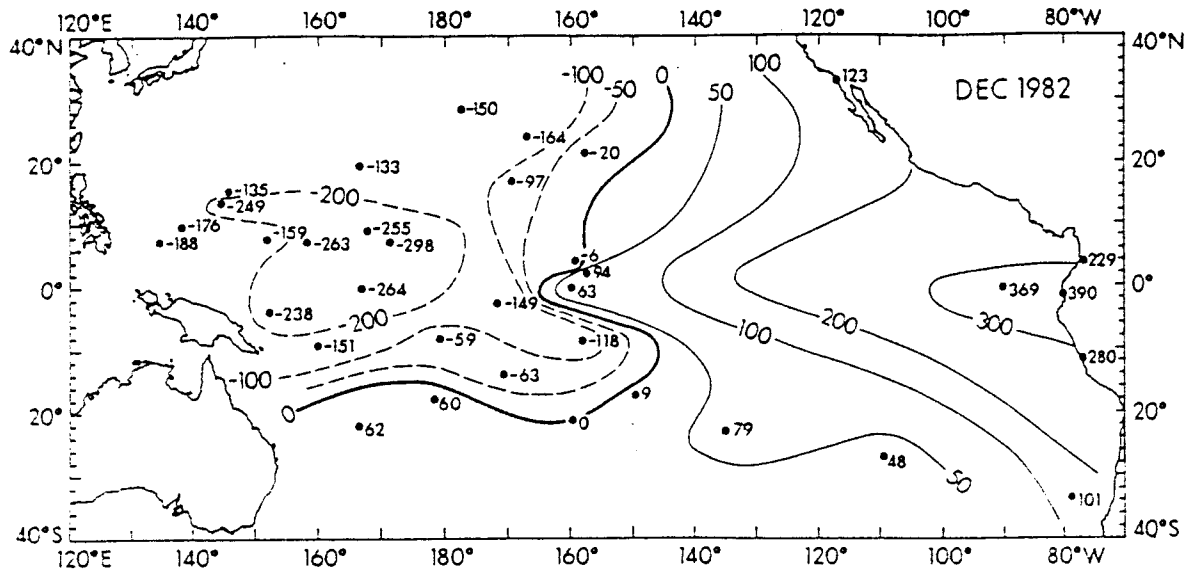


(c)

Figure 1 Sea level anomaly in millimetres in the Pacific Ocean (Wyrtki 1985)



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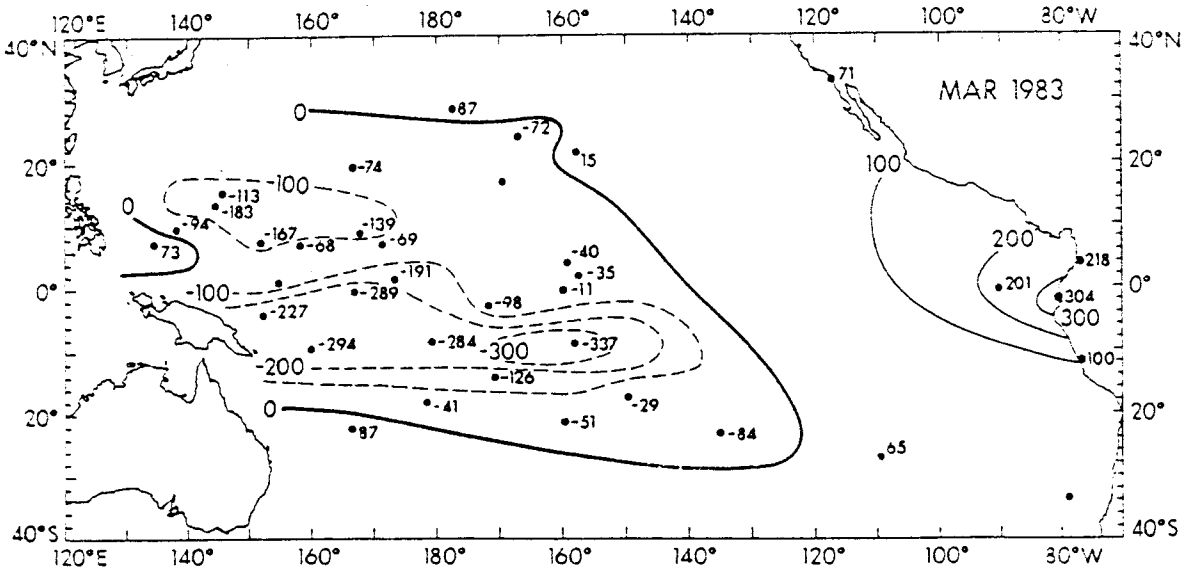

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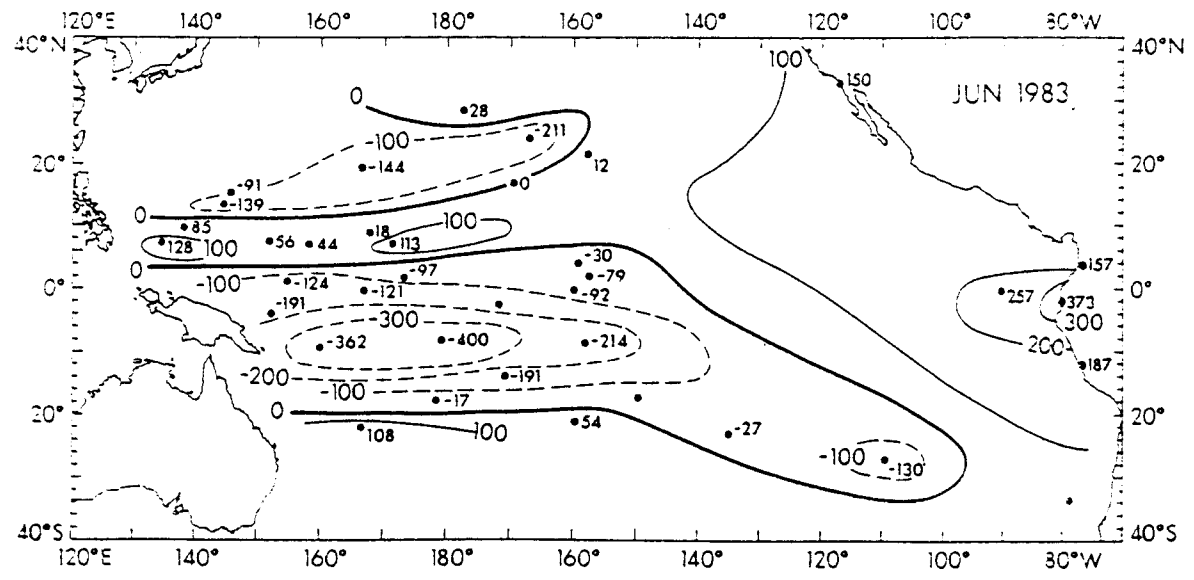
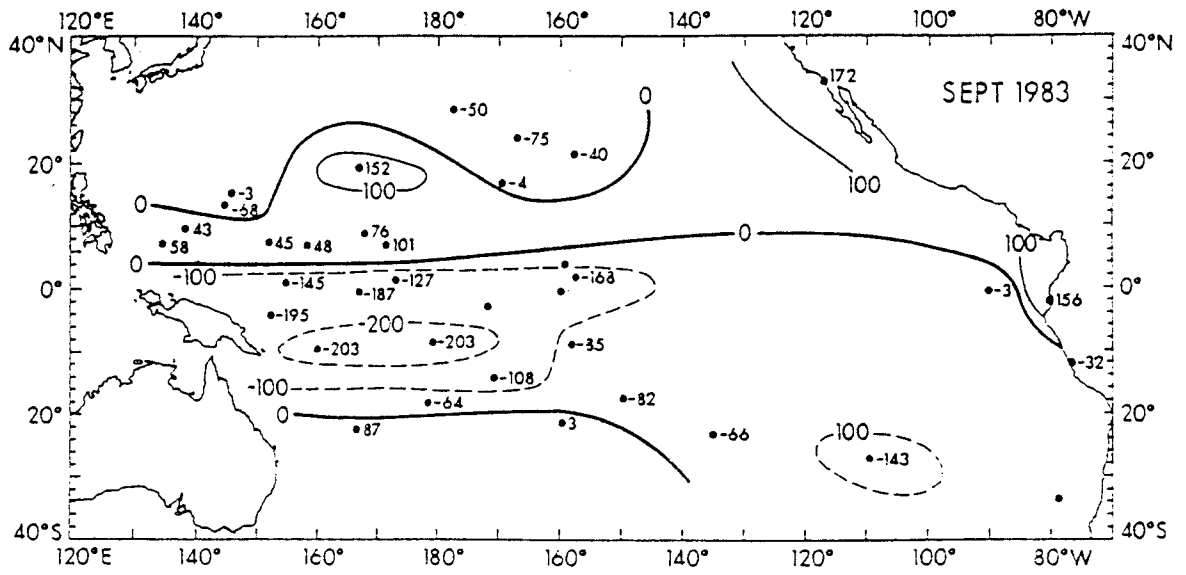


(f)

Figure 1 (cont'd)



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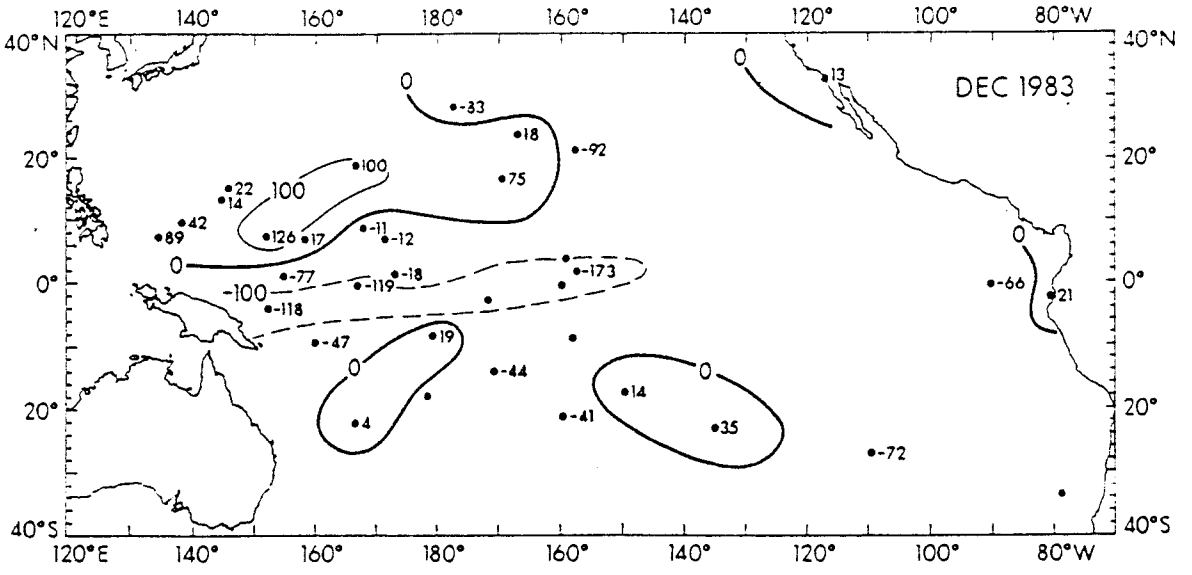

(h)

Figure 1 (cont'd)

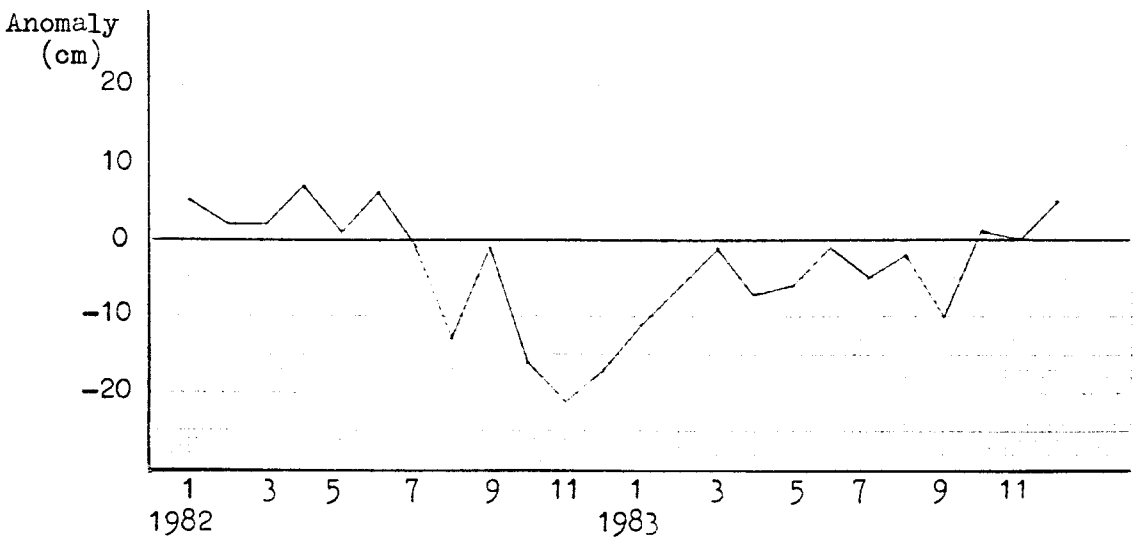

Figure 2 Sea level anomaly at North Point, Hong Kong