

# Seasonal climate summary southern hemisphere (summer 1991-92): the 1991-92 El Niño-Southern Oscillation (ENSO) episode matures

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An analysis is given of Pacific basin tropical climate indicators and the southern hemisphere circulation for the austral summer, December 1991 to February 1992. Summer rainfall and temperature are discussed for the Australian region. The season saw mature phase warm ENSO episode conditions develop in the tropical Pacific. Some aspects of the circulation for the season were similar to those of composite patterns for previous warm episodes. Below average summer rainfall over most of the northern half of Australia was typical of a warm ENSO episode.

## Introduction

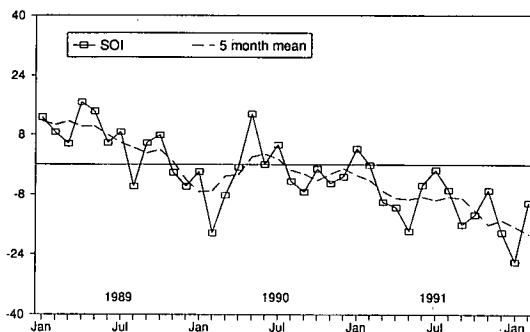
This seasonal summary reviews the climate of the Pacific basin tropics and southern hemisphere (SH) during the 1991-92 austral summer (December 1991 to February 1992). During this period the 1991-92 warm ENSO episode entered its mature phase. This episode was unique in its evolution; positive sea-surface temperature (SST) anomalies and enhanced convection developed in the western equatorial Pacific in late 1989. However, it was not until February 1991 that the Southern Oscillation Index (SOI) was continuously negative. Significantly negative values of the SOI commenced in autumn 1991 and, by mid-1991, a fully-fledged episode had begun. The episode continued to develop during the austral spring (Beard 1993) and reached its mature phase in the 1991-92 austral summer.

The sources of information used for this summary were the *Climate Monitoring Bulletins* issued by the Bureau of Meteorology (Australia), and the monthly *Climate Diagnostics Bulletin*, from the Climate Analysis Center (CAC) Washington. The SH seasonal mean and anomaly analyses presented were produced from grid-point data archived by the National Meteorological Centre, Melbourne, Australia. The addresses of the above sources are given in the Appendix.

## Climate indices

The SOI\* fell from -18.3 in December 1991 to -26.0 in January 1992, then rose sharply to -10.3 for February (Fig. 1). The low January value was principally due to a high positive Darwin pressure anomaly.

Fig. 1 Southern Oscillation Index (SOI), January 1989 to February 1992 inclusive.



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\*The SOI used here is 10 times the anomaly of the monthly mean Tahiti minus Darwin mean sea level pressure difference divided by the standard deviation of that difference for the relevant month, based on the period 1882-1985.

Fig. 2(a) December 1991 sea-surface temperature anomaly (°C).

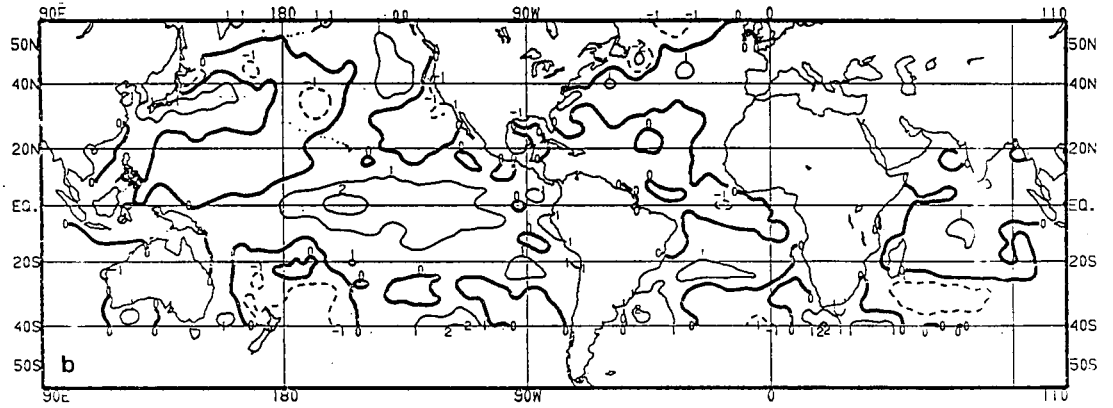


Fig. 2(b) January 1992 sea-surface temperature anomaly (°C).

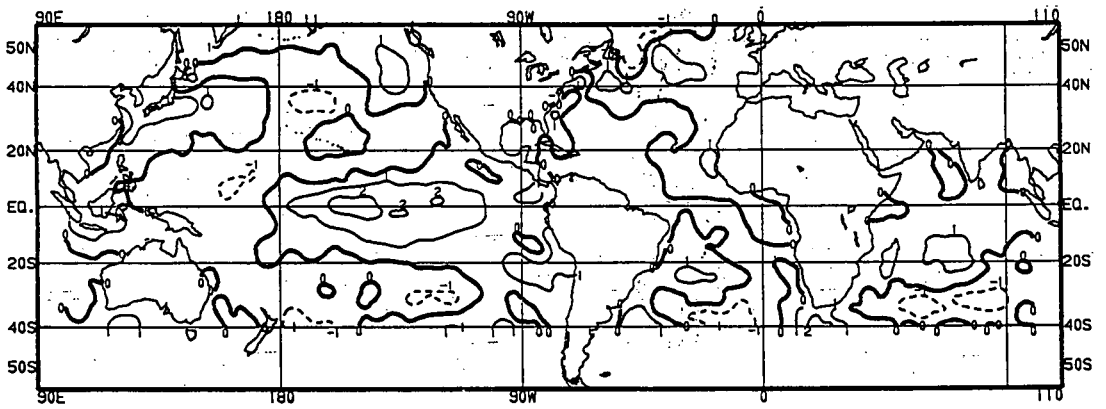
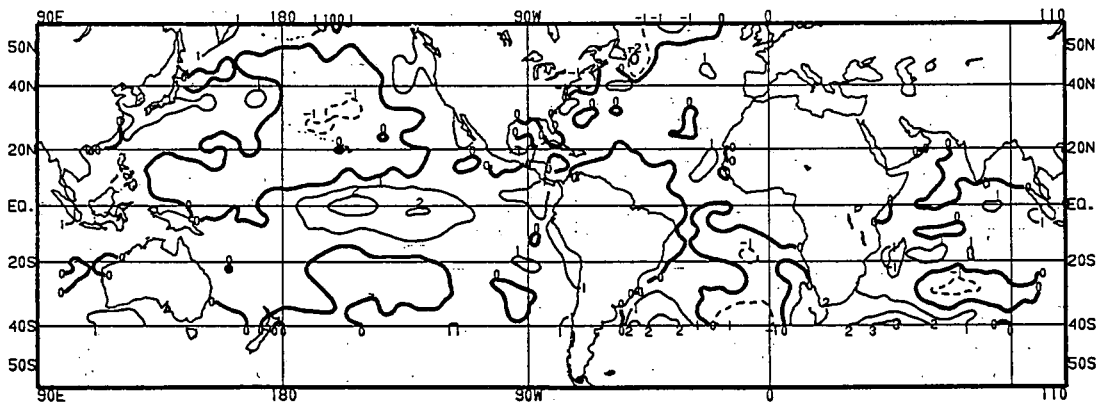


Fig. 2(c) February 1992 sea-surface temperature anomaly (°C).



In the equatorial Pacific, low-level easterlies and upper-level (200 hPa) westerlies were generally significantly weaker than in the previous season; convective activity around the dateline as measured by outgoing long wave radiation was much stronger than normal, and equatorial sea-surface temperature (SST) anomalies were also generally greater than for the previous season.

### Sea-surface temperatures

As with the winter and spring 1991 seasonal summaries (de Hoedt 1992; Beard 1993) in this series, the usual seasonal SST anomaly map derived from satellite data only has been replaced by the monthly blended SST anomaly charts (Fig. 2) extracted from the CAC Washington *Climate Diagnostics Bulletin*. The blended analyses are based on a combination of *in situ* and satellite data. This is a temporary measure until the effects of the Mt Pinatubo volcano eruption (June 1991) become small enough to enable use of the seasonal analyses.

Positive SST anomalies of 1–2°C were evident over much of the central and eastern equatorial Pacific for the season. During January and February this area was flanked to the north and south by negative anomalies; negative anomalies were also evident in the equatorial Pacific west of the dateline. These SST anomaly patterns are typical of the mature phase of a warm ENSO episode (Rasmusson and Carpenter 1982).

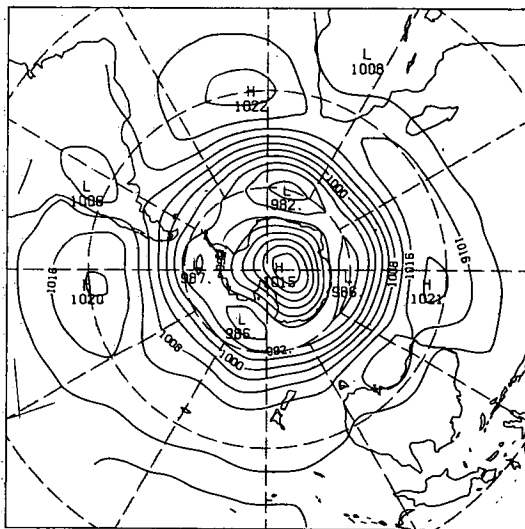
### Surface analysis

The summer mean sea level pressure (MSLP) analysis is shown in Fig. 3. The main feature of this analysis is the weaker than normal (about 2 hPa) high pressure cell in the eastern Pacific. The anomaly analysis (Fig. 4) shows a blocking dipole in the central South Pacific. With the exception of the Southern Ocean region to the south of Australia, there was a tendency for negative anomalies to occur around the hemisphere at mid-latitudes. This, along with positive anomalies over Antarctica, is similar to the composite warm episode pattern found by Karoly (1989) for the December to February mature phase period. Other features of the anomaly analysis are negative anomalies in the tropics east of the dateline and positive anomalies west of the dateline through to the eastern Indian Ocean.

### Upper air analysis

The 500 hPa seasonal mean analysis and anomalies are shown in Figs 5 and 6 respectively. Figure 5 shows a four-wave pattern at high latitudes, with troughs located near 180°E, in the eastern Pacific,

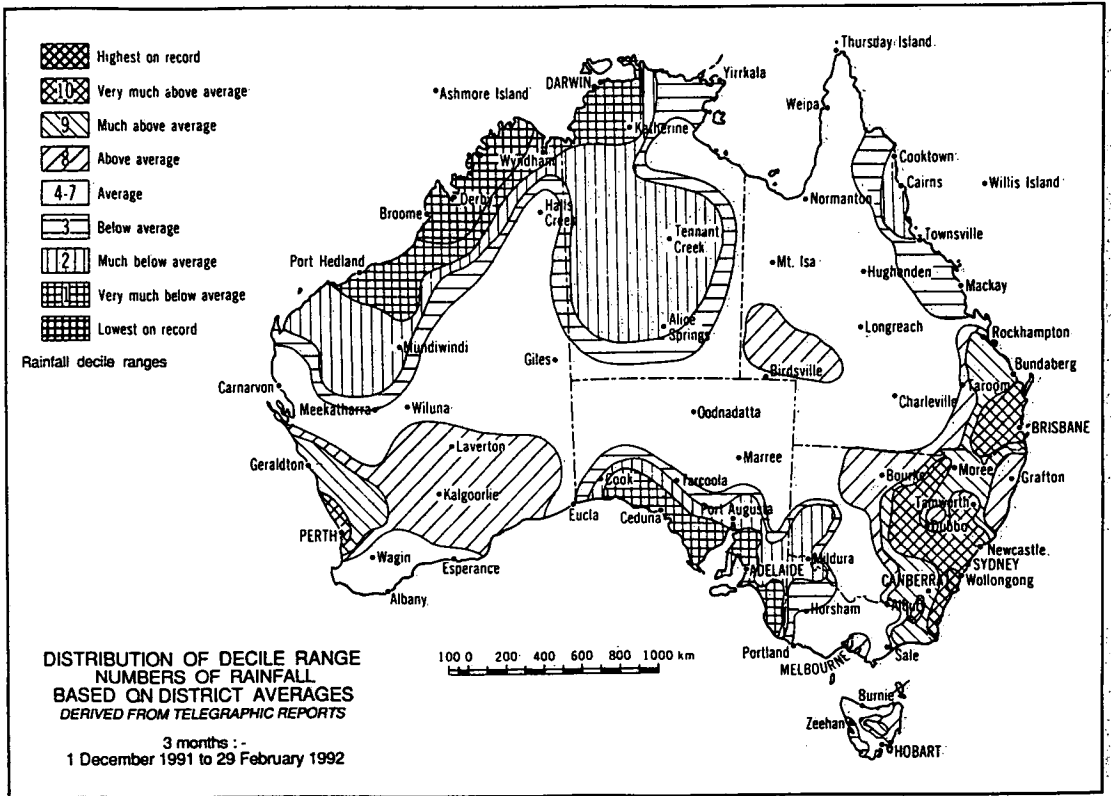
Fig. 3 Summer 1991-92 (December, January, February) mean sea level pressure (hPa).



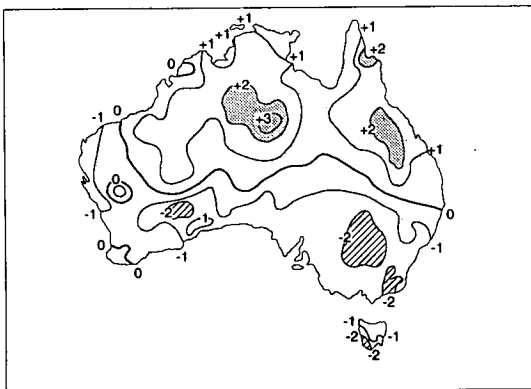




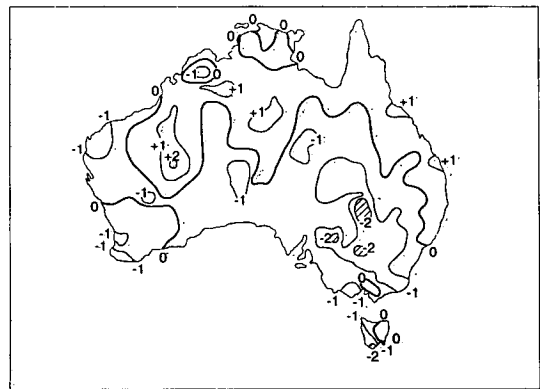
**Fig. 12 Summer rainfall 1991-92 (December, January, February) over Australia: decile range values based on district average rainfall.**



**Fig. 13(a) Summer 1991-92 (December, January, February) maximum temperature anomalies (°C) for Australia.**



**Fig. 13(b) Summer 1991-92 (December, January, February) minimum temperature anomalies (°C) for Australia.**



activity in these regions. Southwest Western Australia was another area of significantly above average rainfall. Evidence of cut-off low activity over eastern Australia can be seen on the 500 hPa height anomaly analysis which shows negative anomalies in this region.

## Temperatures

Maximum temperatures were above normal over most of the northern half of the continent mainly due to reduced cloud cover and increased insolation (Fig. 13(a)); several areas recorded maxima greater than 2°C above normal. The southern half of the continent generally recorded maximum temperatures from 1° to 2°C below normal. Anomalous southeasterly flow (see Fig. 4) reduced maximum temperatures by 2°-3°C below normal over parts of southeastern Australia.

Minimum temperatures were generally within 1°C of normal (Fig. 13(b)). A notable exception was in southeastern Australia where the anomalous southeasterly flow produced negative anomalies of 1°-2°C over a large area.

## References

- Beard, G.S. 1993. Seasonal climate summary southern hemisphere (spring 1991): a maturing El Niño-Southern Oscillation (ENSO) episode. *Aust. Met. Mag.*, 42, 81-6.
- de Hoedt, G.C., 1992. Seasonal climate summary southern hemisphere (winter 1991): a warm Pacific episode develops. *Aust. Met. Mag.*, 40, 239-45.
- Karoly, D.J. 1989. Southern Hemisphere Circulation Features Associated with El Niño-Southern Oscillation Events. *Jnl climate*, 2, 1239-52.
- Rasmussen, E.M. and Carpenter, T.H. 1982. Variations in Tropical Sea Surface Temperature and Surface Wind Fields Associated with the Southern Oscillation/El Niño. *Mon. Weath. Rev.*, 110, 354-84.

## Appendix

Data sources used for this review were:

Climate Analysis Center — *Climate Diagnostics Bulletin*.\*

National Climate Centre — *Climate Monitoring Bulletin — Southern Hemisphere*.†

Southern Hemisphere grid-point analysis data.†

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Obtainable from:

\*Climate Analysis Center, National Weather Service, Washington D.C. 20233, USA.

†National Climate Centre, Bureau of Meteorology, GPO Box 1289K, Melbourne 3001, Australia.