

# Seasonal climate summary southern hemisphere (spring 1987): a season of sustained positive trend in the Southern Oscillation Index

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**An analysis of the southern hemisphere circulation for the austral spring, September to November 1987, is presented. Emphasis is given to the Australian region, an area roughly bounded by Antarctica, the equator, the dateline and 90°E. Tropical and extratropical anomalies in the southern hemisphere circulation are discussed along with their relevance to the El Niño-Southern Oscillation (ENSO) episode which weakened during the season.**

## Overview

During spring, some ENSO indicators showed signs of returning to normal. However, atmospheric circulation features characteristic of an ENSO episode, were persisting.

The Southern Oscillation Index (SOI)\* continued to increase towards zero. Weaker than normal low-level easterlies were evident early in the season in the equatorial western Pacific, however these increased later in the season. This was probably associated with a decrease in anomalous convection around the dateline in the equatorial Pacific. Rainfall over the drought-stricken Fiji region also showed signs of returning to normal during November.

Sea surface temperature anomalies in the equatorial Pacific were generally not appreciably different from those of winter. The anomalous upper-level anticyclonic couplet straddling the equator in the central Pacific continued from winter and associated with this at upper levels were decreased equatorial westerlies and increased higher latitude westerlies.

Higher latitude westerly anomalies were also present over South America, much of the south Atlantic and part of the Indian Ocean.

Data sources used in the preparation of this seasonal summary are listed in the Appendix. The southern hemisphere convention for denoting seasons is used here, namely summer (DJF), autumn (MAM), winter (JJA), and spring (SON).

## The spring circulation

### Antecedent conditions

The El-Niño-Southern Oscillation warm episode which began in late austral spring of 1986, continued through the following summer, autumn and winter 1987 (Gaffney 1988).

The SOI reached a minimum value of -22 in May 1987 and showed a sustained increase throughout winter. This upward swing in the SOI was not accompanied by an appreciable decrease in the sea surface temperatures in the central and eastern tropical Pacific.

Westerly wind anomalies persisted throughout most of the winter season (in the lower troposphere) in the equatorial central and western Pacific. An upper-level anomalous anticyclonic couplet straddling the central equatorial Pacific was present. Associated with this feature at upper levels were negative anomalies in the equatorial westerlies and positive anomalies in the westerlies at about 25°S across the central Pacific.

Enhanced equatorial convection was present throughout winter in the vicinity of the dateline.

### The climatic indicators

The SOI continued to increase throughout spring (see Table 1 and Fig. 1). Darwin's mean sea level

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

pressure (MSLP) anomaly decreased from +1.5 to 0.0 and Tahiti's anomalies for September to November were -0.3, -0.4 and -0.2 hPa respectively.

Sea surface temperature anomalies in the central equatorial Pacific changed little from the previous season and generally ranged from +1.0 to +2.0°C. Positive sea surface temperature anomalies in the eastern equatorial Pacific showed a slight increase from the previous season with peak anomalies of up to about +2.0°C occurring in October. In the western equatorial Pacific, there was an increase in the area of positive sea surface temperature anomaly and a general deepening of the thermocline.

Weaker than normal low-level easterlies were evident early in the season in the equatorial western Pacific, however these increased later in the season.

Associated with the SST anomaly pattern in the central and eastern Pacific were the strong upper-level anticyclonic circulation anomaly centres located to the north and south of the equator that are characteristic of ENSO events (Rasmusson and Wallace 1983). The upper-level wind anomalies in the Pacific were dominated by this feature; significantly reduced westerlies were present over most of the equatorial region and

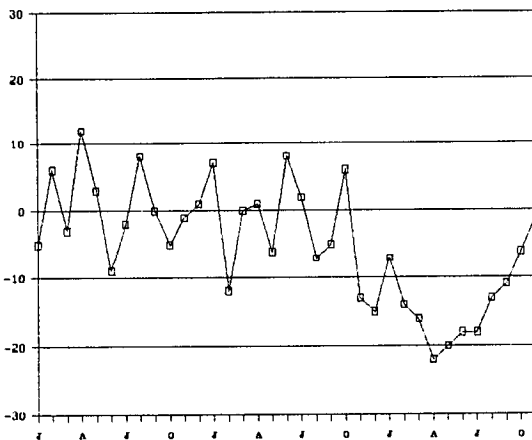
positive westerly anomalies were evident over much of the Pacific at about 20-30°S. Positive westerly anomalies at 20-30°S were also present over South America, much of the south Atlantic and the central Indian Ocean.

Convective activity during spring within the South Pacific Convergence Zone, was generally displaced northeast of its normal location (Garcia 1985). This gave rise to anomalous equatorial convective activity around the dateline, which is characteristic of an ENSO event (Rasmusson and Wallace 1983). However, the anomalous convection was, in general, considerably less intense than in winter. This general reduction in convection around the dateline may have led to reduced compensating subsidence and increased convective activity to the south in the Fiji region, in November. During November, the region received significant rainfall for the first time since April 1987 (Fiji Meteorological Service 1987).

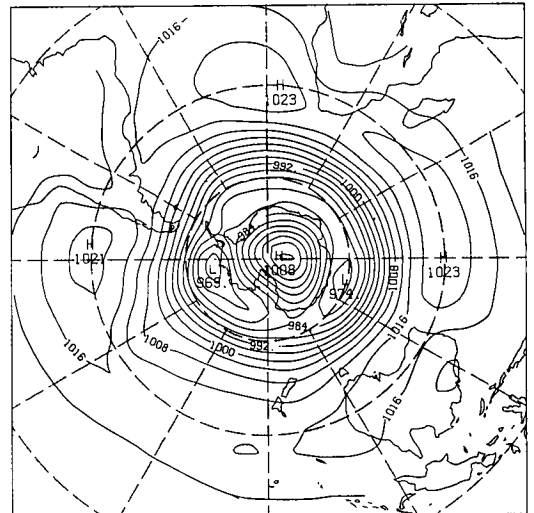
**Surface analyses**

The spring 1987 mean MSLP analysis (see Fig. 2) showed four main troughs: one in the western Pacific; the others in the central Pacific, the Atlantic and eastern Indian oceans. The central Pacific trough was significantly deeper than

**Fig. 1 Southern Oscillation Index — January 1985 to November 1987.**



**Fig. 2 Spring (SON) mean sea level pressure (hPa) analysis.**



**Table 1. Values of the SOI for the period January 1985 to November 1987.**

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1985	-5	6	-3	12	3	-9	-2	8	0	-5	-1	1
1986	7	-12	0	1	-6	8	2	-7	-5	6	-13	-15
1987	-7	-14	-16	-22	-20	-18	-18	-13	-11	-6	-1	



than normal. During September, the region of relatively intense blocking normally located in the eastern Australian/western Pacific region, was shifted eastward (see Fig. 12).

Fig. 6 September 500 hPa height (dam) analysis.

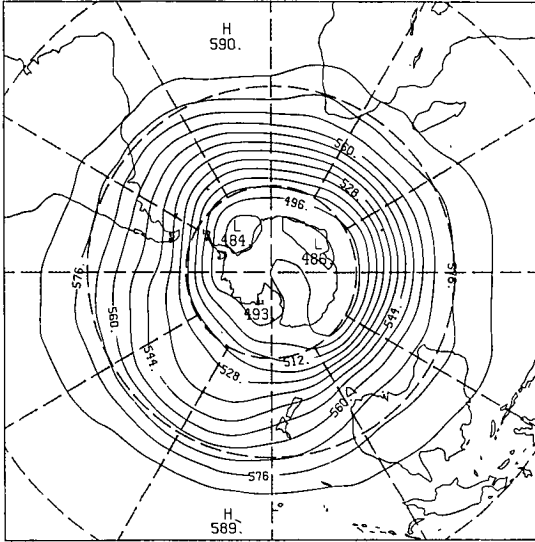


Fig. 7 September 500 hPa height anomaly (dam) analysis.

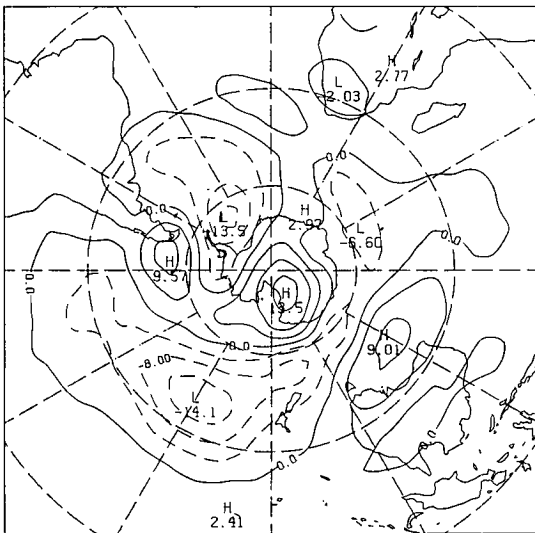


Fig. 8 October 500 hPa height (dam) analysis.

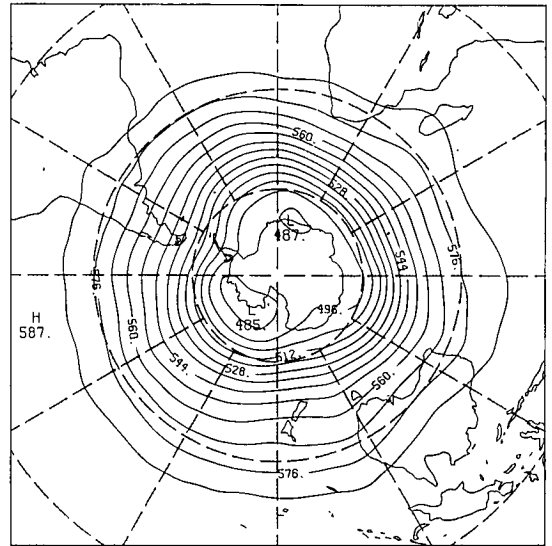
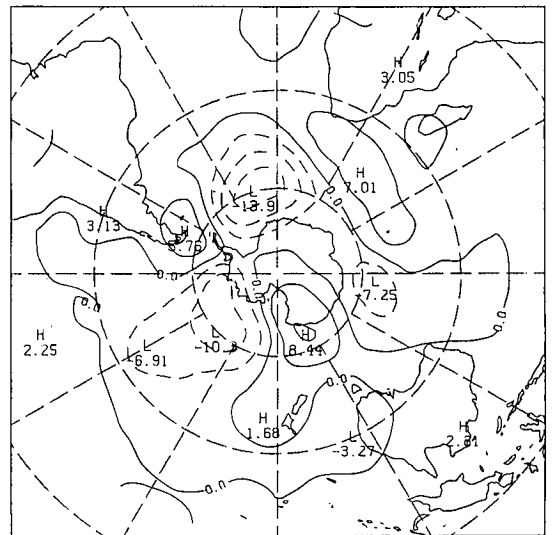


Fig. 9 October 500 hPa height anomaly (dam) analysis.



### Australian conditions

#### Rainfall

Spring rainfall was well below average in northwest Western Australia and over part of far northern Australia (see Fig. 13). It was also below average over much of southeastern Australia — this was partly due to anomalously high atmos-



## Temperature

The main feature of the distribution of spring maximum and minimum temperatures over the continent was a huge region of positive anomaly covering much of inland Australia and parts of northern Australia (see Figs 14 and 15). The anomalies were generally in the range 1.0 to 2.0°C. Negative anomalies were evident over much of eastern Australia in the maximum and minimum temperature patterns. In the case of maximum temperatures, the negative anomalies were generally in the range 0.0 to -1.0, and in the case of minimum temperatures, anomalies were gener-

ally in the range 0.0 to -0.5. The negative anomalies were probably due to advection of cooler southern air into eastern Australia during the season. The positive anomalies were probably due to the advection of relatively warm air from Western Australia into central and northern Australia (refer Fig. 3).

## Acknowledgments

The author wishes to thank Mr R. Willis for assistance in preparation of the figures.

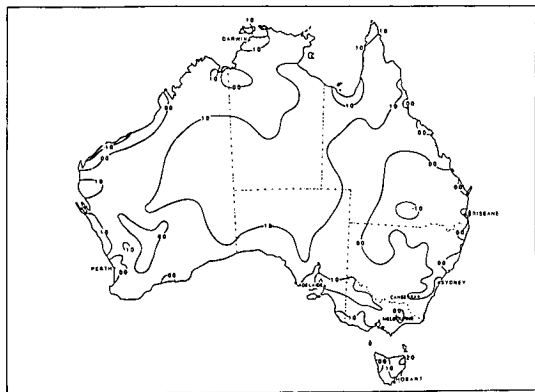
## References

- Fiji Meteorological Service. 1987. *Meteorological Summary for November 1987*. FMS, Nandi, Fiji. 2 pp.
- Gaffney, D.O. 1988. Seasonal climate summary southern hemisphere (winter 1987): a season of characteristic Pacific ENSO anomaly patterns. *Aust. Met. Mag.*, 36, 41-46.
- Garcia, O. 1985. *Atlas of Highly Reflective Clouds for the Global Tropics. 1971-1983*. NOAA, Environmental Research Laboratories, Boulder, Colorado, USA. 365 pp.
- Karoly, D.J. 1986. Southern Hemisphere Circulation features associated with El Niño — Southern Oscillation events. *Second international conference on Southern Hemisphere Meteorology (extended abstracts)*. American Meteorological Society, Boston, 411-13.
- McBride, J.L. and Nicholls, N. 1983. Seasonal Relationships between Australian Rainfall and the Southern Oscillation. *Mon. Weath. Rev.*, 111, 1998-2004.
- Rasmussen, E.M. and Wallace, J.M. 1983. Meteorological aspects of the El Niño/Southern Oscillation. *Science*, 222, 1195-202.

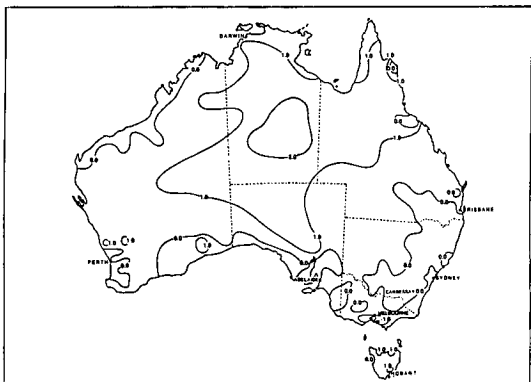
## Appendix

- Data sources used in the compilation of material for this review were:
- Climate Analysis Center Diagnostics Bulletin, Sep., Oct., Nov. 1987.\*
- National Climate Centre Climate Monitoring Bulletin — Southern Hemisphere, Sep., Oct., Nov., 1987.†
- Bureau of Meteorology. 1987. *Monthly Rainfall Review*. (Sep., Oct., Nov., 1987 issues). Bur. Met., Australia.§
- Southern hemisphere grid-point analysis data archived by the World Meteorological Centre, Melbourne.†
- Surface mean sea level pressure data archived by the National Climate Centre, Melbourne.†

**Fig. 14 Spring (SON) maximum temperature anomalies (deg. C) for the Australian continent. Stippled areas indicate anomalies greater than +2.0 deg. C.**



**Fig. 15 Spring (SON) minimum temperature anomalies (deg. C) for the Australian continent. Stippled areas indicate anomalies greater than +2.0 deg. C.**



\* Obtainable from the Climate Analysis Center, National Weather Service, Washington DC 20233, USA.

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

§ Obtainable from the Publications Subsection, Bureau of Meteorology, GPO Box 1289K, Melbourne, 3001, Australia.