Seasonal climate summary southern hemisphere (winter 1995): some signs of a La Niña developing

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A review of the climate patterns in the southern hemisphere during winter (June–August) 1995 is presented in this seasonal summary, with the Australian and Pacific Basin regions receiving particular attention. By the end of winter there were some indications of a weak cool event (La Niña) developing. Subsurface ocean waters in the Pacific were consistent with a modest cool event, although anomalies in sea-surface temperatures and trade winds were fairly weak and the Southern Oscillation Index (SOI) was still hovering near zero.

Introduction

The El Niño episode of 1994–95 reached a peak in early summer 1994–95 (Beard 1995). Autumn saw the warm episode conditions continue to weaken (de Hoedt 1995) and by the end of winter most tropical indicators suggested small anomalies of the opposite phase.

Information was primarily obtained from monthly issues of the Climate Monitoring Bulletin (Bureau of Meteorology, Australia) and Climate Diagnostics Bulletin (Climate Analysis Centre (CAC), Washington). Sources of data are listed in the Appendix.

Pacific Basin climate indicators

Atmospheric circulation indices

The SOI* (Fig. 1) returned to near-zero values during winter with values of −1.7 in June, 4.0 for July and 1.2 for August. Despite this, the average SOI for the previous five months was −3.6, the 59th consecutive month that this statistic had been negative. The period stretched from August 1990 to June 1995 (central month of five-month moving average) and broke the previous record of 58 set between April 1911 and January 1916 (central months).

Other atmospheric indices were also in contrast to those experienced in winter 1994. In the equatorial Pacific, trade winds were stronger than normal in central and western parts, and close to average in the east (Fig. 10). Figure 2, adapted

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* The SOI used here is ten times the monthly anomaly of the difference in mean sea-level pressure between Tahiti and Darwin, divided by the standard deviation of that difference for the relevant month, based on the period 1876–1993.

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Fig. 1 Southern Oscillation Index, January 1989 to August 1995 inclusive.
Fig. 2 Outgoing long wave radiation anomaly index averaged over the area 5°N–5°S, 160°E–160°W, January 1991 to August 1995 (after CAC 1995).

from CAC data (1995), shows a time series of outgoing long wave radiation (OLR) in the equatorial region between 160°E and 160°W. Positive anomalies imply a decrease in cloudiness, and hence rainfall. Convective activity (inferred from OLR anomalies) was a little less than normal about the date-line during winter. Upper-level wind anomalies in this region also support this. The three-month average OLR values show a continued rising trend since late 1994 when the El Niño event peaked.

Ocean indicators

Sea-surface temperatures (SSTs). Winter saw an extension of the cooler than normal waters in the far eastern equatorial Pacific into central parts. By the end of winter a weak cool tongue extended from the South American coast to near the date-line. In the northern Pacific there was a contraction of the anomalously cool waters, a feature since early in the year. In the far western equatorial Pacific, waters were up to 2°C warmer than normal. SSTs around the Australian coast were within 1°C of normal during winter. Figure 3 shows SST anomalies over winter.

Subsurface patterns. The Hovmoller diagram of the depth of the 20°C isotherm (Fig. 4), a proxy for the thermocline, shows the thermocline continued to be closer to the surface than normal through winter over the eastern half of the Pacific, and near average in the west. Conditions were similar to those in autumn, although by late winter positive depth anomalies had strengthened west of the date-line.

During winter, waters in the eastern equatorial Pacific cooled significantly. By the end of August cool anomalies dominated the upper ocean, consistent with a modest cool event.

Fig. 3 Winter 1995 sea-surface temperature anomaly (°C).
Fig. 4  Time-longitude section of monthly anomalies in the depth of 20°C isotherm at the equator from June 1994 to August 1995. Contour interval is 10 m.

Fig. 5  Winter 1995 (June, July, August) mean sea-level pressure (hPa).

Fig. 6  Winter 1995 (June, July, August) mean sea-level pressure anomaly (hPa).

Surface analyses

Figures 5 and 6 show the winter mean sea-level pressure (MSLP) analysis and anomaly patterns respectively. The high latitudes of the southern hemisphere were dominated by above average surface pressures. Average MSLPs for winter were more than 20 hPa above normal off the coast of Antarctica, near 120°W. These strong positive anomalies gave a wave-one bias to the three-wave anomaly pattern. Also significant were the nega-

Fig. 7  Winter 1995 (June, July, August) 500 hPa mean geopotential height (m).
tive anomalies to the southeast of New Zealand, with pressures 17 hPa below average for July.

Over Australia, pressures were near normal in June, below average in the south during July, and higher than normal for August. Anomalies finished higher than normal for winter due to the strong positive anomalies experienced during August.

**Upper-level analyses**

The mean and anomaly charts at 500 hPa are shown in Figs 7 and 8. Southern hemisphere anomalies at 500 hPa are similar to those at the surface, with negative anomalies centred near the southern tips of Africa and South America, and to the southeast of New Zealand.

**Blocking**

Figure 9 shows a time-longitude section of the daily southern hemisphere Blocking Index (BI)*. Positive values of the BI are generally associated with a split in the mid-latitude westerly flow and blocking events. High Blocking Index values occurred over Pacific Ocean longitudes, with the highest values occurring near the date-line in the first half of winter. BI values were low over Australian longitudes in August due to the strong ridging over the continent and negative pressure anomalies further to the south.

**Winds**

Easterly wind anomalies were a feature at 850 hPa (Fig. 10) in the central and western equatorial Pacific, with anomalies gradually strengthening during the winter months. Easterly anomalies were also a feature across the longitude range at 60°S, in large part due to significant anomalies in July, and were associated with a strengthening of the pressure gradient at high latitudes.

Also of note are the strong anticyclonic anomalies off the coast of Antarctica near 120°W and the cyclonic anomalies near New Zealand. This anomaly pattern is clearly evident in both the low-level and upper-level charts. At 200 hPa (Fig. 11) anticyclonic anomalies can be seen over South America near 25°S.

**Australian region**

**Circulation and rainfall**

Figure 12 shows the rainfall deciles during winter. Rainfall was above average across most of Victoria due to heavy rains during June and July.
Fig. 10  Winter 1995 (June, July, August) 850 hPa vector wind anomalies (m s\(^{-1}\)).

Fig. 11  Winter 1995 (June, July, August) 200 hPa vector wind anomalies (m s\(^{-1}\)).
Fig. 12 Winter 1995 (June, July, August) rainfall in Australia: decile range values based on district averages and selected stations.

PRELIMINARY DISTRIBUTION OF DECILE RANGE NUMBERS OF RAINFALL BASED ON DISTRICT AVERAGES AND SELECTED STATIONS DERIVED FROM TELEGRAPHIC REPORTS
3 Months:
1 June to 31 August 1995

Fig. 13 Winter 1995 (June, July, August) maximum temperature anomalies (°C) for Australia.

Fig. 14 Winter 1995 (June, July, August) minimum temperature anomalies (°C) for Australia.
Below average rains were recorded over much of southern Queensland and northeast New South Wales, with August being particularly dry. The dry conditions during August extended right across southern Australia. In New South Wales many central coast locations reported their lowest ever August totals, and for some stations no rain fell at all. In contrast, a major rain event over northeast Queensland in early August resulted in the area around Cairns reporting its wettest winter on record.

Long-term rainfall deficiencies (not shown) were exacerbated during winter in southeast Queensland and northeast New South Wales, although rainfall was sufficient across Victoria and South Australia to remove deficiencies in almost all parts. Small rainfall-deficient pockets persisted in southwest Western Australia and northeast Tasmania.

Temperature
Maximum and minimum temperature anomalies for winter 1995 are shown in Figs 13 and 14, respectively. The charts show that anomalies for winter were within two degrees of normal, although on average winter temperatures were slightly warmer than normal over much of the continent. The most significant monthly anomalies for the season were observed during August, when maximum temperatures were above average across the southern half of the continent, corresponding to above average pressures and below average rainfall. In some places the average maximum temperatures for August were in excess of four degrees above normal.

References

Appendix
Data sources used for this review were:
National Climate Centre, Climate Monitoring Bulletin-Australia.
Climate Analysis Center, (CAC), Climate Diagnostics Bulletin.*

Obtainable from:
+ National Climate Centre. Bureau of Meteorology. GPO Box 1289K, Melbourne Vic. 3001, Australia.