Seasonal climate summary southern hemisphere (spring 1995): a weak Pacific cool episode (La Niña) nears maturity

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Southern hemisphere circulation patterns and anomalies for spring (September–November) 1995 are reviewed, with emphasis given to Pacific Basin climate indicators, and Australian rainfall and temperature patterns. Although the Southern Oscillation Index (SOI) remained near neutral, most other Pacific Basin indicators continued to show development of a weak cool episode. Rainfall was above average across a large part of eastern and central Australia, but temperatures were generally close to normal although there was a bias towards positive anomalies.

Introduction
The initial stages of La Niña, noted in winter 1995 (Holli 1996), continued their development through spring, although the SOI remained close to zero. This summary reviews the southern hemisphere and equatorial climate patterns of spring 1995, with particular attention given to the Australasian and Pacific region.

The main sources of information were the Climate Monitoring Bulletin (Bureau of Meteorology, Australia), and the Climate Diagnostics Bulletin (Climate Prediction Center (CPC), Washington). Data sources are given in the Appendix.

Pacific Basin climate indices
The Southern Oscillation Index (SOI)*
The values of the index for the individual months from September to November were +3.2,-1.3 and +1.3 respectively, with the individual monthly mean sea-level pressure (MSLP) anomalies at both Darwin and Tahiti generally not exceeding 0.5 hPa in magnitude. A sustained positive trend in the five-month moving average commencing mid-1994 peaked in the early part of the season (Fig. 1).

Atmospheric indices
Low-level tropical easterlies were at near-normal strength in the central Pacific, stronger than normal in the western Pacific but weaker in the east. These features were generally present during each month of the season with only slight month-to-month variations.

Figure 2, adapted from CPC (1995), displays the monthly standardised anomaly of outgoing long wave radiation (OLR) centred about the date-line from 1992 to November 1995. Most of this time was characterised by warm Pacific episodes and hence increased cloudiness and reduced OLR in the vicinity of the date-line. However, a sustained upward trend in the anomaly, which began in late 1994, was still in evidence at the end of spring 1995. The establishment of positive OLR anomalies coincided with a cooling of the central equatorial Pacific which in turn impacted on the degree of deep convection over the region.

*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 1933–1992.

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Fig. 1 Southern Oscillation Index, January 1991 to November 1995 inclusive. Means and standard deviations based on the period 1933–1992.

Subsurface patterns. Figure 4 shows the anomaly in metres of the depth of the 20°C isotherm along the equatorial Pacific between January 1994 and January 1996. This isotherm is generally situated very close to the equatorial ocean thermocline, the region of greatest temperature gradient with depth, or the boundary between the upper ocean warm water and the deep ocean cold water. During spring the equatorial Pacific Ocean showed a distinct dipole structure in the subsurface, with a mostly deeper than normal thermocline in the west (positive anomalies in the depth of the 20°C isotherm) and a significantly shallower than average thermocline in the east. Such a structure is characteristic of a Pacific cool (La Niña) episode, although this example is quite weak. For the sake of comparison, during the 1988/89 La Niña, positive anomalies reached 50 m in the western Pacific and negative anomalies 70 m in the east. As spring 1995 progressed, there was an intensification of the western positive anomaly and a slight oscillation in the strength of the negative anomaly in the east.


Surface analyses

Figures 5 and 6 show the mean and anomalous spring 1995 MSLP patterns respectively. Anomalies are deviations from an eleven-year (1979–1989) global climatology from the European Centre for Medium Range Weather Forecasts (ECMWF). A three-wave pattern was evident in the seasonal mean with long wave troughs at middle to high latitudes being located over the central Pacific, central to eastern Atlantic and central Indian Oceans. These circulation features were quite close to their normal positions and strengths as evidenced by the rather diffuse anomaly pattern, although there was considerable variation from month to month within the season in the positions of the major troughs. The most significant anomaly in the Australian region occurred at about 60°S 140°E where MSLP was about 5 hPa above normal. This centre was connected via a ridge of anomalously high pressure to other centres over Antarctica where MSLP was over 10 hPa above average. The South Pacific subtropical ridge was generally stronger than average; high pressure anomalies were located to the east of New Zealand and near the southwest coast of South America.

Oceanic indices

Sea-surface temperatures (SSTs). Weak negative anomalies persisted near and along the equator between 160°E and the west coast of South America during spring (Fig. 3). The strongest negative departures occurred between 140°W and 120°W where anomalies between −1°C and −2°C were observed. There was some warming of the ocean on the southern flank of this cool anomaly as the season progressed, most notably in a region extending southeast from Papua-New Guinea to around 20°S 150°W.
Fig. 3  Spring 1995 sea-surface temperature anomaly (°C).

Fig. 4  Time-longitude section of monthly anomalous depth of 20°C isotherm at the equator from January 1994 to January 1996. Contour interval is 10 m.

Upper-level analyses

Figures 7 and 8 show the mean and anomalous spring 1995 500 hPa patterns respectively. These show a similar three-wave pattern to the MSLP although, with the exception of the Indian Ocean trough, the trough axes at 500 hPa were generally situated to the west of the surface troughs. The pattern of anomalies was devoid of significant structure, but the anomalous ridge from Antarctica to the region south of Australia was evident as on the surface analysis.

Blocking

Figure 9 is a time-longitude section of the daily southern hemisphere Blocking Index (BI) (Wright 1993), measuring the strength of the 500 hPa flow at mid-latitudes relative to that at subtropical and high latitudes. The focus of blocking (positive index values) during the season was located over the Pacific Basin (150°–270° in Fig. 9). Zonal flow (negative index values) predominated over the Atlantic and Indian Ocean sectors apart from a blocking episode over the middle Atlantic in early October.
Fig. 5  Spring 1995 (September, October, November) mean sea-level pressure (hPa).

Fig. 6  Spring 1995 (September, October, November) mean sea-level pressure anomaly (hPa).

Fig. 7  Spring 1995 (September, October, November) 500 hPa mean geopotential height (m).

Fig. 8  Spring 1995 (September, October, November) 500 hPa mean geopotential height anomaly (m).
Winds

Low-level (850 hPa) and upper-level (200 hPa) wind anomalies are shown in Figs 10 and 11 respectively. At low levels the significant features were:

(a) enhanced trade winds over the Pacific, particularly in the southern hemisphere, reflecting the stronger than average subtropical ridge;
(b) weaker than normal mid-latitude westerlies in the Australian sector;
(c) an anomalous anticyclonic circulation well south of Tasmania which was related to the high pressure (height) anomalies evident in Figs 6 and 8; and
(d) northerly or northwesterly anomalies over much of the Australia continent.

At upper levels there was evidence of an enhanced subtropical jetstream over the eastern Indian Ocean and also over Australia, whilst significant westerly anomalies were observed over the western equatorial Pacific, possibly reflecting an increase in the strength of the Walker Circulation.
Australian region

Circulation and rainfall
A succession of upper-level troughs and slow-moving cut-off low pressure systems affected eastern and central Australia during spring 1995. In September an intense low off the central New South Wales coast brought a very wet end to a protracted dry spell in the Sydney region; floods resulted and some new September monthly rainfall records were established. Several upper-level troughs during October produced significant rainfall through much of Queensland, including some areas most seriously affected by long-term rainfall deficiencies. Also in October, a low which formed over the southwest of New South Wales brought heavy rain to eastern South Australia and southern New South Wales, and floods to East Gippsland in Victoria. Several cloud bands in association with upper-level troughs produced above to very much above average rains for November across the southern third of Queensland and most of New South Wales. New monthly records were established at a number of locations in the Darling Downs and the adjacent northeast of New South Wales, giving farmers the best start to the season for many years. Figure 12 shows the overall distribution of spring precipitation. Most of New South Wales, southern Queensland and the east of South Australia were wetter than average, with large parts of the remainder being close to average. The most significant areas with below average rainfall were southern South Australia, Tasmania and western Victoria.

Temperatures
Mean maximum and minimum temperatures for spring 1995 are shown in Figs 13 and 14 respectively. The vast majority of the continent registered maximum temperatures within 1°C of average with positive departures generally favoured over negative. The few places to record anomalies of more than 1°C magnitude were central Victoria, southeast New South Wales and eastern Tasmania where anomalies were in the −1 to −2°C range, and a few spots in Queensland with positive anomalies of similar magnitude.

Minimum temperatures were above normal in most areas with the exception of southern and northern Western Australia, western Victoria, southwest New South Wales and Tasmania. An area extending southeast from inland Queensland to northeast New South Wales recorded minima 1 to 2°C above average, but in the Darling Downs and far northern New South Wales departures approached 3°C above average.
Fig. 12  Spring 1995 (September, October, November) rainfall in Australia: decile range values based on district averages and selected stations.

Fig. 13  Spring 1995 (September, October, November) maximum temperature anomalies (°C) for Australia based on a 1980–1994 mean.

Fig. 14  Spring 1995 (September, October, November) minimum temperature anomalies (°C) for Australia based on a 1980–1994 mean.
References


Appendix

Data sources used for this review were:
National Climate Centre, *Climate Monitoring Bulletin–Australia.* +
Climate Prediction Center (CAC), *Climate Diagnostics Bulletin.*

Obtainable from:
+National Climate Centre, Bureau of Meteorology, GPO Box 1289K, Melbourne Vic 3001, Australia.
*Clim ate Prediction Center (CPC), National Weather Service, Washington, D.C., 20233, USA.*