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Seasonal climate summary southern hemisphere (summer 1992–93): a re-strengthening El Niño-Southern Oscillation (ENSO) episode

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In the tropical Pacific, abnormally warm sea-surface temperatures off the South American coast were the main feature of the season. The warm waters were accompanied by anomalously strong westerlies in the western central Pacific, and re-strengthened atmospheric convection in the tropical central Pacific. Widespread excessive rainfall covered most parts of the Australian continent and caused generally lower maximum and minimum temperatures, especially in December and February.

Introduction

This seasonal summary reviews the southern hemisphere climate for summer 1992–93. Greater emphasis has been placed on the Australian region.

The main sources of information were the *Climate Monitoring Bulletins* issued by the Bureau of Meteorology (Australia), and the *Monthly Climate Diagnostics Bulletins* by Climate Analysis Center (CAC), Washington. Data sources are given in the Appendix.

Overview

Climate indices

The anomalous patterns of sea-surface temperatures (SSTs), low-level winds, sea level pressure and atmospheric convection (outgoing long wave radiation, OLR) indicated that warm episode conditions continued in the tropical Pacific. The Southern Oscillation Index varied from around -7 to -9 during this period (Fig. 1) and was consistent with the warm episode of the ENSO cycle. The lower tropospheric equatorial easterlies continued to be weaker than normal, and the westerlies expanded eastward to the central Pacific, near the date-line. A centre of OLR less than 190 Wm^{-2} was located near the date-line and was indicative of strong atmospheric convection in the tropical Pacific.

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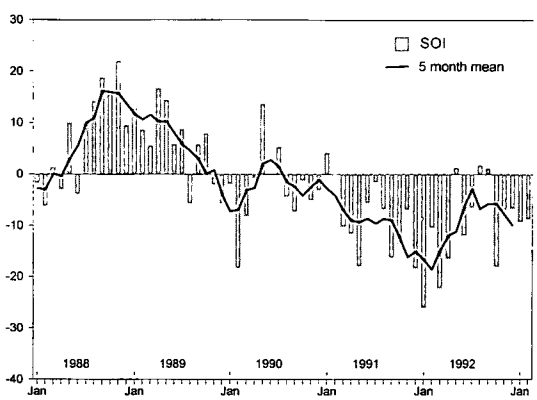
Fig. 1 Southern Oscillation Index, January 1987 to February 1993 inclusive.



Sea-surface temperatures

Satellite-derived SST anomalies (National Meteorological Centre, Australian Bureau of Meteorology) are used in this report (Fig. 2). However, the June 1991 Mt Pinatubo volcano eruption might still have caused a slight cooling bias in some areas. During December, near-normal SSTs extended westward from South America to near 155°W in a corridor along the equator (Fig. 2(a)), although anomalies were located in the vicinity of the date-line. The region of near-normal SSTs contracted eastward during the few months before

Fig. 2(a) December 1992 sea-surface temperature anomaly (°C).

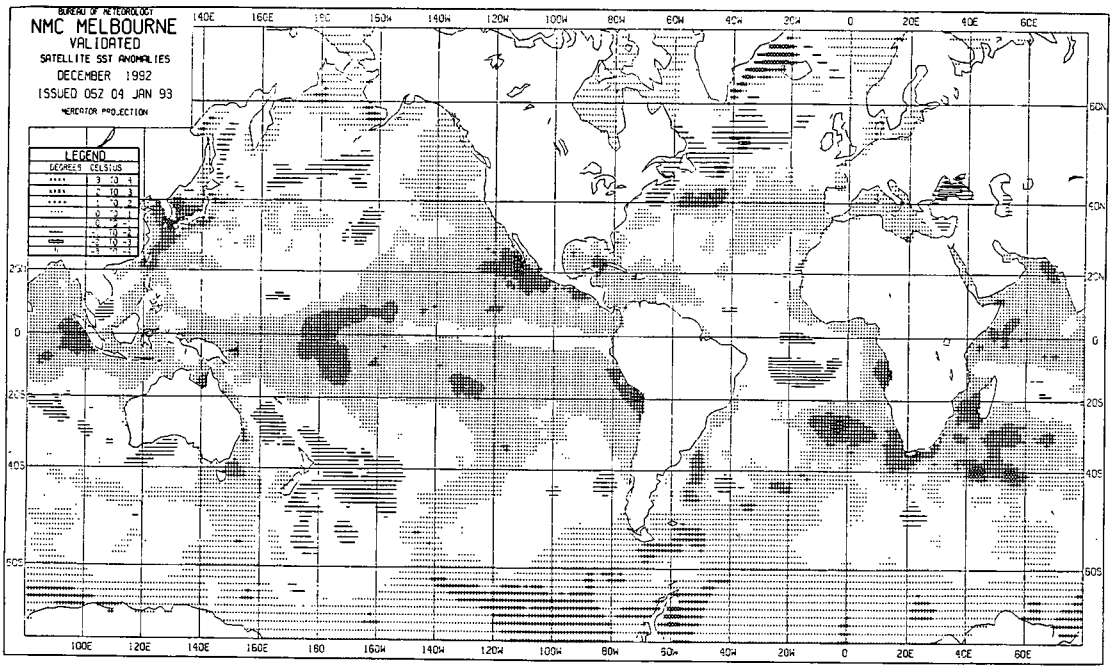


Fig. 2(b) January 1993 sea-surface temperature anomaly (°C).

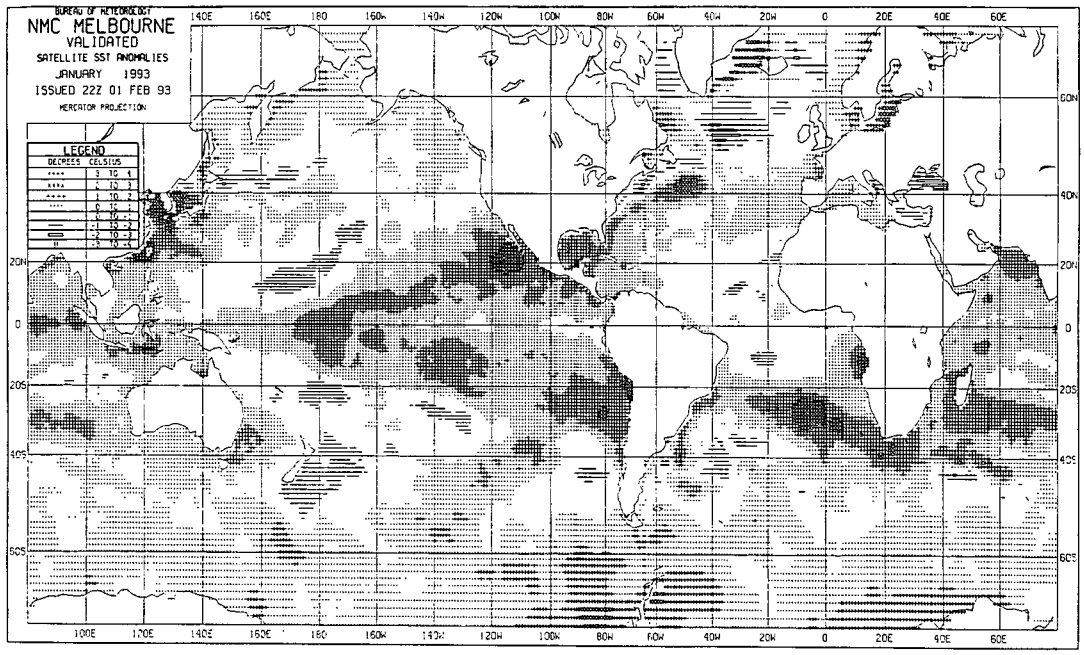
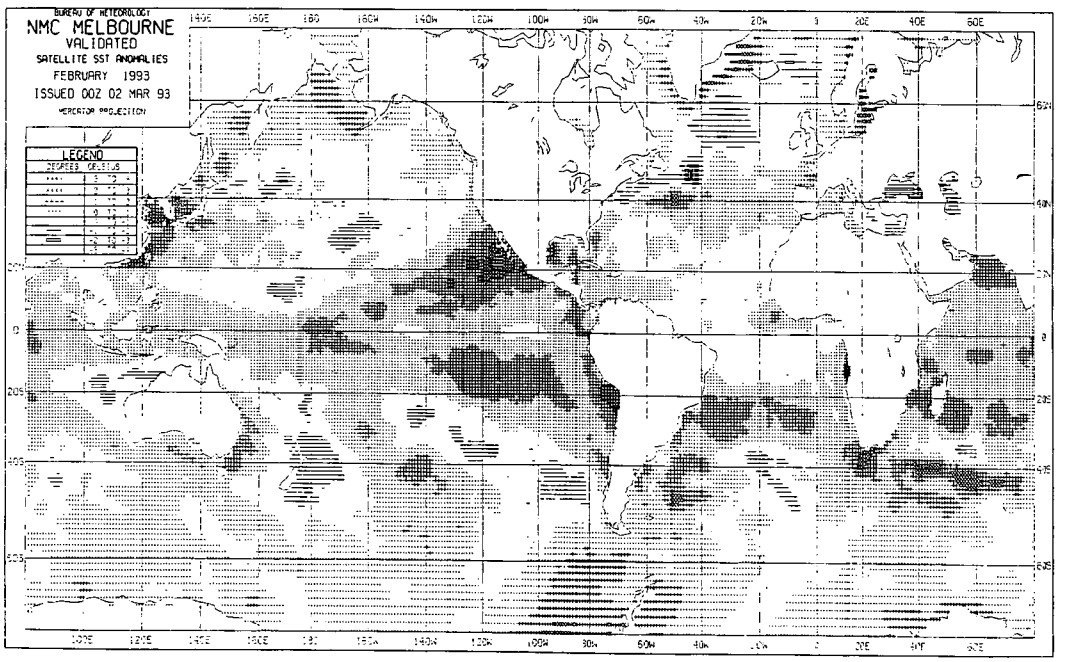


Fig. 2(c) February 1993 sea-surface temperature anomaly (°C).



December. However, SSTs in the central and eastern tropical Pacific have warmed since January (Fig. 2(b)). SSTs off northern Peru and Mexico increased to around 2°C above their normal February values (Fig. 2(c)). Subsurface temperatures in the tropical Pacific in February changed little from their values in January with the western Pacific remaining cooler than normal and central and eastern areas generally continuing warmer.

Surface analysis

Figures 3 and 4 show the summer mean sea level pressure (MSLP) analysis and anomaly respectively. The mean chart shows three high pressure centres located over the southeast Pacific, south Atlantic and southeast Indian Ocean around 30°S. Three prominent troughs were located over Australia, the South American and South African continents. A low pressure centre, situated in the equatorial region south of the equator near the date-line, was consistent with the strong convection over that area.

The anomaly pattern (Fig. 4) was dominated by a broad region of negative anomalies from 170°E to South America in the Pacific, and positive anomalies over most part of the Indian Ocean and the western Pacific. This is consistent with anomalies observed at similar periods of past warm Pacific episodes. In high latitudes, two obvious positive anomaly centres were located around 60°S latitude over the central South Pacific and the western south Atlantic.

Upper-air analysis

The 500 hPa mean summer analysis and anomalies are shown in Figs 5 and 6 respectively. While the mean pattern shows a three-wave configuration with a strong trough anchored over the western Pacific, the anomaly map shows very similar features to the MSLP anomaly pattern. These features are also dominant on the 300 hPa anomaly chart (Fig. 8), indicating that anomaly centres extended throughout the troposphere over these areas. The boundaries between the positive and negative anomalies leaned towards the east with height.

Blocking

A time-longitude section of the daily hemispheric Blocking Index* is shown in Fig. 9. Blocking activities tended to be suppressed, particularly

*Blocking Index (BI) =
$0.5\,(U_{25}+U_{30}+U_{55}+U_{60}-U_{40}-U_{50}-2U_{45})$
where U is the westerly wind component at 500 hPa. The subscripts refer to the latitude.

Fig. 3 Summer 1992–1993 (December, January, February) mean sea level pressure (hPa).

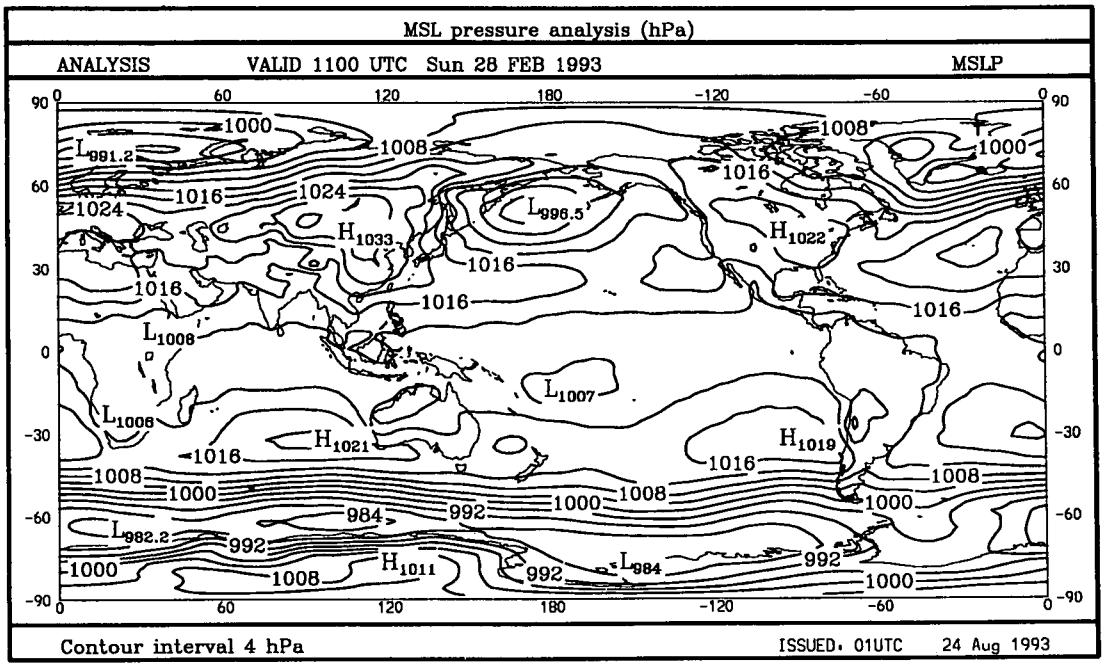


Fig. 4 Summer 1992–1993 (December, January, February) mean sea level pressure anomaly (hPa).

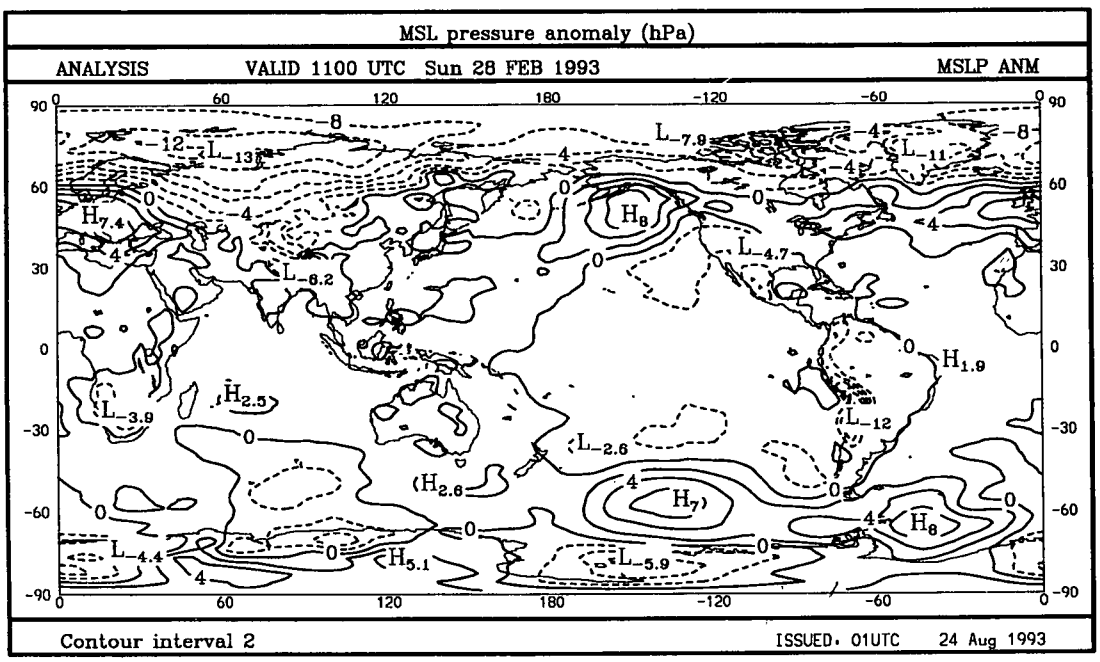


Fig. 5 Summer 1992–1993 (December, January, February) 500 hPa mean height (dam).

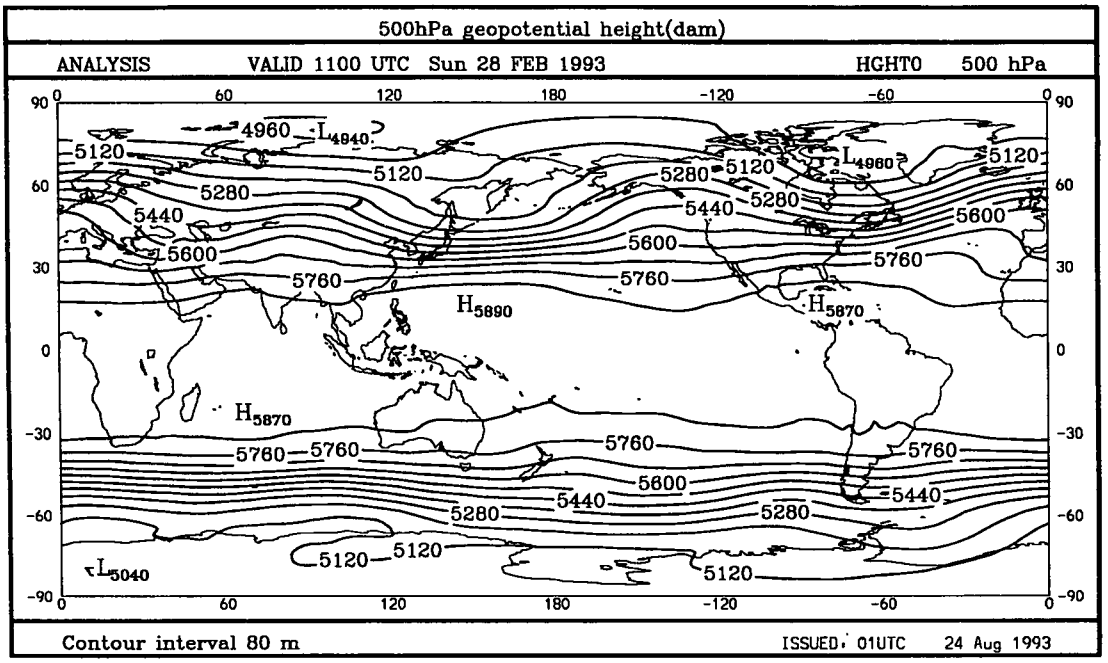


Fig. 6 Summer 1992–1993 (December, January, February) 500 hPa mean height anomaly (dam).

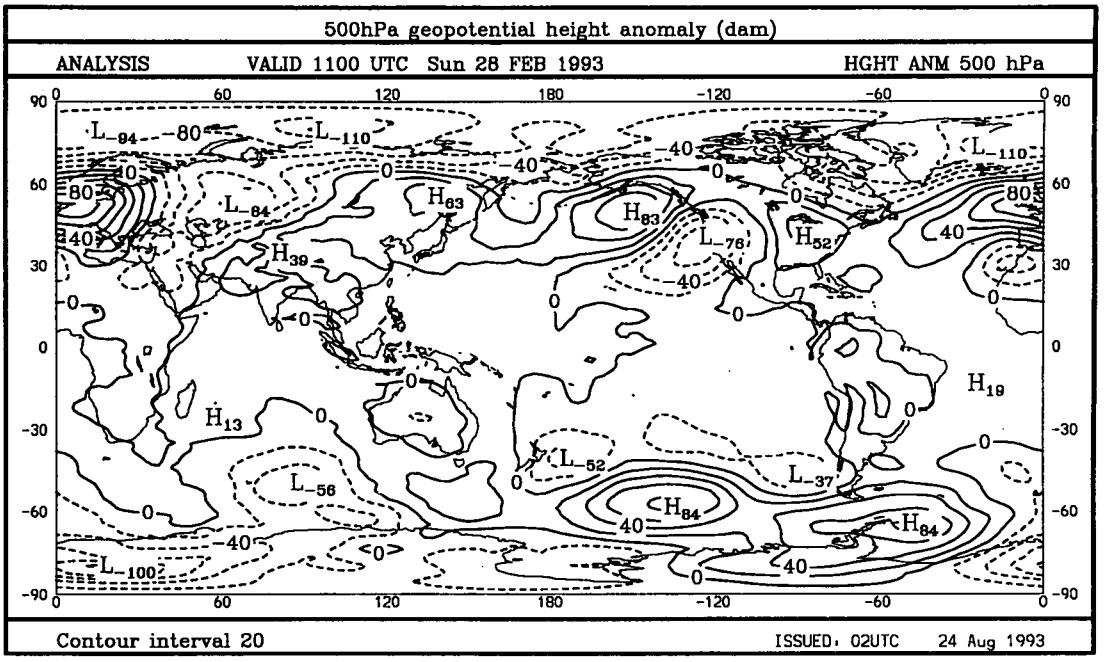


Fig. 7 Summer 1992–1993 (December, January, February) 300 hPa mean height (dam).

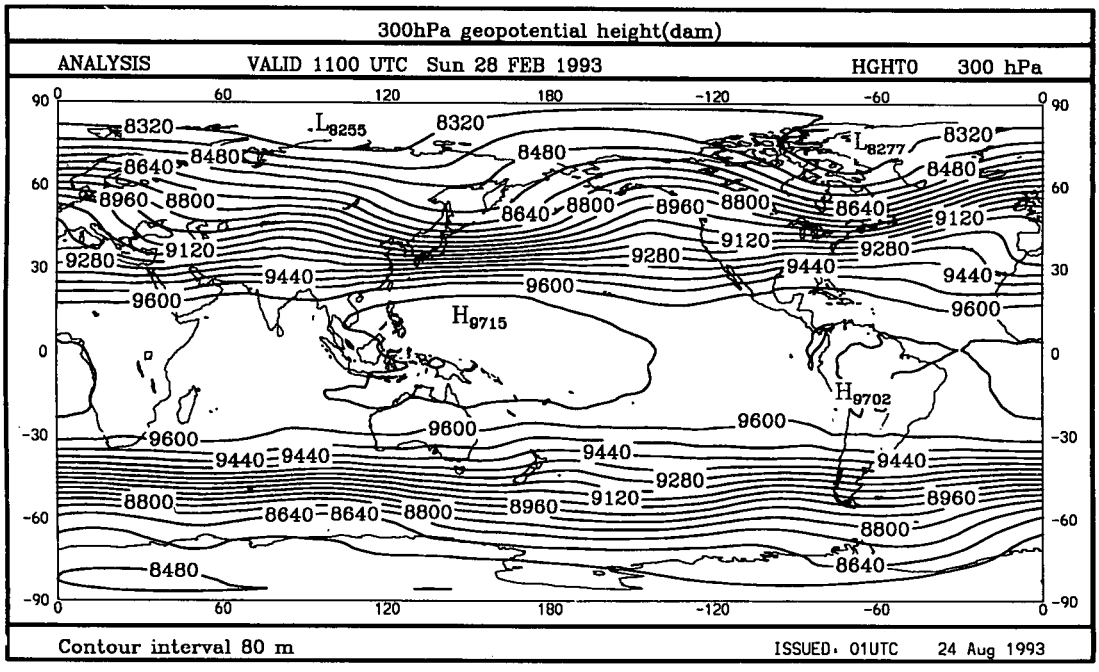


Fig. 8 Summer 1992–1993 (December, January, February) 300 hPa mean height (dam).

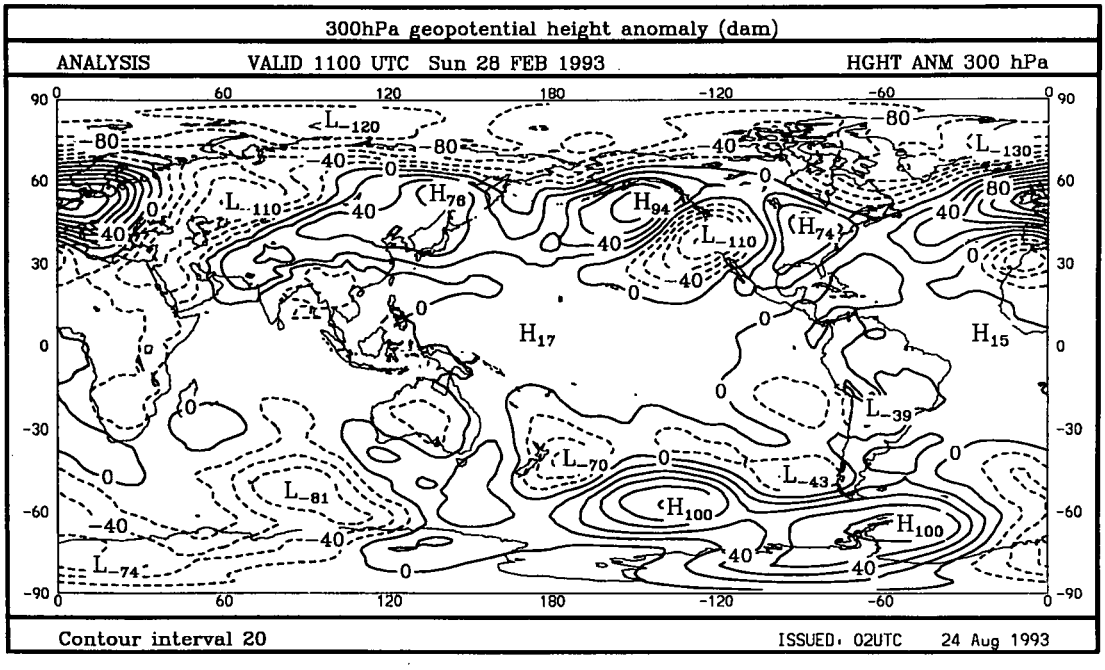
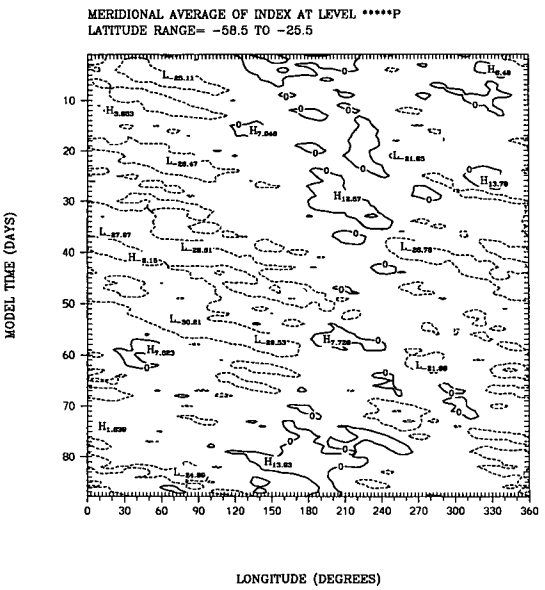


Fig. 9 **Summer 1992–1993 (December, January, February) daily Blocking Index: time-longitude section. Day 1 is 1 December.**



during the middle of the season. However, two blocking episodes were observed near the date-line at the end of December and in mid-February.

Winds

850 hPa and 300 hPa vector wind anomalies are shown in Figs 10 and 11 respectively. In the lower troposphere, strong westerly anomalies in the western tropical Pacific, which extended eastward to the date-line, supported the re-strengthening warm Pacific event (Fig. 10). Strong northerly anomalies were also widespread over the whole Australian continent. In the upper troposphere, strong abnormal easterlies were evident in the eastern tropical Pacific (Fig. 11).

Australian region

Circulation and rainfall

Abundant, even excessive rains continued over southeastern Australia in December, with many places in South Australia, northern Victorian and western New South Wales registering record rainfall totals for the month. Most of this rain was produced by slow-moving depressions and associ-

Fig. 10 **Summer 1992–1993 (December, January, February) 850 hPa vector wind anomalies (m s^{-1}).**

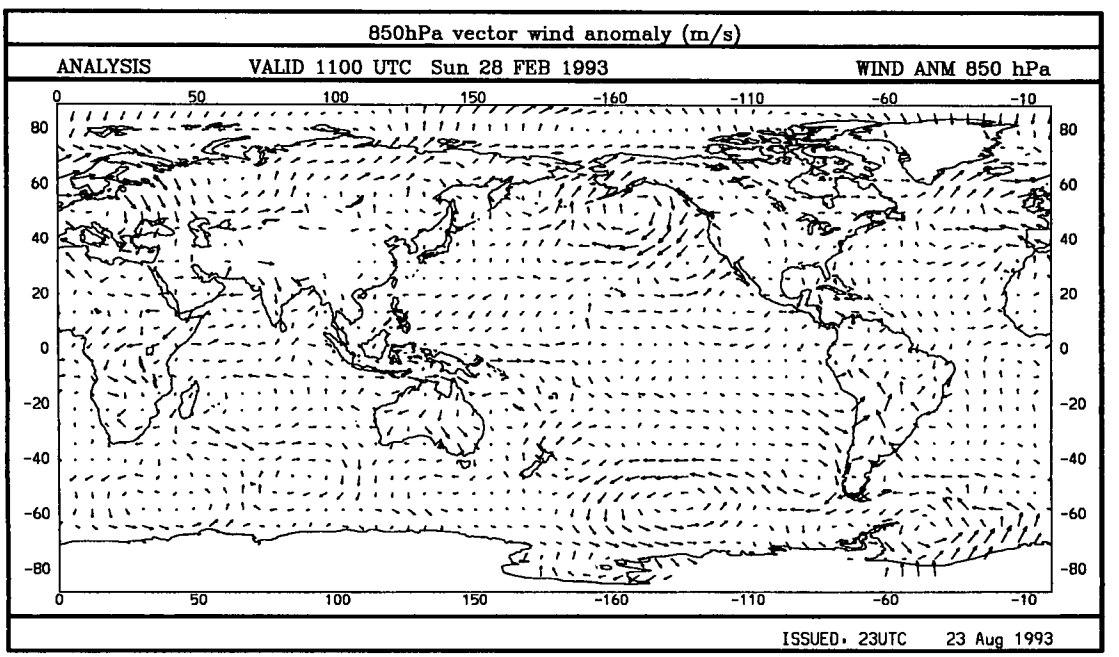


Fig. 11 Summer 1992–1993 (December, January, February) 300 hPa vector wind anomalies (m s^{-1}).

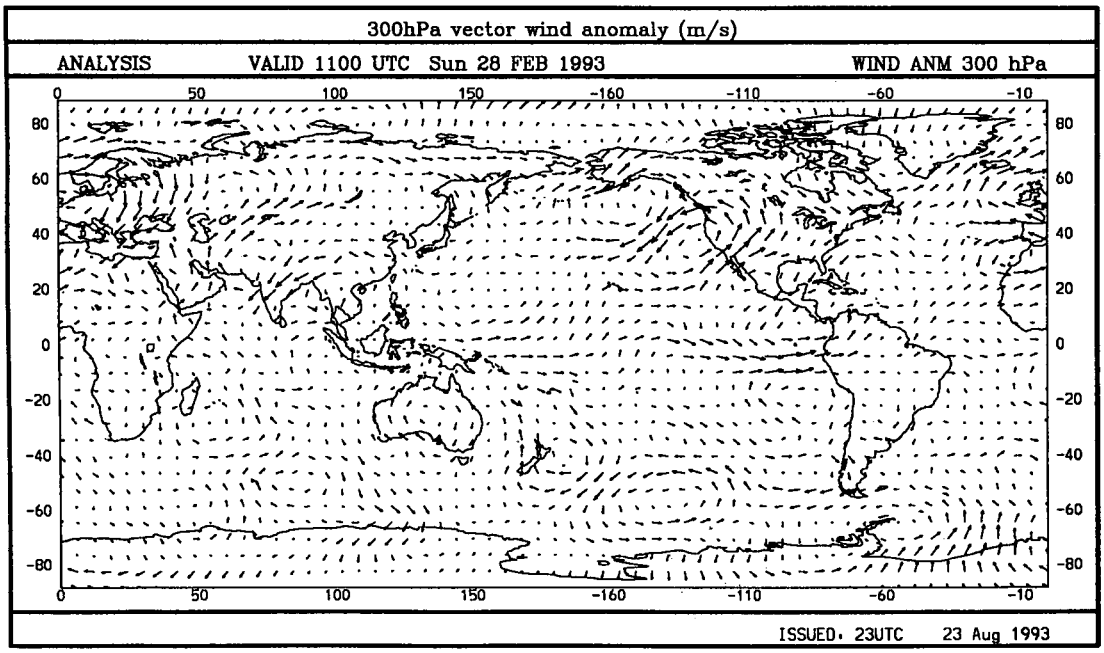


Fig. 12 Summer 1992–1993 (December, January, February) rainfall over Australia: decile range values based on district averages.

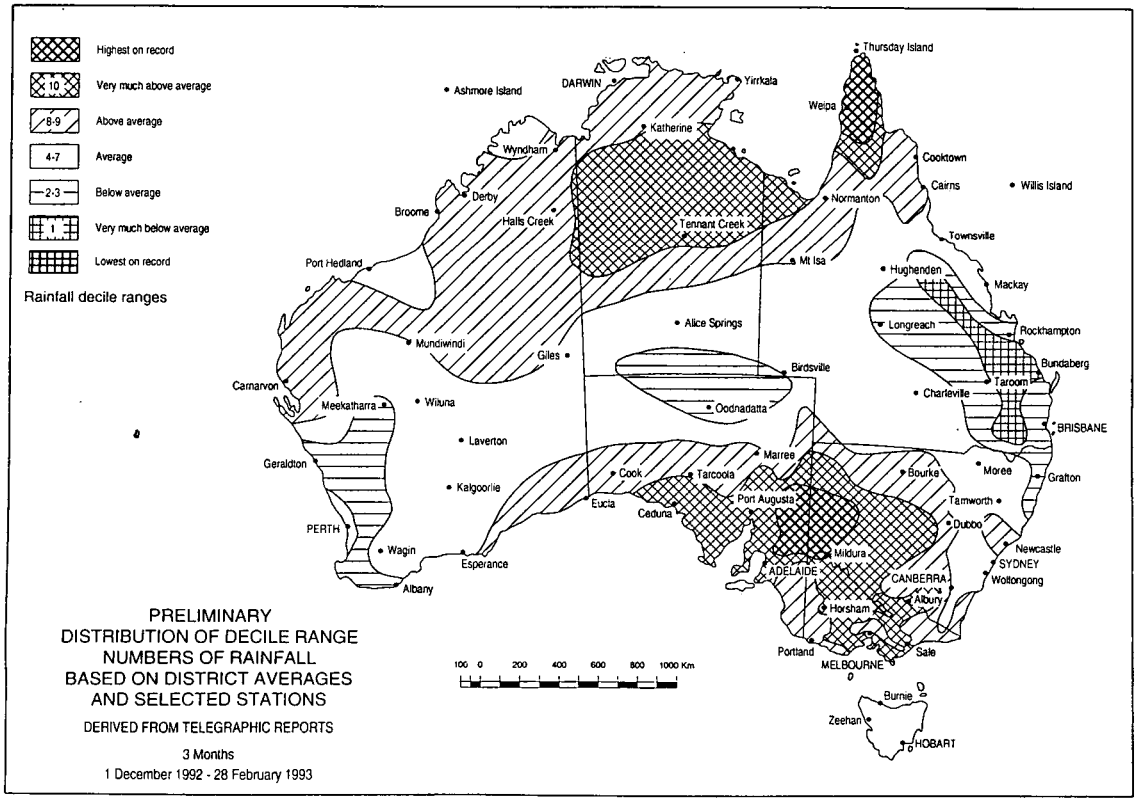


Fig. 13(a) December 1992 maximum temperature anomalies for Australia (°C).

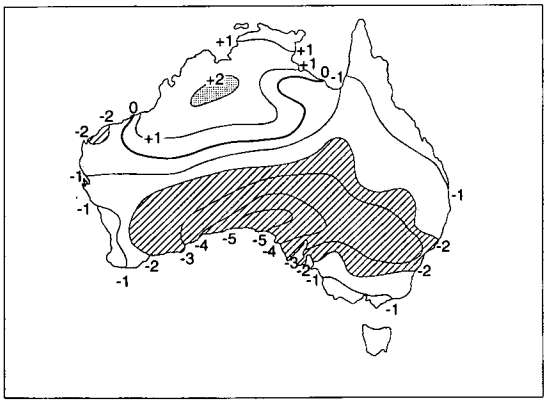


Fig. 13(b) December 1992 minimum temperature anomalies for Australia (°C).

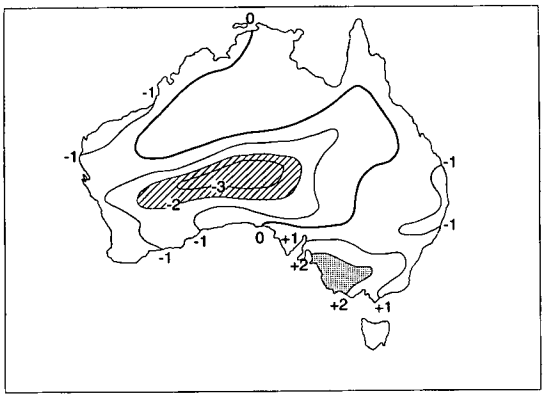


Fig. 13(c) January 1993 maximum temperature anomalies for Australia (°C).

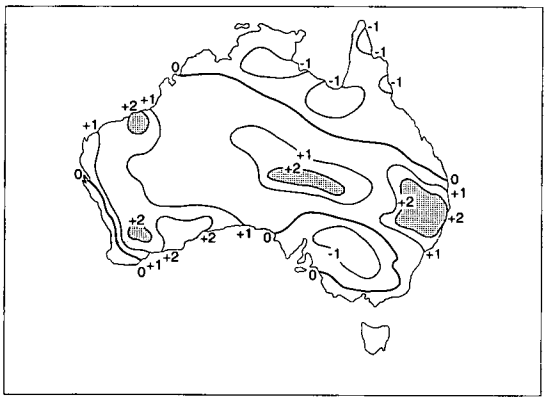


Fig. 13(d) January 1993 minimum temperature anomalies for Australia (°C).

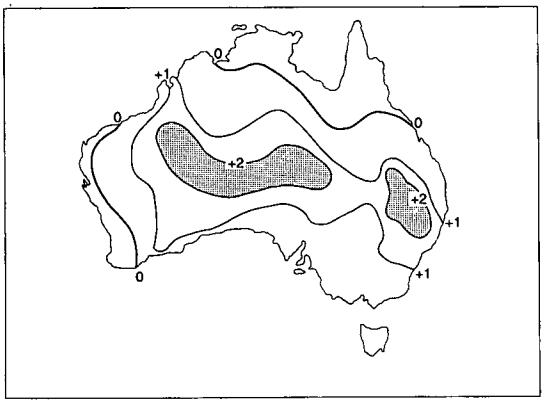


Fig. 13(e) February 1993 maximum temperature anomalies for Australia (°C).

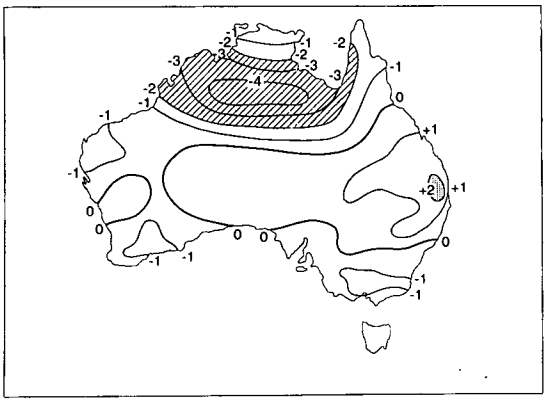
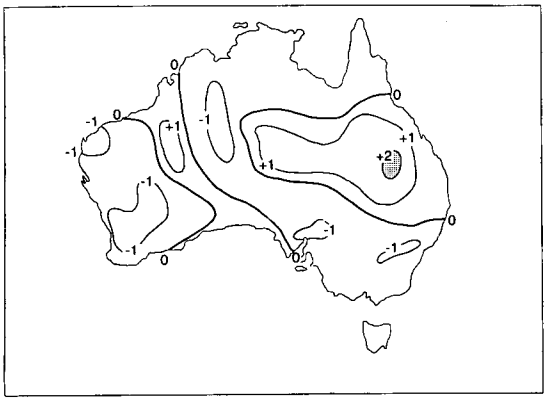


Fig. 13(f) February 1993 minimum temperature anomalies for Australia (°C).



ated troughs which directed moist, tropical air towards the south. Heavy monsoonal rains in late January continued in February, with most places in the tropics receiving well above average rainfall. Record rainfall totals were registered over an extensive area of inland northern and northwestern Australia. The seasonal rainfall analysis (Fig. 12) shows that, despite drier conditions over southern Australia in February, most of this area experienced one of its wettest summers, with record rainfall over an area of eastern South Australia/western New South Wales. However, long-term dry conditions over much of eastern Queensland were accentuated by the general failure of the summer rains.

Temperatures

Persistent cloud cover and rainfall over southern and southeastern Australia during December maintained the trend of cool conditions there. Maximum temperatures (Fig. 13(a)) were two to four degrees below normal over most of the continent outside the tropics. Minimum temperatures were below normal by one to three degrees over southern central Australia, but above normal by up to two degrees in the tropics and over Victoria (Fig. 13(b)).

In January, the relatively wet conditions in the tropics were associated with slightly (about one degree) below normal maximum temperatures (Fig. 13(c)). However, in contrast to the previous month, northerly wind anomalies favoured above normal maxima in all remaining areas except the southeast. Minimum temperatures were generally close to or slightly above normal, with warm anomalies (1 to 2.5 degrees) again over central Australia (Fig. 13(d)).

Significantly below normal maximum temperatures were observed in the tropics in February, particularly between 15–20°S with departures reaching 3 to 4 degrees (Fig. 13(e)). This was the result of well above average cloud and rainfall over this area. Minimum temperatures were mostly within 1 to 1.5 degrees of normal, with the most significant departures in a belt extending from Queensland to central Australia (Fig. 13(f)).

Appendix

Data sources used for this review were:

Climate Analysis Center — *Climate Diagnostic Bulletin.**

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

Obtainable from:

*Climate Analysis Center (CAC), National Weather Service, Washington D.C. 20233, USA.

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