Seasonal climate summary southern hemisphere (winter 2004): El Niño speculation rises with low rainfall and high daytime temperatures in the northeast

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Circulation patterns are reviewed for southern hemisphere winter (June - August) 2004, with particular emphasis given to the tropical Pacific Ocean and the Australian region. Some El Niño indicators strengthened during winter 2004, reviving speculation about the return of a warm event. However, not all indicators supported this development. Values of the Southern Oscillation Index (SOI) and Multivariate ENSO Index were consistent with those of a borderline El Niño event throughout winter. However, outgoing long wave radiation (OLR) did not indicate a shift of convection toward the date-line, nor did upper and lower-level wind anomalies over the tropical Pacific suggest a broadscale suppression of the equatorial Walker circulation. Significantly warmer than normal waters persisted across the central tropical Pacific during winter but the classic El Niño warm tongue in the far eastern equatorial Pacific did not eventuate. Subsurface analyses across the equatorial Pacific showed a gradual contraction of cool anomalies east of the date-line and corresponding eastward progression of warm subsurface anomalies throughout winter. However the magnitude of these anomalies appeared to peak during July. Despite this, some national climate services declared an El Niño event by the end of August. This declaration was not supported by Australia's National Climate Centre, highlighting differences between definitions used and priorities placed on indicators. Nevertheless, speculation that another El Niño-related drought was on the way for Australia increased during winter, especially in Queensland. This speculation was fuelled by winter rainfall patterns which resulted in much of Queensland and northeast and coastal New South Wales (NSW) recording very much below average rainfall for the season. Winter-mean maximum temperatures in parts of these regions were the highest since at least 1950.

Introduction

Ongoing assessment of El Niño-Southern Oscillation (ENSO) indicators suggested that after near-El Niño conditions during summer 2003/04 (Fawcett 2004), the climate system relaxed toward a more neutral state during the following autumn (Trewin 2005). Most El Niño events in the historical record develop by the end of the southern hemisphere autumn. However, in 2004 the climate system remained primed for a late-developing event despite neutral

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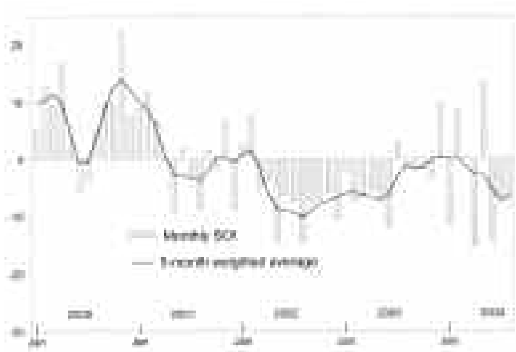
conditions during the autumn. The winter did indeed see a strengthening of some El Niño indicators, increasing speculation that the climate system would evolve into an El Niño state by the end of the year. Many numerical models used for predicting Pacific Ocean temperatures supported this opinion. In fact, some national climate prediction centres (e.g. US Climate Prediction Center (CPC)) had declared the start of an event by the end of winter. But, due to the mixed signals provided by ENSO indicators, this declaration did not receive universal international support.

The main sources of information used for this summary were the *Climate Monitoring Bulletin* (Bureau of Meteorology, Melbourne, Australia) and the *Climate Diagnostics Bulletin* (Climate Prediction Center, Washington D.C., USA). Data sources are given in the Appendix.

Fig. 1 Southern Oscillation Index (SOI), January 2000 to August 2004 inclusive. Means and standard deviations based on the period 1933-92.



Pacific basin climate indices

The Southern Oscillation Index (SOI)*

SOI values of –14.4, –6.9 and –7.6 were recorded for June, July and August 2004 respectively (Fig. 1), resulting in a winter mean of –9.6. The June value was a 27-point drop from May, continuing the month-to-month volatility evident during the previous two seasons. However, the winter values represented the first three consecutive months with moderate negative SOI values since the demise of the 2002/03 El Niño event, fuelling speculation that the phenomenon would soon return. Figure 1 clearly shows the persistent pattern of negative SOI values associated with the El Niño event of 2002/03, followed by neutral behaviour of the SOI to May 2004 in which monthly values were greatly influenced by intraseasonal variability such as the Madden-Julian Oscillation (MJO).

Due to its relative simplicity, long history of use and wide media coverage, the SOI is the most recognised indicator of ENSO amongst the general public, particularly the agricultural community. Consequently, the pattern of three moderately negative monthly SOI values did not go unnoticed and the prospect of an El Niño in 2004 received increased media coverage during winter.

The mean sea-level pressure (MSLP) at Darwin during the winter months was consistent with a developing El Niño event. June, July and August anomalies were +1.8 hPa, +0.8 hPa and +0.8 hPa respectively. However, the pressure at Tahiti was generally only slightly below average, with equivalent anomalies of 0.0 hPa, –0.3 hPa and –0.3 hPa. Consequently, the moderate negative SOI values recorded in winter were mainly due to the Darwin half of the equation, with significant negative pressure anomalies typical of an El Niño yet to be realised at Tahiti.

Multivariate ENSO index

As it is based on observations at only two point locations, there is a limited amount of information that can be conveyed by the SOI. Consequently some national climate services prefer to place greater monitoring emphasis on the Multivariate ENSO Index (MEI) (Wolter and Timlin 1993, 1998) which is based on wider observational inputs, such as surface wind, cloudiness and ocean temperatures. The June/July and July/August values of the US Climate Diagnostic Center MEI were +0.454 and +0.602 respectively. When ranked against historical values, these values sit on the border between neutral and El Niño conditions if a tercile split between La Niña, neutral and El Niño conditions is used. This influenced the US Climate Prediction Center's decision to declare that El Niño conditions would develop in the August-October period (*Climate Diagnostics Bulletin* - July, CPC 2004). By mid-September the organisation had declared that a warm event had developed and was expected to continue until early 2005 (*Climate Diagnostics Bulletin* - August, CPC 2004). This declaration was not supported by Australia's National Climate Centre (NCC 2004), highlighting the lack of an internationally agreed definition of what constitutes an El Niño event.

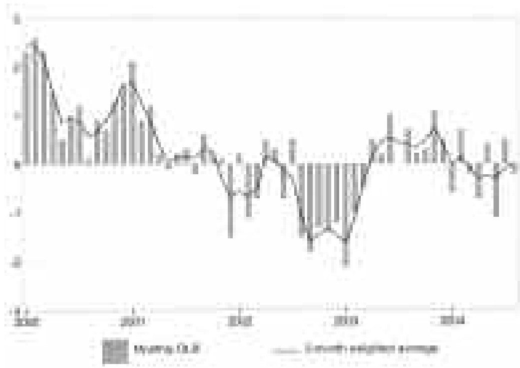
Outgoing long wave radiation

* 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.

A time-series of monthly standardised outgoing long wave radiation (OLR) anomalies from January 2000 to August 2004 is shown in Fig. 2. These data were provided by the CPC, Washington (CPC 2004), and are a measure of the amount of long wave radiation emitted from an equatorial region centred about the date-line (5°S to 5°N, 160°E to 160°W). El Niño events typically exhibit anomalously low OLR values due to increased high cloud and deep convection near the date-line. Such values are evident during the 2002/03 event. Conversely, La Niña events tend to be associated with suppressed convection near the date-line and anomalously high OLR values.

Unlike the SOI, monthly OLR values during winter 2004 continued to exhibit the mix of positive and negative anomalies observed since the start of the year, with values for June, July and August of –1.1, +0.5 and –0.2 respectively. The lack of sustained negative values suggested that convection near the date-line continued to be influenced by intraseasonal variability, rather than broadscale reorganisation of the climate system. Hence, one of the key signatures of El Niño appeared to be lacking. The apparent lack of coupling between the ocean and atmosphere was one of the main reasons for NCC being reluctant to formally declare the start of a Pacific warm event.

Fig. 2 **Standardised anomaly of monthly outgoing long wave radiation (OLR) averaged over 5°N-5°S and 160°E-160°W, for January 2000 to August 2004. Negative (positive) anomalies indicate enhanced (reduced) convection and rainfall. Anomalies are based on a 1979-95 base period. After CPC (2003, 2004).**



Ocean patterns

Sea-surface temperatures (SSTs)

Winter 2004 sea-surface temperature (SST) anomalies (°C) are shown in Fig. 3, obtained from the NOAA optimum interpolation analyses (Reynolds et al. 2002). Positive (warm) anomalies are shown in red shades, and negative (cool) anomalies in blue shades.

Warmer than normal waters across the central tropical Pacific, and cool anomalies north of Australia expanded during winter, supporting the transition toward a Pacific warm event. However, these anomalies were largely less than 1°C in magnitude in the winter mean. Warm anomalies greater than 1°C were confined to relatively small equatorial regions between 170°E and 215°E. Anomalies during winter 2004 in the western warm pool region (as measured by the NINO4 index) were comparable to winter values during the 2002 and 1997 warm events. The central (NINO3.4) and eastern (NINO3) Pacific anomalies for winter 2004 were slightly less than those in the 2002 event but considerably weaker than those in the strong 1997 event. The classic El Niño warm tongue in the far eastern equatorial Pacific had clearly not developed by the end of winter, with strong cool anomalies reaching –1.5°C off the South American coast in the winter mean. Nevertheless, the warmth in the NINO4 region could be used to argue that the winter 2004 SST pattern represented a 'central' Pacific warm event.

The North Pacific was generally warm, with greater than +1.0°C June-August anomalies observed in the north. A tongue of abnormally warm surface water extended from the western end of the tropical Pacific warm anomalies to the central South Pacific, with a region of +1.0°C anomalies centred at 200°E, 40°S.

In the Indian Ocean, SST anomalies were mixed and mostly weak, with weak cool anomalies directly adjacent to the Western Australian (WA) coast. As for autumn, cool winter SST anomalies were observed over most waters near the southern Australian coast, and near New Zealand. Warm anomalies prevailed off the NSW and Queensland coasts, with a small region of +1.5°C anomalies off the southern Queensland coast.

The North Atlantic displayed a strong dipole of cool/warm anomalies consistent with anomalous winds in the low levels.

Subsurface patterns

Figure 4 shows a Hovmöller diagram of the anomaly in the depth of the 20°C isotherm in the equatorial Pacific Ocean from January 2001 to August 2004, as calculated by the Bureau of Meteorology Research Centre (BMRC). This isotherm is normally situated very close to the equatorial ocean thermocline, the

Fig. 3 Anomalies of sea-surface temperature (SST) for winter 2004 (°C).

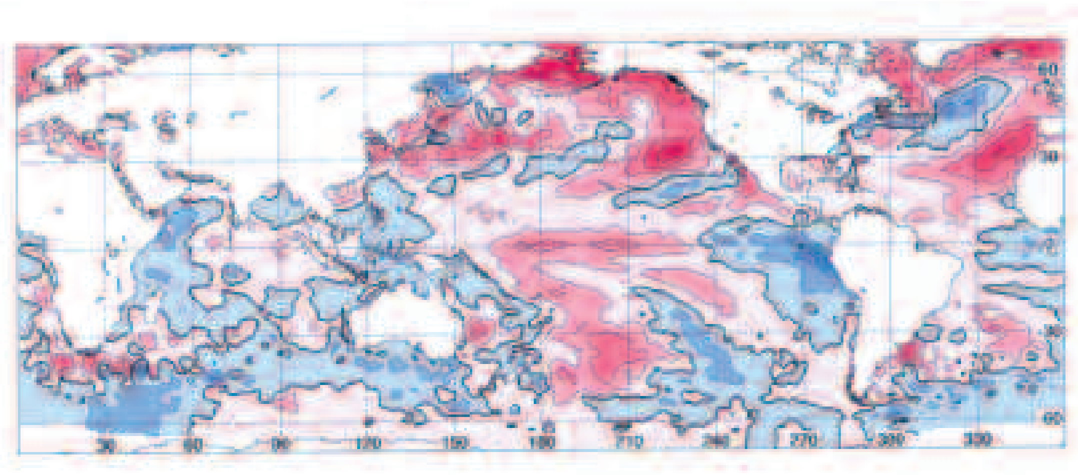
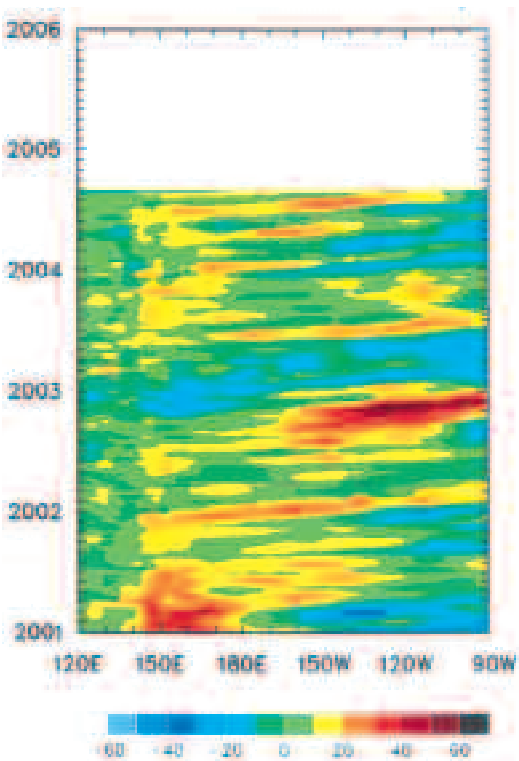


Fig. 4 Time-longitude section of the monthly anomalous depth of the 20°C isotherm at the equator for January 2001 to August 2004. Base period: 1979-89. Contour interval is 10 m.

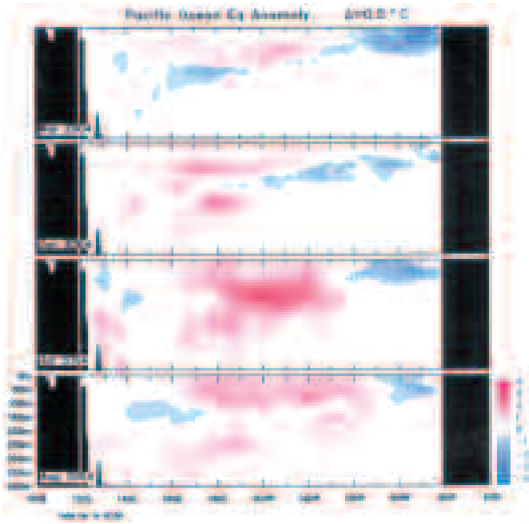


region of greatest temperature gradient which defines the boundary between the warm surface water and cold deep ocean water. An abnormally deep thermocline (positive anomaly) in the eastern Pacific Ocean is characteristic of El Niño events.

Consistent with surface patterns, the 20°C thermocline was generally deeper than normal across the Pacific during winter 2004, apart from in the far east. This deepening peaked in July when anomalies of +20 m to +40 m occurred in a region 160°W to 130°W associated with a downwelling Kelvin wave. This was the strongest Kelvin wave of the year so far but it failed to penetrate further east or develop into a sustained deepening of the thermocline typical of a strong Pacific warm event. Such deepening is evident in the eastern Pacific during the 2002/03 warm event. The shallow thermocline evident during summer and autumn in the far eastern Pacific persisted during winter 2004. However, continuing a trend observed since the start of 2004, the anomaly weakened and contracted during winter so that by the end of the season the thermocline was slightly deeper than normal across almost all the equatorial Pacific.

A cross-section of equatorial subsurface temperature anomalies from May to August 2004 is shown in Fig. 5 (also obtained from BMRC). Red shades indicate warm anomalies, and blue shades cool anomalies. The gradual contraction of cool anomalies east of the date-line and above depths of 200 m was evident throughout winter. Corresponding eastward progression of the warm subsurface anomalies in the central Pacific was also evident. Despite being more

Fig. 5 **Four month (May to August 2004) sequence of vertical temperature anomalies at the equator. Contour interval is 0.5°C.**



widespread in August, the magnitude of these warm anomalies appeared to have peaked during July. The July analysis shows most of the central Pacific with greater than +2°C anomalies at about 150 m depth, whereas the August analysis shows widespread anomalies in the +1.0 to +1.5 °C range.

Despite Pacific subsurface temperatures typical of a developing El Niño event, these anomalies had so far failed to force a strong response at the surface and induce a coupled response with the atmosphere, such as a sustained change in the trade winds or convection. Consequently, many argued it was too premature to be calling 2004 an El Niño year.

Atmospheric patterns

Surface analyses

Winter 2004 MSLP across the southern hemisphere is shown in Fig. 6, with the associated anomalies in Fig. 7. These anomalies are calculated with respect to a 1979-2000 climatology obtained from the National Centers for Environmental Prediction (NCEP). The MSLP analysis has been computed using data from the 0000 UTC daily analyses of the Australian Bureau of Meteorology's GASP model. The MSLP anomaly field is not shown over areas of elevated topography (grey shading).

Fig. 6 **Mean sea-level pressure for winter 2004 (hPa).**

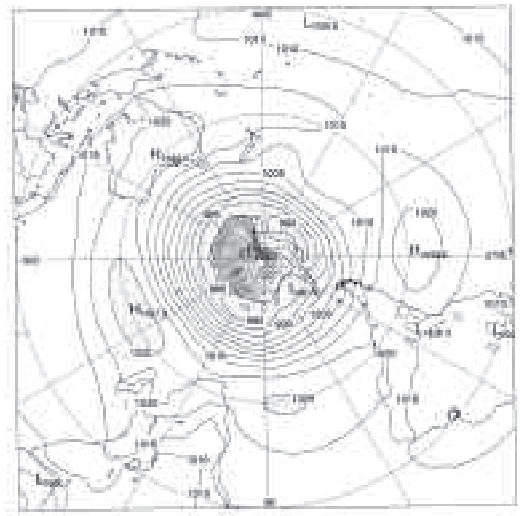
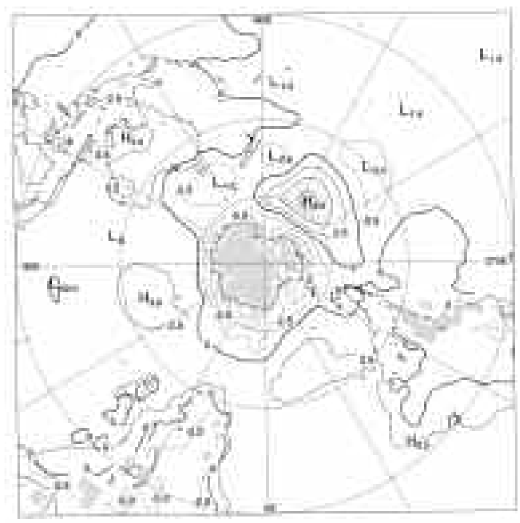


Fig. 7 **Anomalies of the mean sea-level pressure from the 1979-2000 National Centers for Environmental Prediction reanalysis II climatology, for winter 2004 (hPa).**



For the winter mean analysis the Antarctic circumpolar trough showed four minima located at 20°E, 90°E, 150°W and 45°W. As for autumn, the trough was somewhat stronger than usual in winter, with negative MSLP anomalies over most regions south of 60°S. The most obvious anomaly was a large area of higher-than-normal pressure near 210°E, 60°S in the central South Pacific. This anomaly was strongest in the August analysis (*Climate Monitoring Bulletin* – August 2004).

Weak positive anomalies occurred over most of the Australian continent during winter, apart from weak negative anomalies recorded over Victoria and Tasmania. The strongest positive anomalies over the Australian continent were in central northern parts and the Pilbara region of Western Australia.

Mid-tropospheric analyses

The mean 500 hPa geopotential height pattern for winter 2004 is shown in Fig. 8, with departures from the climatological mean shown in Fig. 9. The split flow east of Australia during summer and autumn was again evident in the winter analysis. Anomalies at the 500 hPa level were generally similar in location to those at the surface, with the most prominent feature being positive anomalies centred over mid-high latitudes of the central South Pacific.

Consistent with the surface pattern, higher-than-normal geopotential heights occurred in the mid-troposphere over most of Australia during winter, apart from the far southeast. Lower than normal heights persisted to the south of Australia.

Blocking

A daily southern hemisphere mid-level Blocking Index (BI) may be defined using the equation:

$$BI = 1/2\ [(u_{25} + u_{30}) - (u_{40} + 2u_{45} + u_{50}) + (u_{55} + u_{60})]$$

where u_x indicates the 500 hPa zonal wind component at latitude x°S. The blocking index measures the strength of the 500 hPa flow at the mid-latitudes (40°S to 50°S) relative to that at subtropical (25°S to 30°S) and high (55°S to 60°S) latitudes. Regions of blocking are indicated by positive values of the index. Figure 10 is a time-longitude section of the daily blocking index, while Fig. 11 is a section averaged across the season as a whole.

Averaged over the whole season, blocking activity was near normal through most of the southern hemisphere mid-latitudes, apart from in the central Pacific (Fig. 11). Positive anomalies (mostly around +10 m s^{-1}) prevailed in this region, indicating a suppression of the westerly flow. There were no strong negative anomalies for the seasonal mean, despite a period of enhanced mid-latitude flow between late June and early July in a region 240°E to 360°E. Figure 10 indicates that the positive values of the BI analysed at South Pacific longitudes in the seasonal mean occurred throughout winter, apart from mid-June to mid-July.

Winds

Fig. 8 Mean 500 hPa geopotential heights for winter 2004 (gpm).

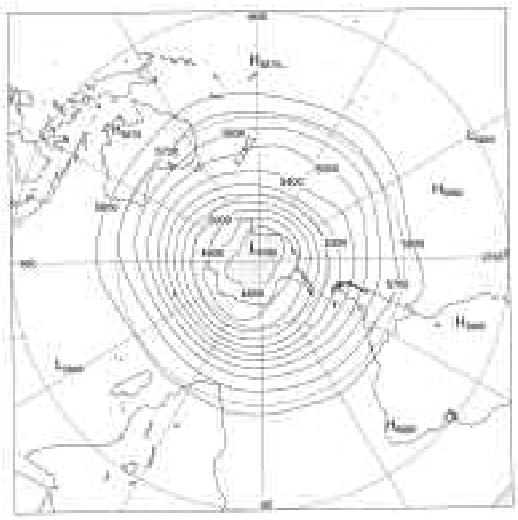
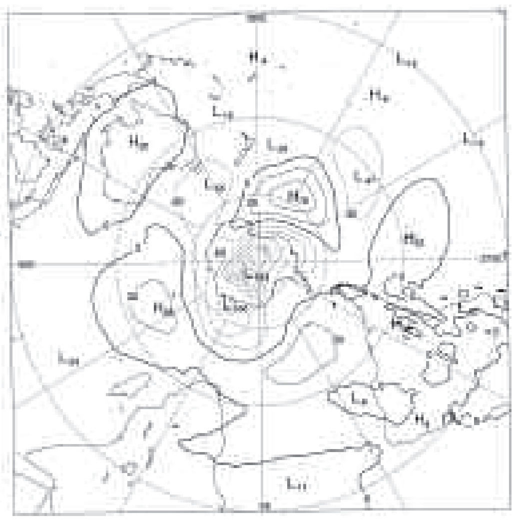


Fig. 9 Anomalies of the 500 hPa geopotential height from the 1979-2000 National Centers for Environmental Prediction reanalysis II climatology, for winter 2004 (gpm).



Low-level (850 hPa) and upper-level (200 hPa) wind anomalies for winter 2004 are shown in Figs 12 and 13 respectively. A small region of suppressed easterly flow was evident near the South American coast, consistent with the weakening cool SST anomalies

Fig. 10 Winter 2004 daily blocking index: time-longitude section. Day 1 is 1 June.

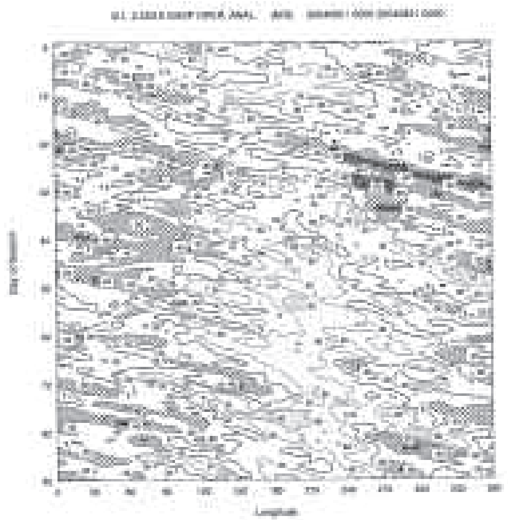
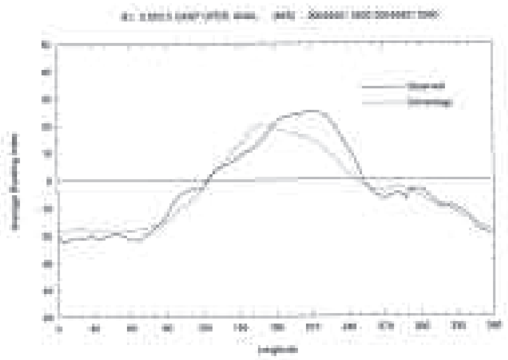


Fig. 11 Mean southern hemisphere blocking index for winter 2004 (bold line). The dashed line shows the corresponding long-term average. The horizontal axis shows the degrees east of the Greenwich meridian.



below. Some weak westerly anomalies were also evident just west of the date-line. However, as for autumn, low-level wind anomalies in the tropical Pacific during winter were mostly weak, failing to exhibit the widely suppressed tradewinds that would be expected during a truly coupled El Niño event. There were few other significant 850 hPa wind anomalies anywhere in the world, apart from anomalous flow associated with the high pressure anomaly at mid-high latitudes of the South Pacific.

The 200 hPa wind vectors show pronounced westerly anomalies over the far eastern tropical Pacific, with values in excess of 5 m s^{-1}. However, upper-level winds were close to the climatological average across the central tropical Pacific, and stronger than normal to the north of Australia. Consequently, both upper and lower-level wind analyses did not suggest a widespread suppression of the equatorial Walker circulation. This was another factor in NCC's reluctance to make a declaration of El Niño.

Australian region

Rainfall

Figure 14 shows winter 2004 rainfall totals for Australia, with winter rainfall deciles shown in Fig. 15, calculated using gridded data for the period 1900-2004.

Reflecting a winter rainfall regime, the highest rainfall totals during winter 2004 were in southwest WA, southwest and alpine Victoria, and western Tasmania. Compared to the historical record, rainfall was below to very much below average over most of Queensland and northeast NSW, extending down the NSW coast and adjacent ranges and into East Gippsland. Analyses for each of the individual winter months (not shown) indicate monthly rainfall shortfalls through large parts of Queensland during each month. Table 1 summarises seasonal rainfall ranks and extremes on a national and State basis. These indicate that Queensland had its 5th driest winter since 1900, with an average of only 15 mm recorded over the State during the season. The winter deficits in northeast and coastal NSW were mostly due to the failure of normal rainfall during June.

In contrast, most of South Australia (SA), southwest Victoria and the western two-thirds of Tasmania recorded above to very much above average winter rainfall. Parts of the Kimberley and the Top End also recorded above average falls, due to dry season rain which fell mostly in June. These amounts were generally below 50 mm. Winter totals were mainly near average across the rest of the country.

For the five-month period from April to August (not shown), severe rainfall deficiencies were evident along the east coast and Great Dividing Range from Queensland's central coast, to southern NSW, and over much of the central highlands in Queensland. For the eight-month period from January to August (not shown), serious to severe rainfall deficiencies affected parts of southern NSW, the ACT and north-central Victoria, together with

Fig. 12 Winter 2004 850 hPa vector wind anomalies with contours of vector magnitude overlayed. The contour interval is 5 m s^{-1}, with values above 5 m s^{-1} stippled.

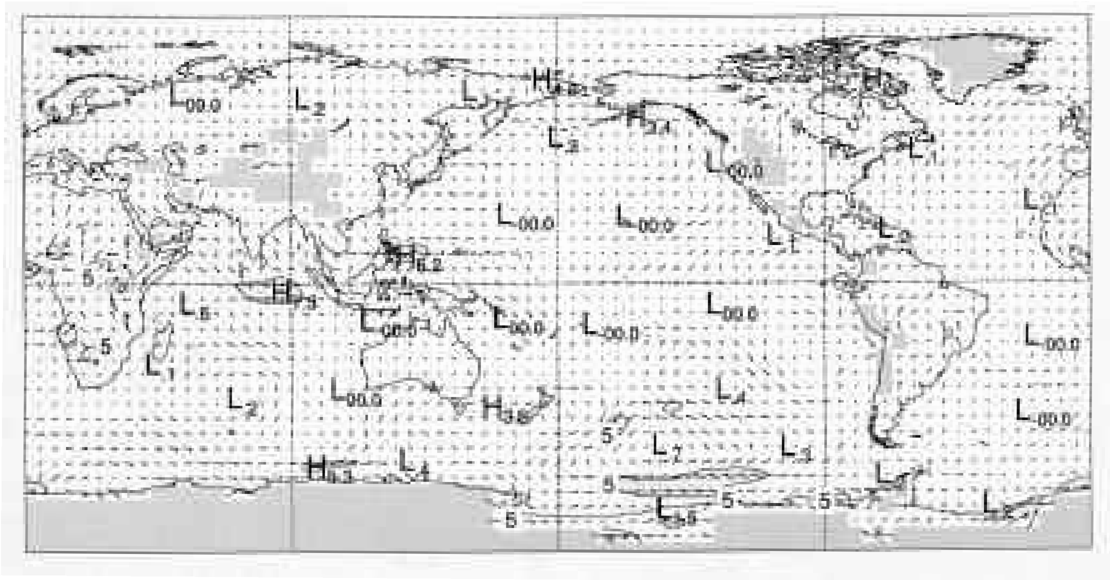
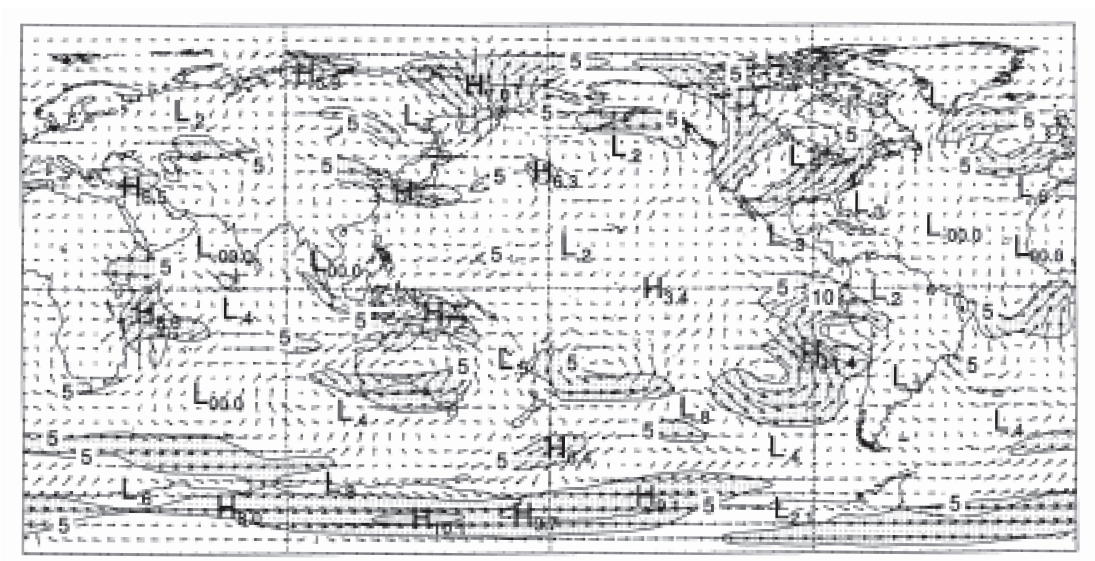


Fig. 13 Winter 2004 200 hPa vector wind anomalies with contours of vector magnitude overlayed. The contour interval is 5 m s^{-1}, with values above 5 m s^{-1} stippled.



the central Queensland region between Rockhampton and Proserpine. Many of these areas overlap with those affected by five-month deficiencies. Much of southern and eastern Australia continued to experience deficiencies for periods of two years and longer, highlighting the long-term impact of the 2002/03 El Niño drought.

Temperature

Mean maximum and minimum temperature anomalies for winter 2004 are shown in Figs 16 and 17 respectively. These are calculated with respect to the 1961-90 period, and use all temperature observation stations for which a 1961-90 normal is available. A high-quality subset of the network is used to calculate the spatial averages and rankings shown in Tables 2 and 3.

Maximum temperatures averaged over the winter

Fig. 14 Rainfall totals over Australia for winter 2004 (mm).

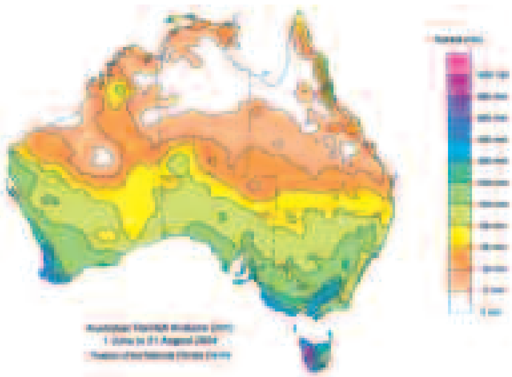
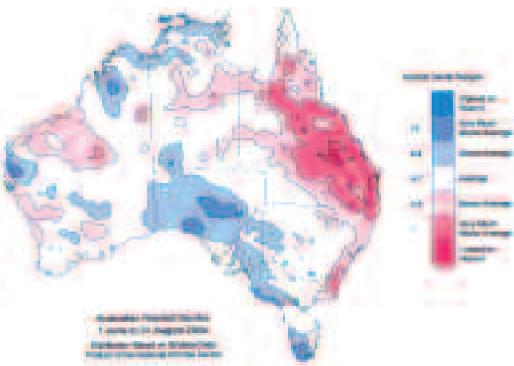


Fig. 15 Winter 2004 rainfall deciles for Australia: decile range based on grid-point values over the winter periods from 1900 to 2004.



season were mostly above average, apart from pockets in the far south and north of the country. Positive departures were mostly less than 1°C, apart from areas in the southern half of Queensland, and northeast and coastal NSW, where lower than average winter rainfall boosted the daytime temperatures. According to a gridded analysis of maximum temperatures available from 1950 (not shown), much of southeast Queensland and central NSW coast recorded highest-on-record winter mean maxima. Table 2 shows that all States recorded higher-than-normal State-mean winter maximum temperatures, with the greatest departures being +0.96 for Queensland and +0.82 for NSW. When ranked, these anomalies indicate Queensland had its 8th warmest, and NSW had its 9th warmest winter daytime temperatures since 1950.

For the individual winter months (not shown) the highest departures from normal occurred during June when parts of southern Queensland, the central NSW coast and the Pilbara region of WA recorded monthly mean maximum temperatures more than 2°C above normal.

Winter mean minimum temperatures were more mixed than the maxima, with cooler-than-normal anomalies across tropical parts, as well as in southeast Queensland, northeast NSW and pockets of southern WA. These departures were greater than 1°C in parts. Cool anomalies were evident in these regions in both June and August (not shown), with July minima being mostly close to normal. A gridded analysis (not shown) indicates much of far northern Queensland recorded its lowest winter-mean minima since 1950. Positive anomalies in the remainder were mostly weak.

Table 1. Seasonal rainfall ranks and extremes on a national and State basis for winter 2004.

	Highest seasonal total (mm)	*Lowest seasonal total (mm)*	*Highest 24-hour fall (mm)*	*Area-averaged rainfall (AAR) (mm)*	*Rank of AAR**
Australia	1272 at Gordon Power Station (Tas)	0 at several locations (WA, NT, SA, Qld)	115 at Dapto (NSW) , 18 August	53	31
WA	790 at Willowdale	0 at several locations	111 at Ningaloo, 22 July	56	43
NT	119 at McCluer Island	0 at several locations	95 at McCluer Island, 2 June	9	49
SA	721 at Piccadilly	0 at Cordillo Downs	68 at Lake Leake, 30 August	80	86
QLD	700 at Bellenden Ker (Top Station)	0 at several locations	71 at Lucinda, 26 August	15	5
NSW	557 at Charlotte Pass	13 at Bemboka	115 at Dapto, 18 August	90	24
VIC	976 at Weeaproinah	64 at Manangatang	80 at Falls Creek, 15 August	205	63
TAS	1272 at Gordon Power Station	94 at Swansea	77 at Strathgordon Village, 28 June	463	89

* The rank goes from 1 (lowest) to 105 (highest) and is calculated on the years 1900 to 2004 inclusive.

Fig. 16 Winter 2004 maximum temperature anomalies (°C) for Australia based on 1961-90 mean.

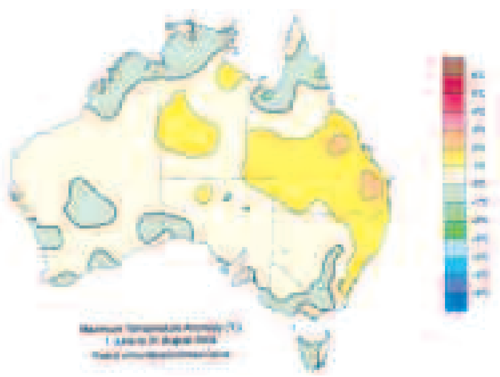
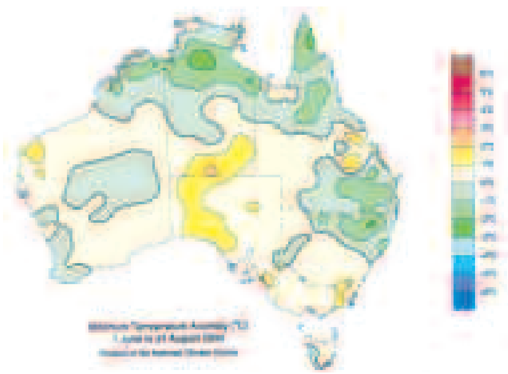


Table 3 indicates that, despite mixed anomalies throughout the country, most States recorded near-zero or positive mean winter minima anomalies. The exception was Queensland which recorded an all-State anomaly of -0.50°C (15th lowest since 1950), consistent with low rainfall and lower-than-normal overnight cloud coverage. SA recorded the greatest positive anomaly with +0.96° (7th highest since 1950).

Conclusions

Fig. 17 Winter 2004 minimum temperature anomalies (°C) for Australia based on 1961-90 mean.



Whether or not the winter of 2004 can be considered the start of an El Niño event is likely to be debated for many years to come. If only the MEI or central Pacific Ocean indicators are considered, winter 2004 may be classified as the start of a 'borderline' El Niño event, or perhaps a 'central' Pacific warm event. However, with a more holistic assessment which also includes atmospheric indicators, the evidence was too mixed to declare a truly coupled ocean-atmosphere El

Table 2. Seasonal maximum temperature ranks and extremes on a national and State basis for winter 2004.

	Highest seasonal mean (°C)	*Lowest seasonal mean (°C)*	*Highest daily recording (°C)*	*Lowest daily recording (°C)*	*Anomaly of area-averaged mean (°C) (AAM)*	*Rank of AAM**
Australia	32.2 at Jabiru (NT)	–0.5 at Mt Hotham (Vic)	36.8 at Century Mine (Qld), 7 June	–6.6 at Mt Hotham (Vic), 18 July	+0.53	37
WA	32.1 at Wyndham	14.3 at Mount Barker	36.2 at Wyndham, 2 August	7.8 at Manjimup, 27 August	+0.25	32
NT	32.2 at Jabiru	20.2 at Kulgera	36.1 at Elliott, 2 August	12.2 at Arltunga, 18 July	+0.48	37
SA	20.9 at Oodnadatta	9.3 at Mount Lofty	34.1 at Oodnadatta, 28 August	4.2 at Mount Lofty, 17 July	+0.44	33
QLD	31.3 at Weipa	15.8 at Applethorpe	36.8 at Century Mine, 7 June	8.0 at Applethorpe, 20 June	+0.96	48
NSW	22.6 at Murwillumbah	–0.2 at Thredbo (Top Station)	31.5 at Lightning Ridge, 29 August	–6.0 at Thredbo (Top Station), 18 July	+0.82	47
VIC	16.5 at Mildura	–0.5 at Mt Hotham	27.9 at Mildura, 25 August	–6.6 at Mt Hotham, 18 July	+0.25	35
TAS	14.1 at Bicheno	2.0 at Mount Wellington	22.8 at Grove, 26 August	–3.6 at Mount Wellington, 17 July	+0.04	26

* The temperature ranks go from 1 (lowest) to 55 (highest) and are calculated on the years 1950 to 2004 inclusive.

Table 3. Seasonal minimum temperature ranks and extremes on a national and State basis for winter 2004.

	Highest seasonal mean (°C)	*Lowest seasonal mean (°C)*	*Highest daily recording (°C)*	*Lowest daily recording (°C)*	*Anomaly of area-averaged mean (°C) (AAM)*	*Rank of AAM**
Australia	23.2 at Coconut Island (Qld)	–6.1 at Charlotte Pass (NSW)	26.3 at Troughton Island (WA), 7 June	–19.0 at Charlotte Pass (NSW), 16 August	+0.06	31
WA	22.9 at Troughton Island	4.0 at Southern Cross	26.3 at Troughton Island, 7 June	–4.9 at Eyre, 21 June	+0.11	33
NT	22.9 at McCluer Island	5.8 at Alice Springs	25.9 at McCluer Island, 3 June	–4.2 at Alice Springs, 21 July	–0.08	24
SA	11.8 at Neptune Island	3.2 at Yongala	19.5 at Arkaroola, 26 August	–5.0 at Yunta, 21 July	+0.96	49
QLD	23.2 at Coconut Island	1.2 at Oakey	25.6 at Coconut Island, 2 June	–7.0 at Warwick, 30 June	-0.50	15
NSW	12.7 at Cape Byron	–6.1 at Charlotte Pass	19.2 at Cape Byron, 3 June	–19.0 at Charlotte Pass, 16 August	+0.12	27
VIC	9.1 at Wilsons Promontory	–3.7 at Mt Hotham	16.8 at Moorabbin, 26 August	–8.8 at Mt Hotham, 18 July	+0.49	43
TAS	8.5 at Cape Grim	–2.2 at Mount Wellington	14.4 at Friendly Beaches, 1 June	–9.1 at Liawenee, 16 August	+0.21	34

* The temperature ranks go from 1 (lowest) to 55 (highest) and are calculated on the years 1950 to 2004 inclusive.

Niño event. Given the importance of ENSO to the global climate an internationally agreed set of criteria to define the state is required. Whether or not the climate system is classified as an El Niño event is irrelevant to seasonal prediction schemes as these will continue to provide objective guidance independent of human interpretation. However, the widespread recognition of El Niño and its impacts amongst the general public means that national climate services need to be very careful about declaring these events. Too many ‘false alarms’ could undermine public confidence and potentially lead to complacency when a strong El Niño event inevitably occurs.

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Appendix

The main sources for data used in this review were:

- National Climate Centre, *Climate Monitoring Bulletin - Australia*. Obtainable from: National Climate Centre, Bureau of Meteorology, GPO Box 1289, Melbourne, Vic. 3001, Australia.
- The Bureau of Meteorology’s *Monthly Significant Weather Summaries*. Obtainable from: http://www.bom.gov.au/inside/services_policy/public/sigwxsum/sigwmenu.shtml
- Climate Prediction Center, *Climate Diagnostics Bulletin*. Obtainable from: Climate Prediction Center, National Weather Service, Washington D.C., USA, 20233. Obtainable from: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/bulletin/