

FIG. 6.41. 2006 annual precipitation anomalies (mm, 1979–2000 base) for Oceania from CAMS-OPI.

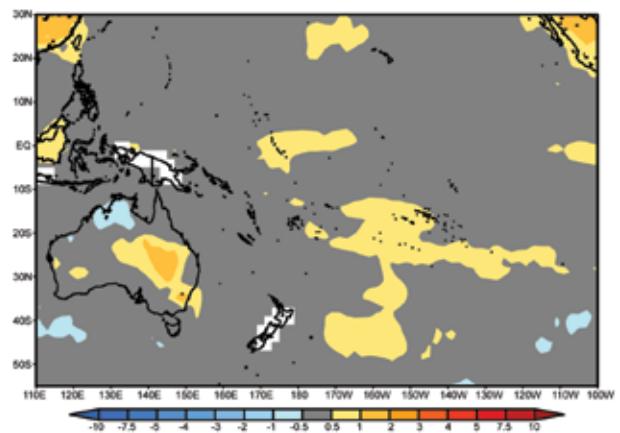


FIG. 6.42. 2006 annual temperature anomalies (°C, 1971–2000 base) for Oceania from CAMS-OPI.

in the year, largely offset the acute dry in the country’s main population and agricultural areas of the south and east (Fig. 6.41). The wetter-than-average conditions in the north and northwest of the continent earlier in the year reduced daytime maximum temperatures in these areas, while high pressures brought clear skies and cold nights to the southeast and a cool winter in the Tropics. Overall, much of eastern Australia had above-average temperatures in 2006, while a small patch in the north was cooler than average (Fig. 6.42).

For eastern and southwestern Australia, the big drought of 2006 was exacerbated in the latter months of the year by very warm conditions. Spring 2006 was Australia’s warmest since seasonal records commenced in 1950. The driest and warmest 5-year period on record in the major Australian cropping zones, in addition to a general failure of rainfall during the 2006 April–October crop and pasture growing season, contributed to extremely large downturns in agricultural production.

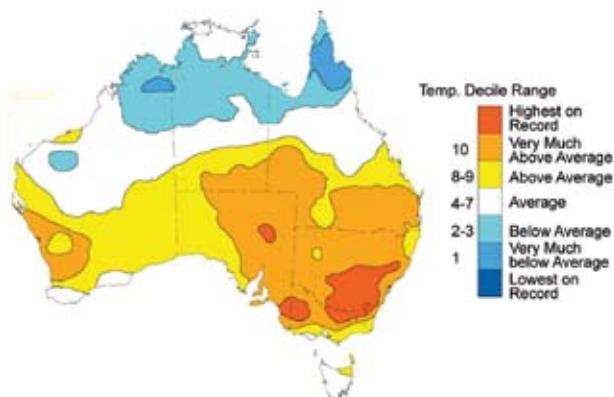


FIG. 6.43. Australian maximum temperature deciles for 2006 (1950–2006 base).

(i) Temperature

Maximum temperatures for 2006 were mostly above normal for areas south of the Tropics, resulting in 33% of the continent experiencing daytime temperatures in the top decile (Fig. 6.43). New South Wales, Victoria, and the Murray Darling Basin (Australia’s “food basket”) all recorded their second warmest annual maximum temperatures (behind 2002) on record⁷ (1.55°, 0.97°, and 1.54°C above average, respectively). Overall, Australia’s maximum temperatures were the ninth warmest on record, with an anomaly of +0.60°C.

In some contrast, minimum temperatures for the year were cooler than normal in the southeast, as well as in the top end of the Northern Territory and the Kimberly region of western Australia. However, inland regions were generally warm at night despite the reduced cloud cover, with temperatures ~0.5°C above normal. South Australia and Queensland both had their 10th warmest nighttime temperatures on record (+0.65° and +0.56°C above the 1961–90 average, respectively), and with 40% and 36% of the states in decile 10. The Australian minimum temperature anomaly for 2006 was +0.34°C, the 17th warmest.

⁷ High-quality *annual* Australia-wide temperature anomalies have been calculated for all years since 1900 (Della-Marta et al. 2004), while high-quality *monthly* anomalies are available from 1950. High-quality nationwide rainfall measurements commenced in 1900 (Lavery et al. 1997). Anomalies are calculated with respect to the 1961–90 average, in accordance with World Meteorological Organization guidelines.

Australia's mean temperature for the year was 0.47°C above the 1961–90 mean, making it the 11th warmest year on record.

(ii) Precipitation

With only January, April, and July bringing widespread near- or above-average rainfall to Australia, 2006 proved to be an extremely dry year for most regions south of the Tropics (Fig. 6.44). Aside from Darwin, Australia's northern-most major city, all of the densely populated regions of Australia, as well as the vast majority of Australian agricultural areas, experienced significantly below normal rainfall for the year. Victoria, New South Wales, and Tasmania had 96%, 45%, and 72% of their state in decile 1, giving them their third (366 mm), ninth (349 mm), and third (877 mm) driest years, respectively. For south-eastern Australia, this was the second-driest year (367 mm) after 1982 (355 mm), while in the southwest of the continent, it was sixth driest (476 mm). It was the driest year on record for the cities of Perth and Hobart, and the second driest for Adelaide. The agriculturally vital Murray Darling Basin experienced its third-driest year on record, after 1902 and 1944. When added to the long-term dry, the resulting inflows to Australia's second-longest river, the Murray, were lower than that of the previously lowest inflows, which occurred in the Federation drought of 1902. Rainfall anomalies were particularly extreme in the highlands of eastern Victoria, southern New South Wales, and northern Tasmania. Stations such as Burnie in northwestern Tasmania (408 mm, previous record 670) and Harrietteville in northeastern Victoria (504 mm, previous record 710) were more than 200 mm below their driest recorded year.

The dry conditions blanketing the major population and agricultural regions added to long-term rainfall

deficiencies. By the end of 2006, New South Wales had experienced dry conditions for over five years; south-east Queensland, seven years; Victoria, northern Tasmania, and eastern south Australia, 10 years; and in southwest western Australia, some 30 years.

In contrast, the wet season (October 2005–April 2006) over northern Australia was the fifth wettest since high-quality rainfall records commenced in 1900, with an average of 674 mm falling over the period. This was despite an initially weak and late start to the Australian monsoon. At Darwin, the monsoon onset did not occur until around 13 January, about two weeks later than the usual timing of 28–29 December (Drosdowsky 1996). Overall, Australia recorded 490 mm (long-term average 472 mm) for the year, making it the 32d wettest year of the 107 years of record. However, such a relatively wet year would be contrary to the experience of most Australians, with the vast majority living within the 39% of the continent, which received rainfall in the lowest three deciles.

(iii) Notable events

Tropical Cyclone Larry (see section 4) was category 5 shortly before it crossed the coast as category 4, the most intense system at landfall in Queensland since 1918. Similarly, during the passage of Tropical Cyclone Monica along the Northern Territory coast, it became a category 5 system and the strongest ever observed in the Northern Territory region.

A major unseasonal cold outbreak affected south-eastern Australia from 15 to 17 November (late spring). Snow fell near sea level in southern Tasmania, above 400 m in central Victoria, through large parts of the NSW tablelands, including the nation's capital Canberra, and as far north as Queensland. Numerous record low maximum temperatures were set. A Queensland State November record of 0.0°C was set at Stanthorpe and Applethorpe, and Sydney (8.3°C) had its coldest November night since 1905.

Persistent extreme heat affected much of eastern inland Australia from late December 2005 through early March 2006, with many records being set for average temperatures or consecutive days above thresholds. At Windorah (Queensland), there were 55 consecutive days above 37.8°C (100°F) from 30 December to 22 February, and 63 consecutive days above 35°C ending on 2 March. Birdsville's January mean monthly minimum of 30.0°C was the first time an Australian station had recorded a monthly average minimum of 30°C or above.

A severe early spring heat wave occurred in south-eastern Australia in early October, with many locations

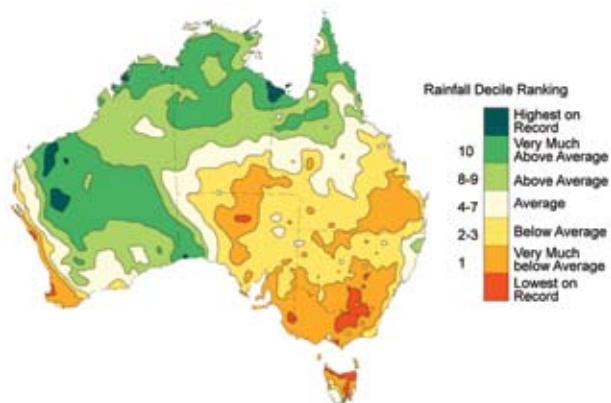


FIG. 6.44. Australian rainfall deciles for 2006 (1900–2006 base).

setting early season records. On 12 October Adelaide reached 37.9°C, Melbourne 36.6°C, and Hobart 33.1°C, all early season records. This was Melbourne's earliest postwinter 35°C+ day on record (records commence 1856), which followed its earliest postwinter 30°C+ day which had occurred only the month before (30.1°C on 19 September 2006). October was the hottest on record for New South Wales and Victoria.

Persistent extreme heat affected much of central and inland eastern Australia during the second half of November. November record highs were set over much of southwestern Queensland, and Birdsville reached 48.5°C on 30 November, which was 0.2°C below the Australian November record set there in 1990. Many locations set records for extended November hot spells, including Canberra (11 days above 30°C) and Alice Springs (12 days above 37.8°C, or 100°F).

Numerous major bushfires occurred in Victoria during January 2006. There were also significant fires during this period in Tasmania. With dry and hot conditions, major fires in South Australia, New South Wales, Victoria, and Tasmania occurred far earlier than in previous years. Lightning strikes on 1 December sparked an immense blaze in Victoria's Gippsland and northeast regions. The fire lasted over two months and burned approximately 1.1 million ha.

With clear skies and very low soil moisture, a number of major frost episodes occurred in the southern half of Australia during late May and June. One extreme event occurred on 30 May, when state records for the month were set for Queensland (-6.8°C at Stanthorpe) and Tasmania (-10.5°C at Liawenee). In western Australia, a state record for June (-6.0°C) was set at Collie East on 17 June, the same day the city of Perth recorded its first subzero minimum (-0.7°C). A succession of frost events also caused damage in southeastern Australia during late September and October. The most damaging event occurred on 25 September, when widespread subzero temperatures in northern Victoria led to major losses in the Goulburn Valley fruit crop (estimated at \$70 million Australian). A new Australian record low temperature for October was set on the 29th when Charlotte Pass (New South Wales) reached -12.0°C.

2) NEW ZEALAND—J. Salinger

(i) General conditions

Erratic and sometimes extreme, New Zealand's climate for 2006 featured one of the severest winter snowstorms in decades, a very windy spring, and a rather cool start to summer in December 2006. The national average temperature of 12.4°C in 2006 was

0.2°C below the 1971–2000 normal. Thus, 2006 ended up very close to the 1971–2000 normal, as a compromise between very warm months (April and September) and very cold months (March, June, December). April was the warmest and June the coldest in the last 30 years, September was the third warmest on record, and December one of the coldest in the last 60 years. Temperatures were above normal in the northeast of both islands, but below normal in inland areas of the South Island. Well-below-normal rainfall occurred throughout parts of central Otago (south-east of South Island), with totals less than 75% of normal, as well as in Awatere Valley in Marlborough. Rainfall was well above normal in the southern North Island and Christchurch areas, with totals at least 120% of normal. The year was dominated by more anticyclones in the Australian Bight/Tasmania area, with stronger westerlies in the Southern Oceans, giving windier southwesterlies over New Zealand.

(ii) Notable events

The highest recorded extreme temperature of the year occurred during a heat wave in central Otago toward the end of January. Alexandra recorded maximum temperatures of 36°C for three consecutive days from 27–29 January (unheard of in their historical record, commencing in 1930).

The lowest air temperature for the year was -14.0°C recorded at both Tara Hills, Omarama, on 14 June, and Fairlie on 28 June. The minimum air temperatures were -10°C or lower in parts of inland south Canterbury and/or north Otago, on nine days between 14 and 29 June.

The highest recorded wind gust for the year was 180 km h⁻¹ and was recorded from the northwest, at Southwest Cape (Stewart Island) on 2 September, which is a new record for a wind gust at that site. Mean wind speeds reached 128 km h⁻¹.

The driest rainfall recording locations were Alexandra in central Otago with 266 mm of rain for the year, followed by Clyde with 286 mm.

Of the regularly reporting gauges, the Cropp River gauge in Westland, inland in the headwaters of the Hokitika River, recorded the highest rainfall with a 2006 annual total of 11,370 mm.

Nelson was the sunniest center in 2006, recording 2580 hours, followed by Blenheim with 2528 hours, and Tauranga with 2507 hours.

Invercargill recorded its sunniest year on record with 1853 hours, and Kaitai, Tauranga, and Dunedin their second sunniest.

The year began with significant soil moisture deficits in the north and east of the North Island and

eastern South Island, which persisted in these regions until March. March was cold, and an ex-tropical cyclone produced high rainfall in the north of the North Island. Flood-producing rainfall events occurred in north and east Otago and in the Hauraki-Coromandel region during April. As a result, the month's rainfall was very high in these regions. Rainfall in north and east Otago totalled 300%–400% of normal, and totals in the Hauraki-Coromandel region were at least 200% of normal. It was the eighth warmest April on record. May produced well-above-average rainfall in the north of the North Island, and east of the South Island, with low rainfall in parts of the south of the South Island. Two severe winter snowstorms accompanied by bitterly cold conditions, and later heavy frost, contributed to a particularly cold June. Temperatures were 2°C below average in some regions. It was much sunnier than normal in all western and southern regions, with record high June totals in the north of the North Island, and coastal Otago. In contrast, July was warmer than June, going against the usual trend. It was very wet in the south and west of the North Island, with twice the normal rainfall in Wairarapa with flooding. July was rather dry in other areas with rainfall totals a mere 25%–50% or less of normal in the north of the North Island and Otago. High rainfall continued in August in the south and west of the North Island, but it was dry in much of the South Island, and extremely sunny in the south. September was a month of climate extremes with record low rainfall and high mean temperatures at many locations. Rainfall was low throughout much of New Zealand, especially in the east, with some locations recording 10% or less of normal rainfall. In some areas temperatures were 2°C above average, with windy conditions in the south. It was windier than usual over most of the South Island and southern half of the North Island in October, with several locations in Marlborough and Otago recording their windiest October in over a decade. November produced stormy westerlies over the South Island: it was particularly warm in the east of the North Island, yet cold in the southwest of the South Island. Significant soil moisture deficits existed in Northland and central Marlborough by the end of the year. December ended the year on a cool note, with one of the coldest Decembers in the last 60 years, as more frequent south-erlies brought temperatures 2°C below average.

Notable climate features in various parts of the country included numerous heavy rainfall events of which 18 produced floods. Snowfall events occurred on 11 occasions, mainly in high country areas from midautumn to late winter, with ski areas having an

extended season. Other climate extremes included a summer heat wave, seven tornado-like incidents, three severe hailstorms, and many damaging windstorms. The most significant extreme event of the year was the winter snowfall event over the night of 11/12 June in Canterbury, especially in the south, with snow settling to sea level. The worst flooding events during 2006 were those of 25–26 April in Otago and 4–6 July in Wairarapa. In the Otago flood, rivers ran extremely high, and much of the Taieri Plains including Mosgiel were flooded, with some evacuations. Floodwaters also affected the towns of Oamaru and Waitati. The Wairarapa flood occurred during a 3-day period of high rainfall, also affecting Wanganui and Wellington.

3) SOUTHWEST PACIFIC—J. Salinger

This year saw a change from a La Niña to an El Niño climate pattern in the Pacific. The first quarter of the year was dominated by weak La Niña-like (cold episode) characteristics, followed by a neutral period. Weak-to-moderate El Niño conditions in the tropical Pacific were in place by September, which peaked in December. A higher frequency of surface equatorial westerlies occurred near the date line from August through November (the highest persistence since the 2002 El Niño event when surface westerlies were much stronger). Trade winds generally were near normal in strength at other times of the year. The SPCZ was farther south than usual from January through May (typical for La Niña), but was near its normal location throughout much of the remainder of the year. Below-average equatorial SSTs occurred around western and eastern Kiribati with the cold episode (–1°C anomalies), returning to normal by April. Positive SST anomalies (+0.5°C) became apparent near the date line in the equatorial Pacific in June. These warmed to a constant +1.5°C above average in the seas around western and eastern Kiribati from August/September onward. Negative SST anomalies occurred around New Caledonia from August through December, more than 1°C below average in October. These features were also consistent with El Niño development. From January through June, OLR anomalies showed enhanced convection over the Solomon Islands and Papua New Guinea. Suppressed convection occurred over western and eastern Kiribati from January through May, with a reversal to enhanced convection from August through December. For much of the year, mean SLP was below average east of the date line. However, positive anomalies prevailed in the western Pacific over Australia and the Tasman Sea from May onward.

For 2006 as a whole, above-average SSTs occurred

throughout much of the tropical southwest Pacific. These were at least $+0.7^{\circ}\text{C}$ above average throughout central and southern French Polynesia, extending to the southern Cook Islands and Pitcairn Island. Some locations experienced above-average SSTs for 11 months of the year. SSTs were at least $+0.5^{\circ}\text{C}$ above average in many other tropical island nations, especially those near and east of the date line. SSTs were near average in the region between Papua New Guinea and New Zealand, including New Caledonia. Southwest Pacific island surface air temperature anomalies for 2006 were consistent with the SST anomalies throughout the region. It was an extremely warm year in Fua'amotu, Tonga, where the mean temperature of 24.6°C was 0.8°C above the historical average and was highest since measurements commenced in 1980. Tahiti Faa'a, in French Polynesia was also much warmer than usual, with a mean temperature of 26.9°C (0.7°C above the 1971–2000 normal).

OLR anomalies (Fig. 6.45) showed a region of enhanced convection over Papua New Guinea and the Caroline Islands to the north, extending southeast to the Solomon Islands and northern part of Vanuatu. Another area of enhanced convection, although not as strong, occurred over Niue and the southern Cook Islands. Convection was suppressed in a horseshoe-like pattern in 2006 over eastern Kiribati and parts of western Kiribati, extending to the northern Cook Islands and southeast over the Tuamotu Islands of French Polynesia and to Pitcairn Island.

The year's rainfall anomalies were similar to those

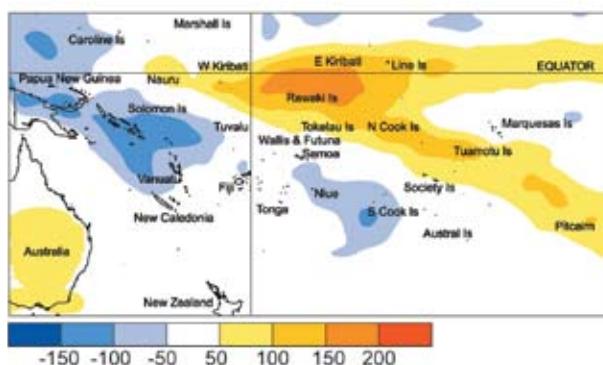


FIG. 6.45. Annual South Pacific OLR anomalies (W m^{-2}). High radiation levels (yellow or orange) are typically associated with clearer skies and lower rainfall, while low values (blue) often indicate cloudy conditions and more rain for the region.

of the OLR, with above-average (at least 110% of normal) rainfall over much of the Solomon Islands, northern Vanuatu, Niue, and the Southern Cook Islands, as well as parts of central and southern French Polynesia. Rainfall was below average (less than 90% of normal) in the North Tasman and over New Caledonia, as well as parts of eastern Kiribati and the northern Cook Islands. One location, Rotuma Island, Fiji, recorded an extremely high 2006 rainfall of 4378 mm (128% of normal). Two locations recorded well-below-average annual totals. These were Noumea, New Caledonia, with 735 mm (75% of normal), and Raoul Island, New Zealand, with 948 mm (61% of normal).