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Bureau of Meteorology



Special Climate Statement—record warmth in the Tasman Sea, New Zealand and Tasmania

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Cover image: Kapiti Coast, North Island, New Zealand. (Photograph: Dave Allen, NIWA).

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Introduction

Sea surface temperatures in the southern Tasman Sea rose to exceptionally high levels in late 2017 and early 2018. These temperatures were far above any others previously observed at that time of year in the region, and extended west from New Zealand to Tasmania and mainland southeast Australia. In parallel with this, land temperatures were well above average in areas near the Tasman Sea warm anomalies, with many records set both in New Zealand and in southeast Australia (especially Tasmania).

Sea surface temperatures in the southern Tasman Sea were above average throughout 2017 but rose sharply from November, reaching 2 °C or more above average¹ over most of the Tasman Sea south of 35 °S. In November, they were at record-high levels over a region extending from New Zealand to Tasmania. This warming coincided with an extended period of blocking high pressure over the Tasman Sea sector, with monthly mean sea level pressure (MSLP) for November as much as 10 hPa above average in places, and 7.5 hPa or more above average over a belt extending from the South Island of New Zealand to west of Tasmania. Sea surface temperatures persisted at record-high levels through December 2017 and January 2018. The peak of the event had passed by February 2018, with sea surface temperatures falling below record levels but remaining well above average.

Abnormally warm conditions developed on land on both sides of the Tasman in relation to the Tasman Sea marine heat wave. In New Zealand, very warm conditions began to develop in the interior South Island from October onwards, before extending nationwide during the summer. The summer of 2017–18 (December 2017 to February 2018) was the hottest on record for New Zealand, and January 2018 was the hottest month recorded. Atmospheric moisture over much of New Zealand was also notably high during this time, and February 2018 saw several extreme rainfall events, two of which were associated with former tropical cyclones.

Tasmania also warmed markedly from October 2017 onwards. In Tasmania, November was the most extreme month of the period, with the largest mean temperature anomaly on record for any month in the State. October 2017, December 2017 and January 2018 were all the second-warmest on record for the respective month, and the October–January and November–January periods were both the warmest on record by substantial margins. Tasmania cooled substantially in February 2018 with temperatures in that month close to average, resulting in summer mean temperatures falling below record levels. It was also a very warm period in coastal and near-coastal areas of mainland southeast Australia, particularly southern Victoria and adjacent areas of southeast South Australia and the southern New South Wales coast, although conditions in these regions were generally less exceptional than those in Tasmania.

1.1 Record-high temperatures in the south Tasman Sea

The south Tasman Sea² experienced record-high monthly sea surface temperature (SST) anomalies for November 2017 (+1.19 °C), December 2017 (+2.12 °C) and January 2018 (+1.96 °C). Records commence in 1950 and use a 1981–2010 baseline for calculation of anomalies..

The December 2017 and January 2018 values were close to a degree above the previous records for those months (respectively, +1.00 °C in December 2005 and +0.98 °C in January 1971), whilst November 2017 was 0.25 °C above the previous November record from November 2005. The December 2017 and January 2018

¹ Consistent with national reporting standards, a 1981-2010 base period is used for averages for New Zealand and for sea surface temperatures, and a 1961-1990 base period is used for Australia.

² Defined here as the region bounded by longitudes 145 °E and 175 °E, and latitudes 35 °S and 45 °S.

values are also clearly the largest monthly anomalies on record for any month, surpassing the previous record of +1.52 °C set in February 1971.³

These higher than average SSTs developed from higher than normal mean sea level pressures that began in October 2017 and persisted until the end of December 2017 (Figure 1). These blocking highs suppressed cloud development in the region, which created sunny conditions that warmed the surface ocean, and low winds that suppressed vertical mixing between the upper and lower ocean waters over the subsequent months. The warmer than average SSTs developed first in the waters surrounding Tasmania in mid-November 2017 where the weekly mean SSTs in the Tasman Sea exceeded 16 °C, which is over 3 °C above the 1981–2010 average and ranked as some of the highest values on record. The persistent highs led to the warmer than average SSTs expanding across the Tasman Sea to New Zealand. Record-high SSTs were analysed over an area extending from Tasmania to New Zealand in November and December 2017 and January 2018 before becoming more localised at the end of summer (Figure 2).

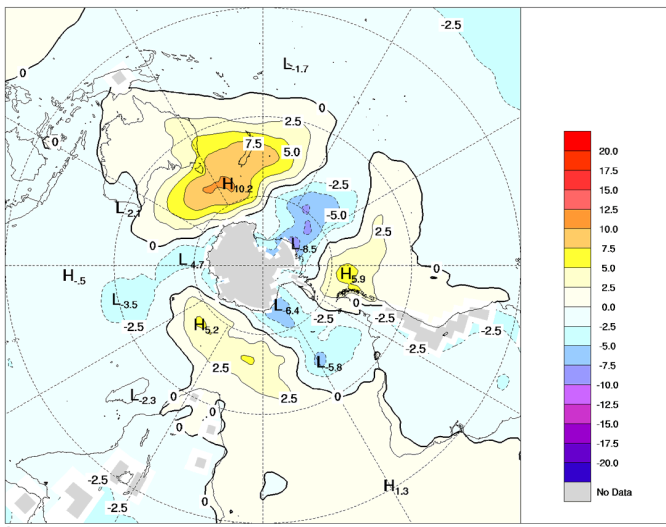
In February 2018 the SSTs in the Tasman Sea had cooled to the second warmest on record (1.09 °C above average compared to 1.52 °C in 1971), but the SSTs maintained record-high warmth to the south and east of New Zealand. This was due to the high mean sea level pressures that had developed in the east and southeast of New Zealand from January 2018 onwards, and lower than normal pressures over and to the west of the country (over the Tasman Sea).

³ The early 1971 event coincided with severe flooding both in the Taranaki region of New Zealand, and two separate major flood events on the South Coast of New South Wales and in eastern Victoria. A fall of 450.3 mm at Brogo (Stockridge) on 6 February 1971 is the highest daily total ever recorded so far south in Australia.

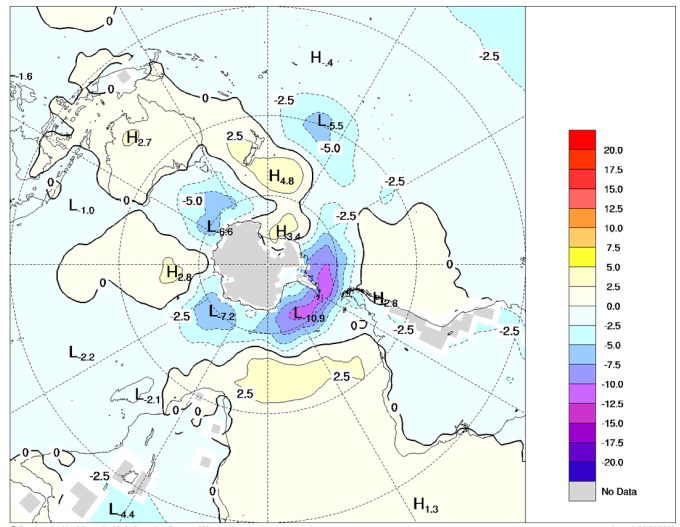
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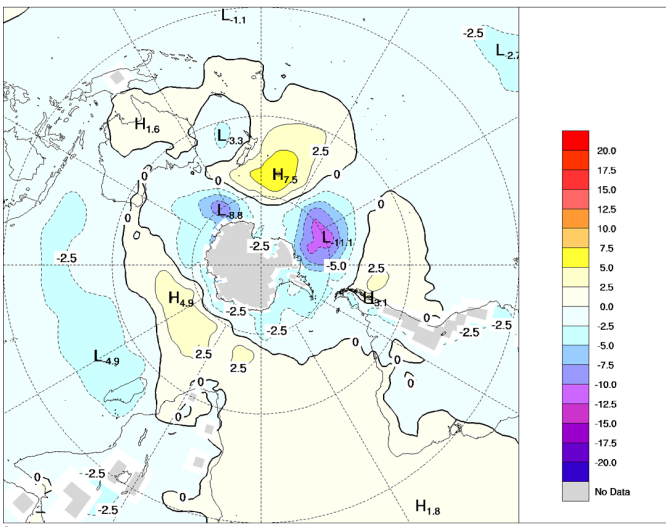
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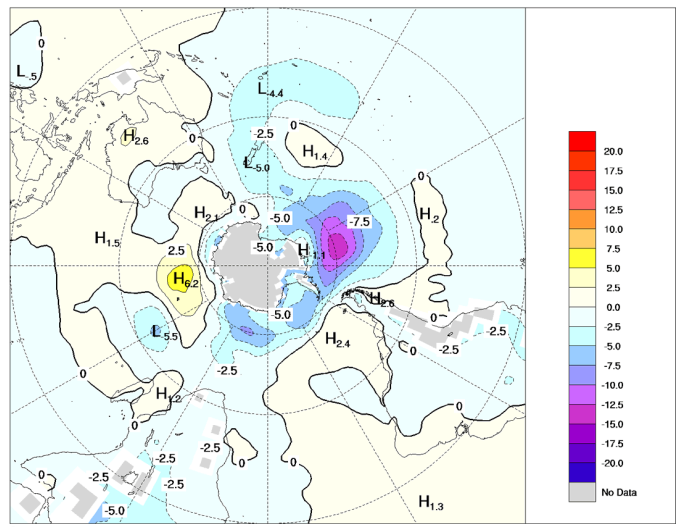
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MSLP 2.5X2.5 ACCESS OP. ANAL-NCEP2 (hPa) 20180201 0000 20180228 0000



Issued: 02/02/2018



Issued: 01/03/2018

Figure 1. Mean sea level pressure anomalies (hPa) for: (top left) November 2017, (top right) December 2017, (bottom left) January 2018, (bottom right) February 2018. Climatology period 1979–2000.

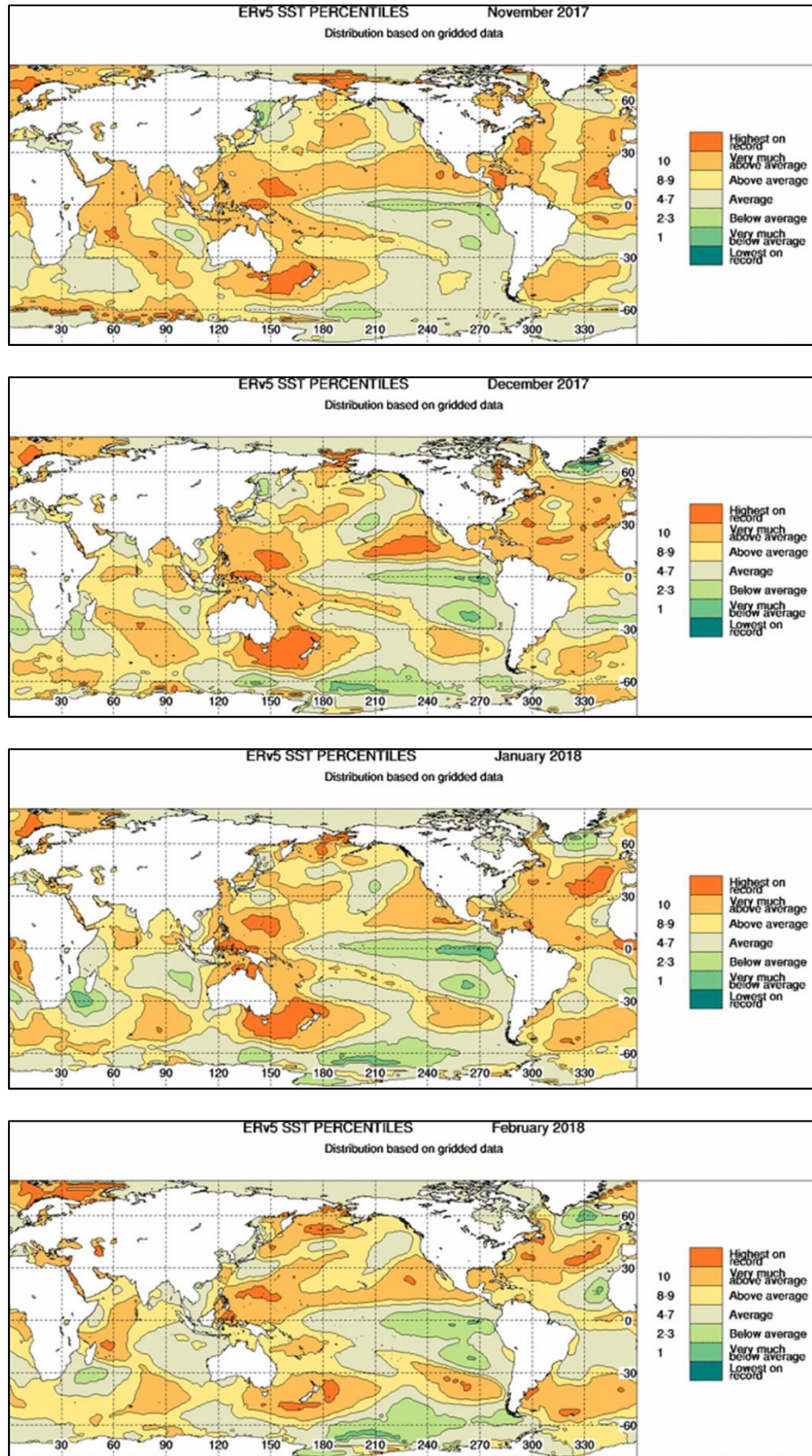


Figure 2. Monthly sea surface temperature deciles for November and December 2017, and January and February 2018, from the ERSSTv5 dataset.

1.2. Major climate anomalies in New Zealand

November 2017-February 2018 was characterised by mean sea level pressures that were higher than usual across the New Zealand region. This pressure pattern delivered more frequent warm northerly and northeasterly winds than normal, consistent with La Niña conditions. The warm air temperatures and sunny conditions warmed the surface ocean around the country. In addition, calm winds meant there was lower than normal vertical mixing between the warm surface ocean and cooler underlying water. These influences resulted in a relatively thin (in the order of 25 m) surface layer of anomalously warm water forming in the Tasman Sea during November and December 2017. This combination of high SSTs and increased frequency of northerly winds, as well as the background influence of climate change on global temperatures, delivered unprecedented warmth to New Zealand during summer.

In November 2017, Invercargill (southern South Island) set a record for its highest November average mean sea level pressure, with 1019.2 hPa, with records going back to 1948. Nelson had its 2nd-highest average November MSLP (records back to 1942) and Milford Sound had its 3rd-highest average November MSLP (records back to 1934).

The marine heatwave in the Tasman Sea also affected rainfall during summer 2017–18 (December 2017-February 2018). Subtropical and tropical storms (including ex-tropical cyclones) that affected New Zealand during the summer were able to retain characteristics which are usually present over warmer oceans, resulting in intense rainfall rates and large rainfall amounts not typically observed in New Zealand. For example, as ex-tropical cyclone *Gita* approached New Zealand, its low-level centre became displaced and then moved north over the abnormally warm waters of the eastern Tasman Sea. This allowed for some warm core tropical storm characteristics to persist, along with a rejuvenation in convection and heavy rainfall.

1.2.1. Temperature

Summer 2017–18 was New Zealand's hottest summer on record. The nationwide average temperature for summer was 18.8 °C—2.1 °C above the 1981–2010 summer average using NIWA's seven station temperature series which begins in 1909⁴. Summer 2017–18 exceeded the former record held by the summer of 1934–1935, which was 1.8 °C above the 1981–2010 summer average temperature.

Although outside of the official summer season, it is worth noting that the warmth was initiated on land in November 2017 (Figure 3). The persistent ridge of high pressure that was located over New Zealand and the Tasman Sea caused very warm and dry conditions for the time of the year, particularly in the second half of the month. The South Island experienced particularly warm temperatures, with some locations having their warmest November on record. Cromwell (south-central South Island) experienced 23 consecutive days with a maximum temperature above 25 °C, ending on 10 December 2017, which is unprecedented for Cromwell at that time of year.

⁴ <https://www.niwa.co.nz/our-science/climate/information-and-resources/nz-temp-record/seven-station-series-temperature-data>

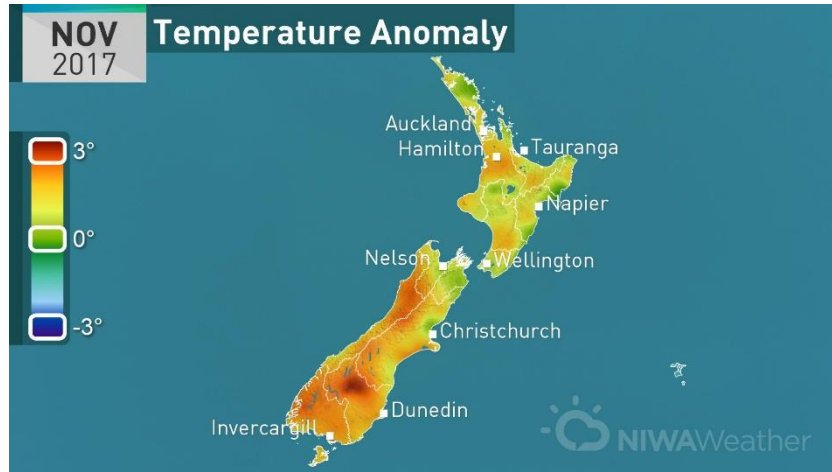


Figure 3. Mean temperature anomaly for New Zealand, November 2017 (1981–2010 climatology period).

The official summer season was off to a hot start with nearly the entire country observing well above average mean temperatures (more than 1.20 °C above the 1981–2010 December average) during December 2017 (Figure 4). This was the second-warmest December on record for New Zealand with a nationwide mean temperature of 18.1 °C—2.4 °C above the 1981–2010 December average temperature from NIWA’s seven station temperature series. Thirty-eight locations experienced record-high mean December temperatures. Notably, three locations experienced their warmest December, with records going back into the 19th century: Nelson in the northern South Island)—1862, Levin in the southwest North Island—1895, and Ranfurly in the south-central South Island—1897.

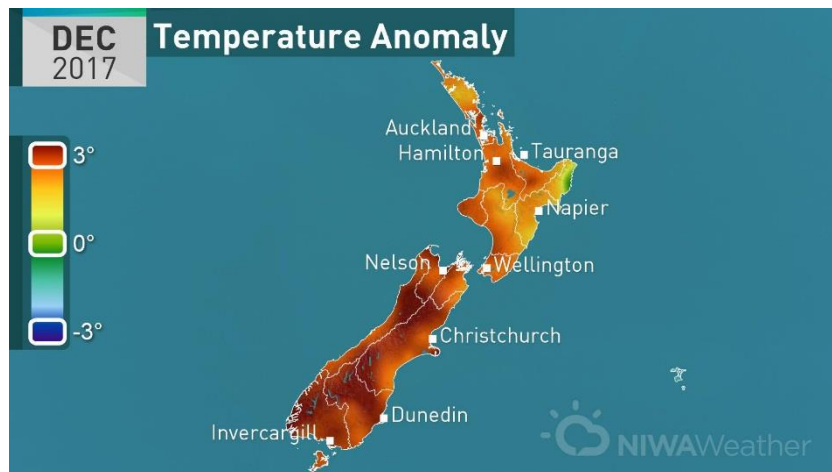


Figure 4. Mean temperature anomaly for New Zealand, December 2017 (1981–2010 climatology period).

January 2018 was the hottest month on record for New Zealand, with a nationwide mean temperature of 20.3 °C, 3.1 °C higher than the 1981–2010 January average temperature using NIWA’s seven station series (Figure 5). The previous hottest month on record was February 1998, with a nationwide average temperature of 19.6 °C. Over half of New Zealand’s regularly reporting climate stations observed mean temperatures at least 3 °C above their 1981–2010 January average in January 2018, and 94 stations observed their highest mean January temperature on record. Notably, Christchurch (eastern South Island) and Hokitika (western South Island) observed their hottest January since records began in 1863 and 1866, respectively. Gore (southern South Island) had a mean temperature of 19.2 °C—4.8°C higher than its January average—which is equal to the average daily maximum temperature for January in the town. Mean maximum temperatures for January 2018 were highest about Central Otago (south-central South Island), where Cromwell and Clyde observed maximum temperatures above 30 °C on 21 and 20 days, respectively. On average, these towns would usually observe 6 days above 30 °C in an entire year.

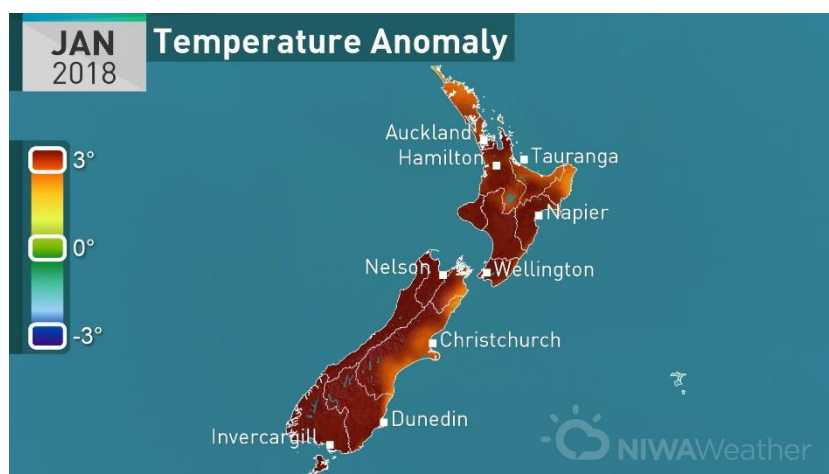


Figure 5. Mean temperature anomaly for New Zealand, January 2018 (1981–2010 climatology period)

February 2018 recorded a nationwide average temperature of 18.0 °C—0.8 °C above the 1981–2010 February average temperature from NIWA’s seven station temperature series (Figure 6). February was a contrasting month for temperatures, compared with December and January which saw widespread warmth across the country. In February, many North Island locations experienced above (0.51–1.20 °C above average) or well above average (more than 1.20 °C above average) temperatures while the South Island had above average temperatures in the north and near (-0.50 to 0.50 °C of average) or even slightly below average (-0.51 to -1.20 °C of average) temperatures elsewhere. The number of near-record high mean maximum (day time) temperatures, which was a product of a very humid month marked by sub-tropical and tropical airflows, keeping overnight temperatures elevated. Wellington (Kelburn) fell to just 20.2 °C on 1 February, making it the warmest minimum temperature of any month there (records go back to 1928). Humidity was also a fixture in the capital, where on 11 February the city’s highest dew point temperature (meteorological measure for humidity) was recorded.

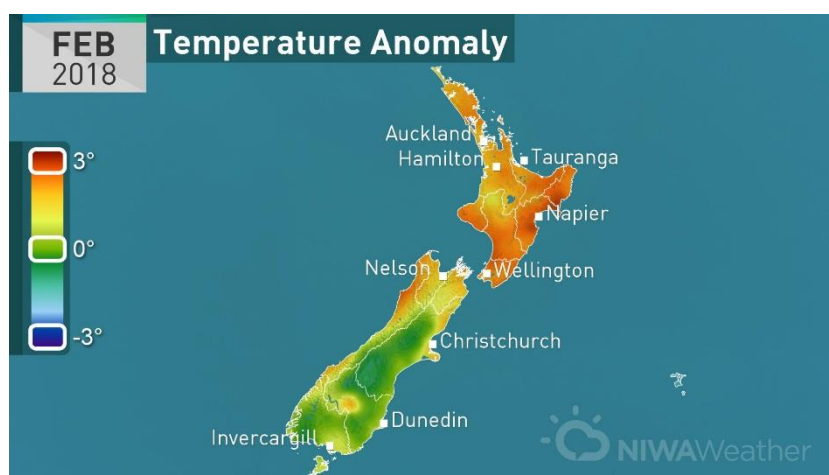


Figure 6. Mean temperature anomaly for New Zealand, February 2018 (1981–2010 climatology period).

For summer as a whole, over 50 locations set new summer mean temperature records, and approximately 50 other locations experienced their second- or third-hottest summer on record. The largest mean temperature anomaly was experienced in Masterton in the southeast of the North Island, where the summer mean temperature was 3.2 °C above average. Meanwhile, Leigh (northeast of Auckland) observed the highest mean temperature overall for summer 2017–18 with 21.8 °C.

Many record or near-record high summer mean maximum (daytime) and mean minimum (night-time) temperatures were also observed across all regions of the country. Notably, eight locations recorded mean summer maximum temperatures which were at least 3.0 °C warmer than average. This includes Leigh, Levin (in the southwest North

Island), and Westport (western South Island) which each experienced mean daytime maximums which were 3.4 °C above average. Meanwhile, a further seven locations observed mean summer minimum temperatures which were also at least 3.0 °C warmer than average. Of these, the most extreme was Masterton where mean night-time minimum temperatures were 3.6 °C warmer than average.

Eighteen locations observed new record-high daily maximum temperatures during summer 2017–18, with an additional two sites recording their equal-highest daily maximum temperature on record. During January 2018, Invercargill (southern South Island) recorded three consecutive days above 30 °C. This is unprecedented in records going back to 1905; the city had never previously recorded consecutive days above 30 °C. Alexandra (south-central South Island) recorded 38.7 °C in late-January, which is New Zealand's equal 15th-highest temperature on record.

1.2.2. Rainfall

Summer 2017–18 was a contrasting season for rainfall in New Zealand, particularly due to the impacts of ex-tropical cyclones *Fehi* and *Gita* during February.

During November 2017, numerous locations experienced their driest November on record, and much of the South Island and southern North Island had well below normal rainfall (less than 50% of the 1981–2010 November normal). Christchurch had its driest November in its record of 154 years, and Lincoln (near Christchurch) had its 2nd-driest month overall since records began there in 1881. Levin also recorded its driest November since records began there in 1895.

The summer season had a dry start with most of the country experiencing calm weather and below normal (50–79% of the 1981–2010 normal December rainfall), or well below normal (less than 50% of normal) rainfall during December 2017. A large number of locations observed either their lowest or near-lowest December rainfall on record. This included Auckland Airport, which recorded only 8 mm of rain (9% of the 1981–2010 December normal rainfall total), its driest December since records began there in 1959. A medium scale adverse drought event was declared by the Ministry for Primary Industries in the lower North Island, the West Coast, Otago, and Southland during December due to prolonged dry conditions. Christchurch Airport observed a 47-day dry spell (defined as less than 1 mm of rain on any day), which ended in mid-December 2017.

During January 2018, several rainfall events occurred, delivering above normal (120–149% of the 1981–2010 January normal rainfall), or well above normal (greater than 149% of January normal rainfall) rainfall levels to much of the top half of the South Island, as well as many areas of the North Island. Below normal, or well below normal January rainfall was experienced for much of Southland, Otago, and Hawke's Bay. The wet month contrasted to a relatively dry end to 2017 in many areas. For example, Auckland's North Shore observed a total of 275 mm of rain for January 2018, which was higher than the combined rainfall of the previous four months (256 mm was observed from September to December 2017).

February 2018 was the wettest month of the season as the passage of ex-tropical cyclones *Fehi* and *Gita* over the country brought significant amounts of rainfall and contributed to rounds of flooding and severe slips, especially across the upper and eastern South Island. Rainfall totals in some locations in the northern and eastern South Island were 300–400% of the February normal (Figure 7), and parts of the northern and southern North Island experienced over 200% of normal February rainfall. Nelson recorded 234 mm of rain for February 2018, which made it the wettest February in the 156-year historical record there. In Cromwell (south-central South Island), 97 mm of rain occurred during the month, making it the wettest February on record for that station. This gave the town 35% of the total rainfall that it received last year—Cromwell was New Zealand's second-driest location in 2017 (280 mm of rain fell). Kaikoura (northeast South Island) recorded 233 mm of rain during February—422% of the February normal or about a third of the annual normal rainfall total. Most of this rain fell in an 18-hour window on 20 February during ex-tropical Cyclone *Gita*. In contrast, parts of Gisborne, Hawke's Bay, Manawatu-Whanganui and Southland were somewhat sheltered from the moist northerly-quarter airflows and observed near normal (80–119% of normal), or slightly below normal (50–79% of normal) rainfall.

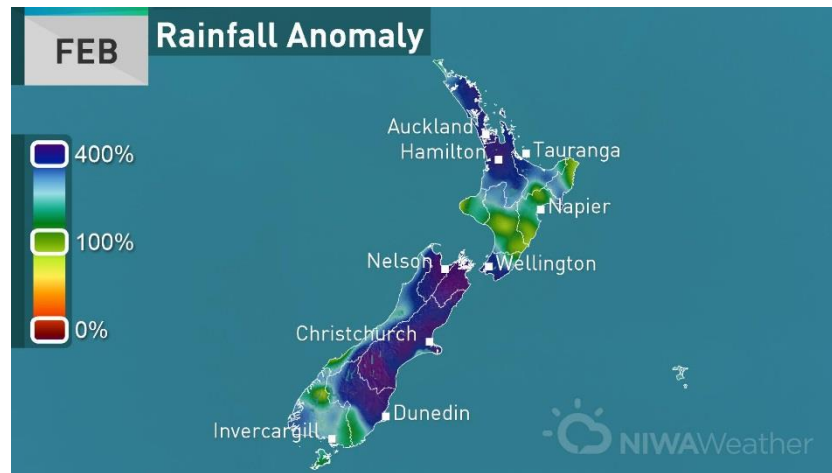


Figure 7. Rainfall percentage of normal for New Zealand, February 2018 (1981–2010 climatology period).

For the summer as a whole, the north and east of the South Island received above or well above normal summer rainfall where the impacts of the ex-tropical cyclones were most intense. Notably, Appleby (northern South Island) and Waipara (northeast South Island) recorded their wettest summer on record, observing 276% and 211% of normal summer rainfall, respectively, while several other South Island stations observed near-record amounts. Due to the dry start and the wet end to summer, there were not many records or near-records for high or low summer rainfall totals.

1.3. Major climate anomalies in Australia

1.3.1. October and November 2017

Above-average temperatures became established in Tasmania during October. It was the second-warmest October on record for the State, with mean temperatures 1.48 °C above the 1961–1990 average. October was also significantly warmer than average in Victoria (mean temperatures 1.40 °C above average), although well short of the records set in October 2015.

The most relatively extreme conditions in Tasmania occurred in November, as a result of a large blocking high being positioned to the east for most of the last three weeks of the month. This caused an exceptionally persistent period of warm temperatures (at a time of year which is more commonly characterised by high variability). In total, there were 14 consecutive days, from 17 to 30 November, when daily mean temperature averaged over the State was 5 °C or more above the 1961–1990 monthly average. This was far in excess of the longest previous such sequence at any time of year, an 8-day sequence from 6 to 13 March 2013. Several locations, especially in southern and western Tasmania, set records for persistent warmth for any time of year, despite it not yet being summer; at Strahan, seven consecutive days of 27 °C or above, and 18 consecutive days of 21 °C or above were both records for any month, whilst Hobart's six consecutive days of 25 °C also equalled its record, last set in January 2013.⁵The warm spell was more notable for its duration than its intensity, with only a few locations, mostly in the State's north, experiencing their highest November temperature on record.

⁵ Further details on November 2017 climate anomalies in Tasmania and Victoria are available in [Special Climate Statement 63—A prolonged warm spell in Tasmania and Victoria](#).

Mean temperatures for Tasmania for November were the highest on record almost everywhere in the State, except for the Bass Strait islands (Figure 8). The statewide average was 2.58 °C above the 1961–1990 average, which was 0.54 °C above the previous November record, set in 2000, and 0.33 °C above the previous largest monthly anomaly for any month. Daytime maximum temperatures were particularly high, with the monthly mean anomaly of +3.79 °C also the highest on record for any month (previously +3.20 °C in October 1914), and 1.7 °C above the previous record. Combined with the warm October temperatures, this gave Tasmania its warmest spring on record, despite below-average temperatures in September.

Southern Victoria, and some adjacent parts of eastern South Australia, also experienced extended periods of warmth, both by day and night. Melbourne had six consecutive days of 30 °C or above, equalling the previous November record, whilst fourteen consecutive nights of 15 °C or above easily surpassed the previous November record of nine (and is a sequence unmatched previously before January). Numerous stations in an area extending from Melbourne to Bairnsdale, in Gippsland, set November records for consecutive days of 25 °C or above, while records for consecutive November nights of 15 °C or above were set across a range of stations in the western half of Victoria and eastern border areas of South Australia. Whilst monthly mean temperatures for Victoria (3.08 °C above the 1961–1990 average) fell well short of those observed in November 2009—the most extreme month on record in mainland southeastern Australia, although with a limited impact on Tasmania—it was still the State's second-warmest November on record, and only the sixth month in which Victorian mean temperatures have been 3 °C or more above average.

A major contributor to the warmth was exceptionally high pressure over and south of Australia. The monthly mean sea level pressure at 9am local time at Hobart was 1019.6 hPa—7.1 hPa above the 1961–1990 average, and the highest on record for November (previously 1018.8 hPa in November 2007). Other long-term stations to set record November monthly mean pressures included Launceston Airport in northern Tasmania, and Gabo Island in far eastern Victoria.

Persistent onshore flow on the northern side of the blocking high resulted in a notable lack of warm days in coastal New South Wales and southern Queensland, and the adjacent ranges. This was most significant in northeastern New South Wales, where Armidale failed to reach 22 °C on 16 consecutive days, a November record. Sydney had 17 consecutive days below 25 °C, the longest such sequence in November since 2000.

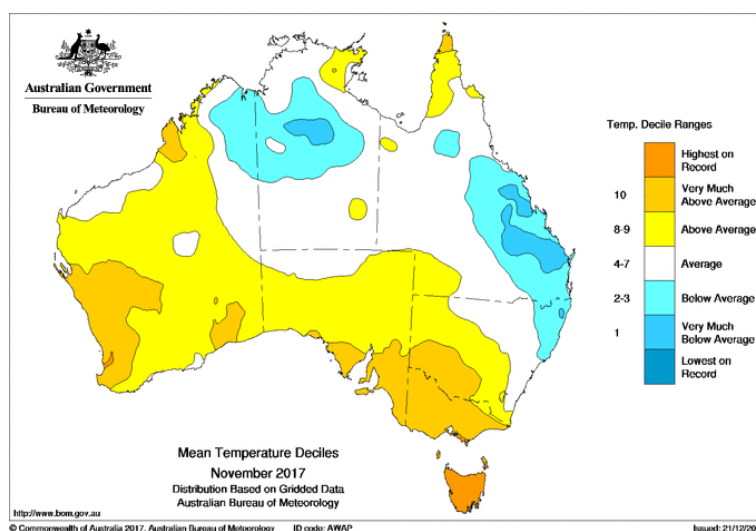


Figure 8. Mean temperature deciles for Australia, November 2017.

1.3.2. Summer

Although the blocking high in the south Tasman Sea broke down in early December, abnormally warm conditions continued in Tasmania through December and January (Figure 9). Both had the second-warmest mean temperatures on record for their respective months; December (1.73 °C above the 1961–1990 average) ranked

behind December 2015 (+2.17 °C), while January (1.84 °C above average) was second after January 1961 (+2.18 °C).

December's warmth was more prominent by night than by day, with statewide minimum temperatures setting a new record (1.78 °C above average, previously 1.58 °C in December 1985), and as in November, was marked more by persistent warmth than individual extremes. January was particularly warm in the second half of the month, which featured two significant periods of extreme heat. In the first, Irapuna (Eddystone Point) had its hottest day on record with 38.2 °C on the 19th, whilst in the second, Campania reached 39.6 °C on the 28th, the highest temperature in Tasmania since January 2013. This was followed by exceptionally high overnight temperatures on the 29th, which had the highest statewide mean daily minimum on record for Tasmania (19.47 °C, surpassing the previous record of 18.70 °C on 30 January 2009). Numerous locations in northern and central Tasmania had their warmest night on record on either the 28th or 29th, including Irapuna (Eddystone Point), Low Head, Devonport, Burnie, Smithton and Butlers Gorge.

Conditions cooled significantly in Tasmania in the last two days of January (Marawah in the far northwest, which had had its warmest night on record on the 29th, had its coldest January day on record on the 31st), setting the scene for a near-average February. Despite the very warm December and January, the mild conditions in February prevented any significant summer mean temperatures from being set. Overall summer mean temperatures for Tasmania were 1.24 °C above the 1961–1990 average, which made it the fifth-warmest summer on record, and 0.54 °C cooler than the record set in 2015–16.

December was particularly notable for overnight warmth on the mainland. Mean monthly minimum temperatures for the month were the highest on record over coastal areas and the adjacent ranges for most of eastern Victoria, and for eastern New South Wales as far north as the Sydney region—although not in Sydney itself. Monthly mean temperatures were generally less significant than those in Tasmania (partly because the normal range of variability is higher on the mainland). Victoria's December mean was 1.48 °C above the 1961–1990 average, which ranks as equal 11th highest of the post-1910 period.

January was a period of more general warmth through eastern mainland Australia, with monthly mean temperatures well above average throughout Victoria, New South Wales and Queensland (except the far north), rather than being focused in southern coastal areas as they had been in December. There were several significant heatwaves, particularly in New South Wales and northern Victoria. Mean January temperatures in Victoria were 2.75 °C above average, the third-highest on average. Unlike Tasmania, Victorian mean temperatures were also significantly above average in February (1.00 °C above the 1961–1990 average), although not as much so as in New South Wales and Queensland, or as they had been in Victoria earlier in the summer. Overall it was Victoria's third-warmest summer on record, and the warmest since 2000–01.

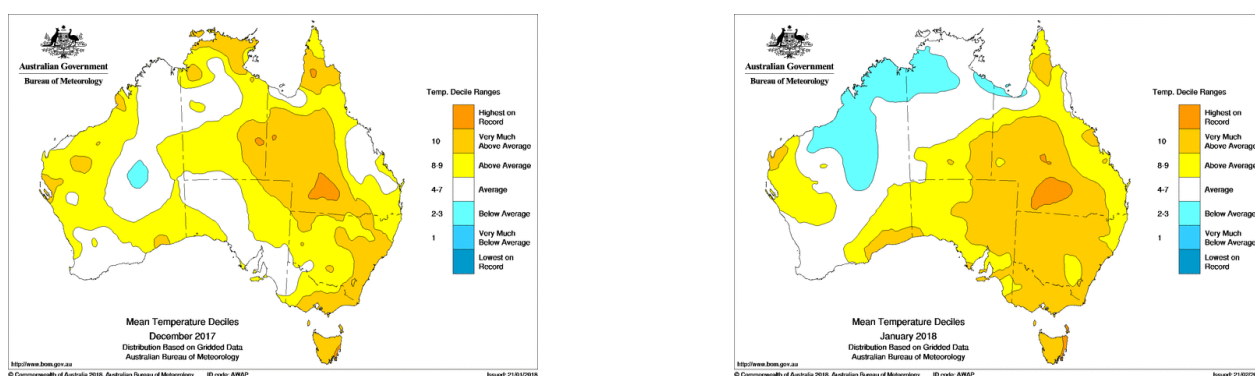


Figure 9. Mean temperature deciles for Australia, December 2017 and January 2018.

1.3.3. Overall warmth across the period

The most significant temperature anomalies on land were focused on the period from November to January, which coincided with the most extreme sea surface temperature anomalies in the southern Tasman Sea.

For the November–January period, mean temperatures were 2.05 °C above the 1961–1990 average for Tasmania, and 2.44 °C above average for Victoria. It was the warmest such period on record for both States. In Tasmania, the record was set by a substantial margin—0.44 °C above the period from November 2015 to January 2016. The differential was less in Victoria, where 2017–18 was 0.07 °C warmer than the period from November 2009 to January 2010. Record-high mean temperatures over this period occurred over almost all of Tasmania, and much of central and western Victoria (Figure 10).

Records were also set for Tasmania for some longer periods; both October to January (1.91 °C above average, previously +1.53 °C in 2015–16) and November to February (1.58 °C, previously +1.55 °C in 2015–16). In Victoria, the October to January and November to February periods ranked as second- and third-warmest respectively.

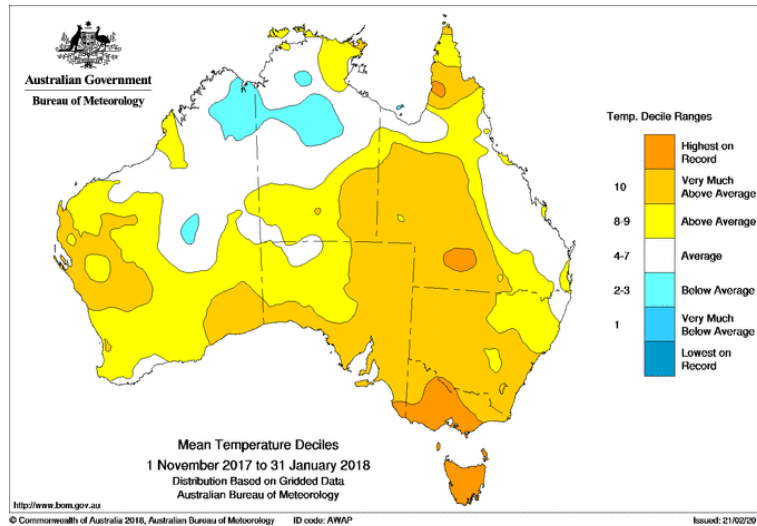


Figure 10. Mean temperature deciles for Australia, November 2017 to January 2018.

References and further information

This statement is based on information available as of 19 March 2018. There may be changes to some data points as a result of routine quality control processes.

Reference periods used for anomalies are according to standard national practices. 1981–2010 is used as the standard base period for New Zealand and for sea surface temperatures, whilst 1961–1990 is used as the standard base period for Australia.

Further Australian information is available from:

<http://www.bom.gov.au/climate>

Further New Zealand information is available from:

<http://www.niwa.co.nz/our-science/climate>