



Special Climate Statement 71—severe fire weather conditions in southeast Queensland and northeast New South Wales in September 2019

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Executive summary

- From 6 September, areas of northeast New South Wales and southeast Queensland had warmer than average daytime temperatures, very low humidity, and gusty winds leading to dangerous fire weather conditions.
- In these areas, fire risk was exacerbated by rainfall that was below average on a range of timescales from months to years, leading to a prolonged and severe drought and very high dryness factors for fuels.
- Maximum temperatures on the 5th and 6th were more than 10 °C above average in some areas.
- Many locations in the affected areas experienced January to August rainfall totals that were 50 per cent below average, and some locations had their driest January to August period on record since (at least) 1900.
- In addition to large year-to-date rainfall deficits in 2019, below average rainfall totals in 2017 and 2018 saw large multi-year rainfall deficits accumulate in areas on and west of the ranges in northern New South Wales and southern Queensland. Rainfall over much of this area had been lowest on record for the 20 months starting January 2018, and the 32 months starting January 2017.
- Trends towards a lengthened fire season have already been discerned in some areas of the country, with the fire season typically starting earlier in the year in southern Queensland, inland and southern New South Wales, and Victoria.

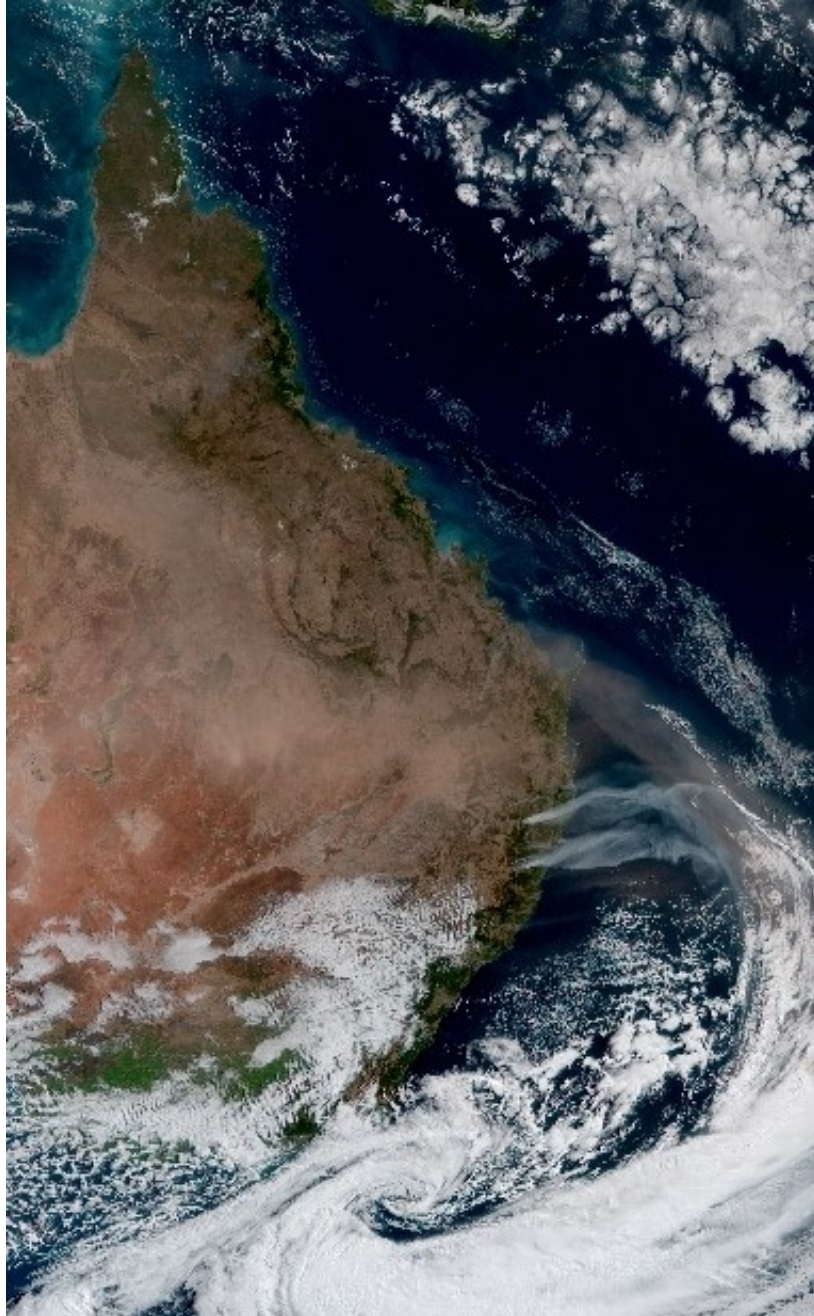


Figure 1: Satellite image from Himawari-8 on 6 September 2019 22:30 UTC showing plumes of smoke extending eastwards from fires burning in New South Wales, and dust blowing southeast off the Queensland coast. An intense low pressure system and associated large cloudband was situated southeast of the mainland.

Introduction

In coastal areas of southeast Queensland and northeast New South Wales, September has historically been the month with the highest Forest Fire Danger Index (FFDI) values of the year¹. Further inland in eastern Australia, the highest FFDI values are typically late in spring, while in southern Australia fire danger typically peaks in summer. The daily FFDI values observed during this event were above anything previously observed in most of these areas so early in September, compared to observations since 1950. This Statement discusses these conditions and the factors that contributed to the situation on a range of timescales.

Areas in the southern districts of Queensland and northeast New South Wales were primed for high fire danger ratings. Rainfall for January to August 2019 was very much below average to driest on record in some localities, along with very much warmer than average mean maximum temperatures. These areas largely overlap with the northern Murray–Darling Basin, which has had very much below average rainfall and warmer than average maximum temperatures since 2017².

On Friday 6 September, strong west to northwesterly winds ahead of the passage of a surface trough produced extreme to locally catastrophic fire conditions in the Warrego and Maranoa, and Darling Downs and Granite Belt districts of Queensland, and the northeastern districts of New South Wales.

For the Southern Downs Region, the fire weather during this event was comparable to October 2002, when fires in southeast Queensland burnt 40 000 hectares.

¹ FFDI is one common measure of fire weather conditions.

² For more information see [Special Climate Statement 70—drought conditions in eastern Australia and impact on water resources in the Murray–Darling Basin](#)

1. Preceding climate conditions

Low rainfall

Fire weather reflects a combination of factors including longer-term rainfall and temperature patterns, and shorter-term weather on a given day, including temperature, humidity and wind. Fire risk is driven by a number of factors including fire weather and fuel availability. Rainfall influences the dryness of fuels and is a key factor in calculating indices for determining fire weather risk such as the Forest Fire Danger Index (FFDI).

Rainfall prior to September 2019 had been below average on a range of timescales from months to years, leading to a prolonged and severe meteorological and hydrological drought in southern Queensland and northern New South Wales. Figures 2, 3, and 4 show the rainfall deciles across eastern Australia for January to August, winter, and August 2019 respectively, with large areas of very much below average rainfall at each timescale.

Rainfall for January to August 2019 was lowest on record in the Southern Downs (Queensland) and Northern Tablelands (New South Wales). For example, Tenterfield and Stanthorpe were each more than 20% below their previous record low January–August rainfall (and 77% below the long-term average).

Rainfall in the Gold Coast hinterland had been well below average, but generally not lowest on record for the year-to-date. In this area, conditions were extremely dry at the start of the year, with rainfall in January and February below average to locally lowest on record for those months. Rainfall for March to June was generally close to average, with a return to drier than average conditions in July and August. August was very dry (less than 10 mm at most sites) but August is a seasonally dry month for the region.

Year-to-date rainfall was generally about 50% below average at sites with at least 40 years rainfall record such as Mount Tamborine, Wunburra, Springbrook, and the longest-running Gold Coast site (Miami). Those long-term sites all had one of their ten driest starts to the year: Wunburra (second-lowest); Springbrook (third-lowest); Miami (fourth-lowest); and Tamborine (eighth-lowest).

At Tewantin on the Sunshine Coast, the year-to-date rainfall total was around 35–40% below average and ninth-lowest on record. Most of that deficit was in January and February. March to June had near-average rainfall, but July and August were about 60% below average. Tewantin had only received 6.4 mm in the 30 days before the start of the fires.

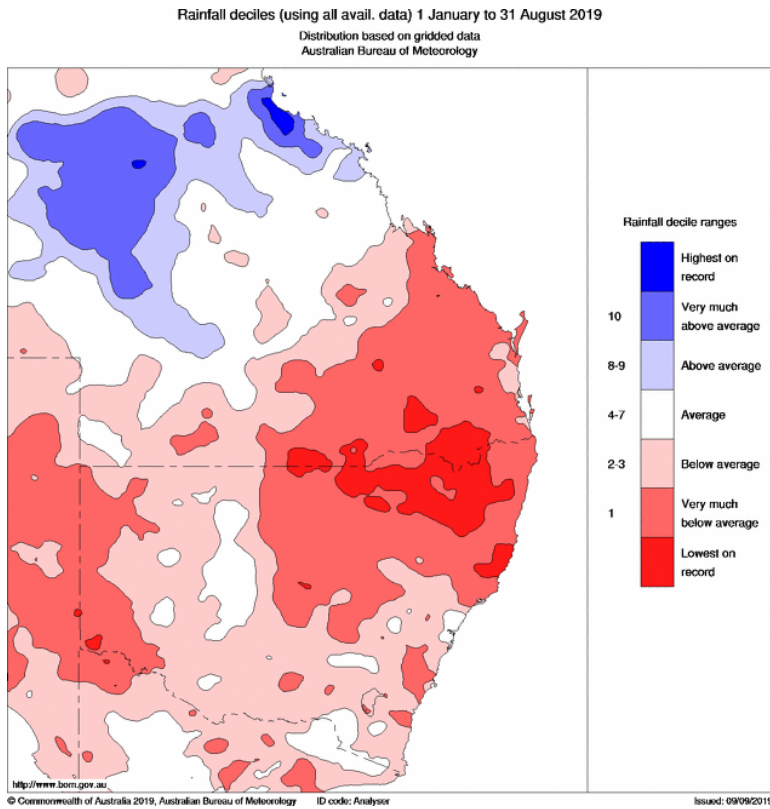


Figure 2: Rainfall deciles map for January to August 2019 (based on all years since 1900).

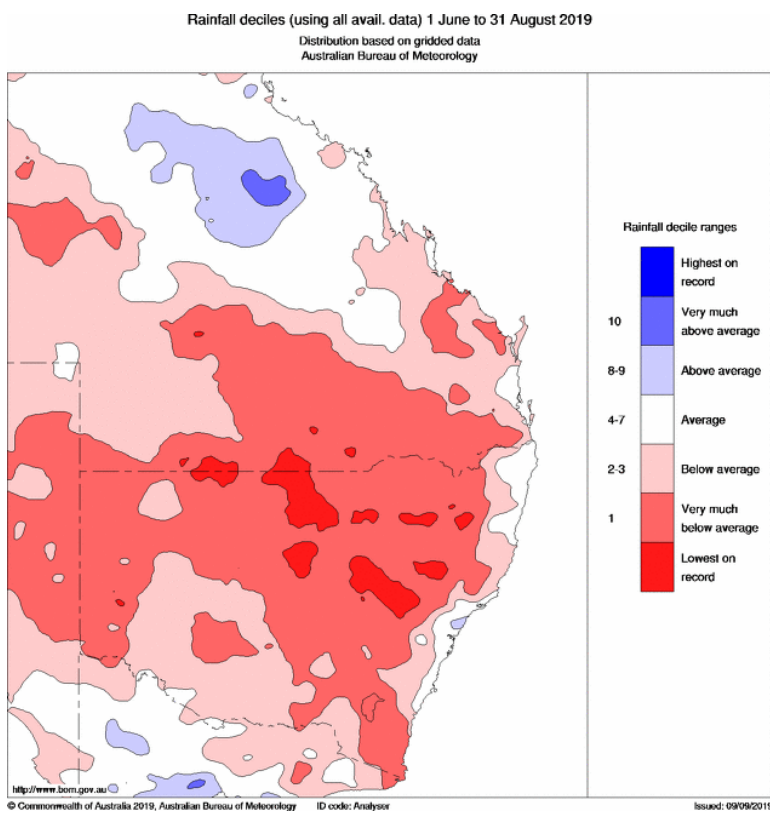


Figure 3: Rainfall deciles map for winter (June to August) 2019 (based on all years since 1900).

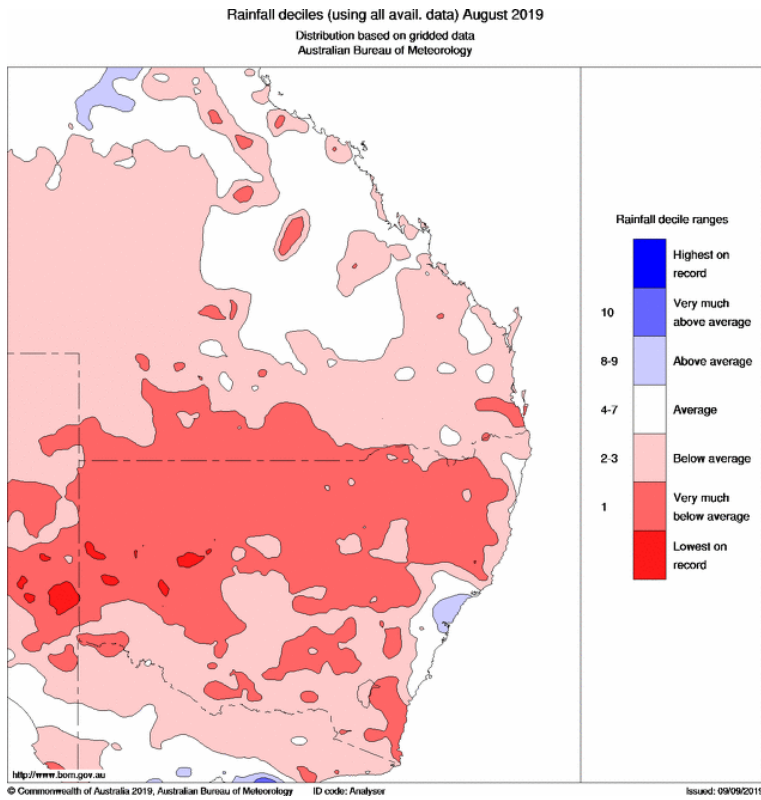


Figure 4: Rainfall deciles map for August 2019 (based on all years since 1900).

Dry soils

Based on the Australian Water Resources Assessment Landscape model (AWRA-L) 6.0, the modelled root-zone soil moisture (top 100 cm of the soil profile) was below average to driest on record for the first week of September 2019 over much of southeast Queensland and northeast New South Wales (see Figure 5, based on all years since 1911). The low soil moisture reflected both the recent intense dry conditions, as well as longer-term below average rainfall stretching back to the start of 2017. Low soil moisture means high stress in the vegetation and will mean fuels that might not normally burn become available to bushfires.

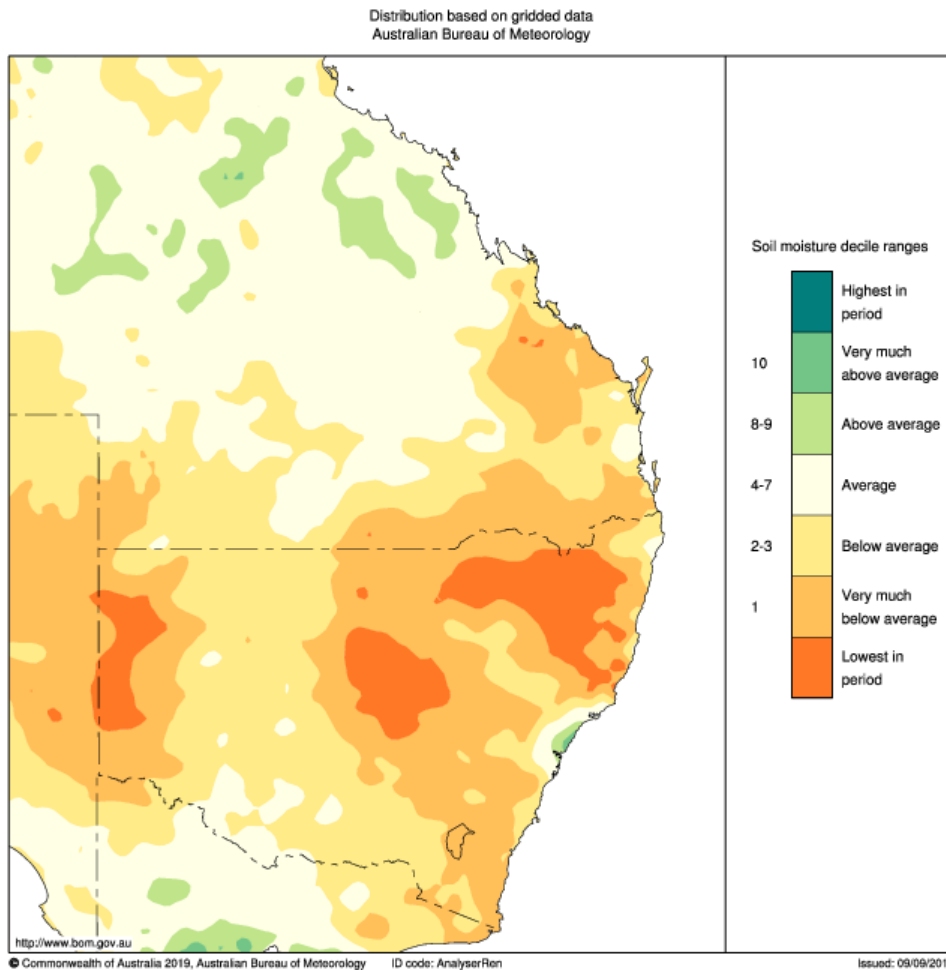


Figure 5: Mean September root-zone soil moisture deciles for 1–8 September 2019 from the Australian Water Resources Assessment Landscape model (AWRA-L) 6.0 (based on all years since 1911).

The low rainfall and dry soils meant runoff had also been below average to locally lowest on record across most of southeast Queensland and northeast New South Wales (see Figure 6). This highlighted that the long meteorological drought (lack of rainfall) was also reflected in an intense and long-lived hydrological drought (depleted surface and groundwater storages). These factors set in place the preconditions for dangerous fire weather.

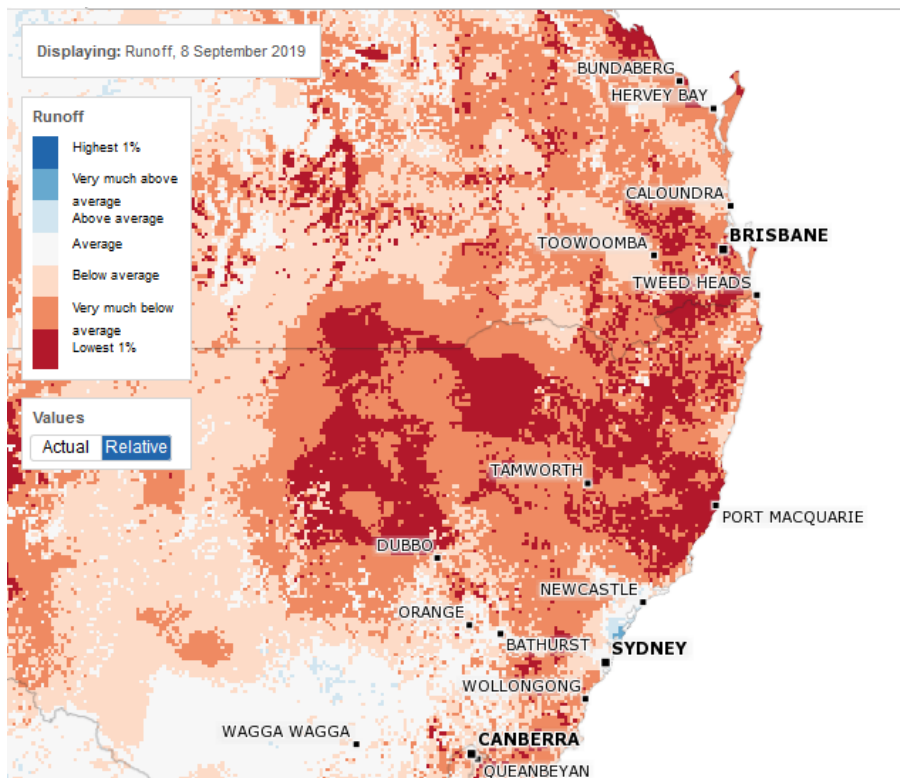


Figure 6: Runoff deciles for 8 September 2019 from the Australian Water Resources Assessment Landscape model (AWRA-L) 6.0 (based on all years since 1911).

The drought factor³, which is an input into the calculation of the FFDI, was above 9 at sites throughout northern and central Australia, including almost all sites in southeast Queensland and northeast New South Wales. This means the dryness of fuels was at or near the highest value used for the FFDI calculation.

Very warm year-to-date

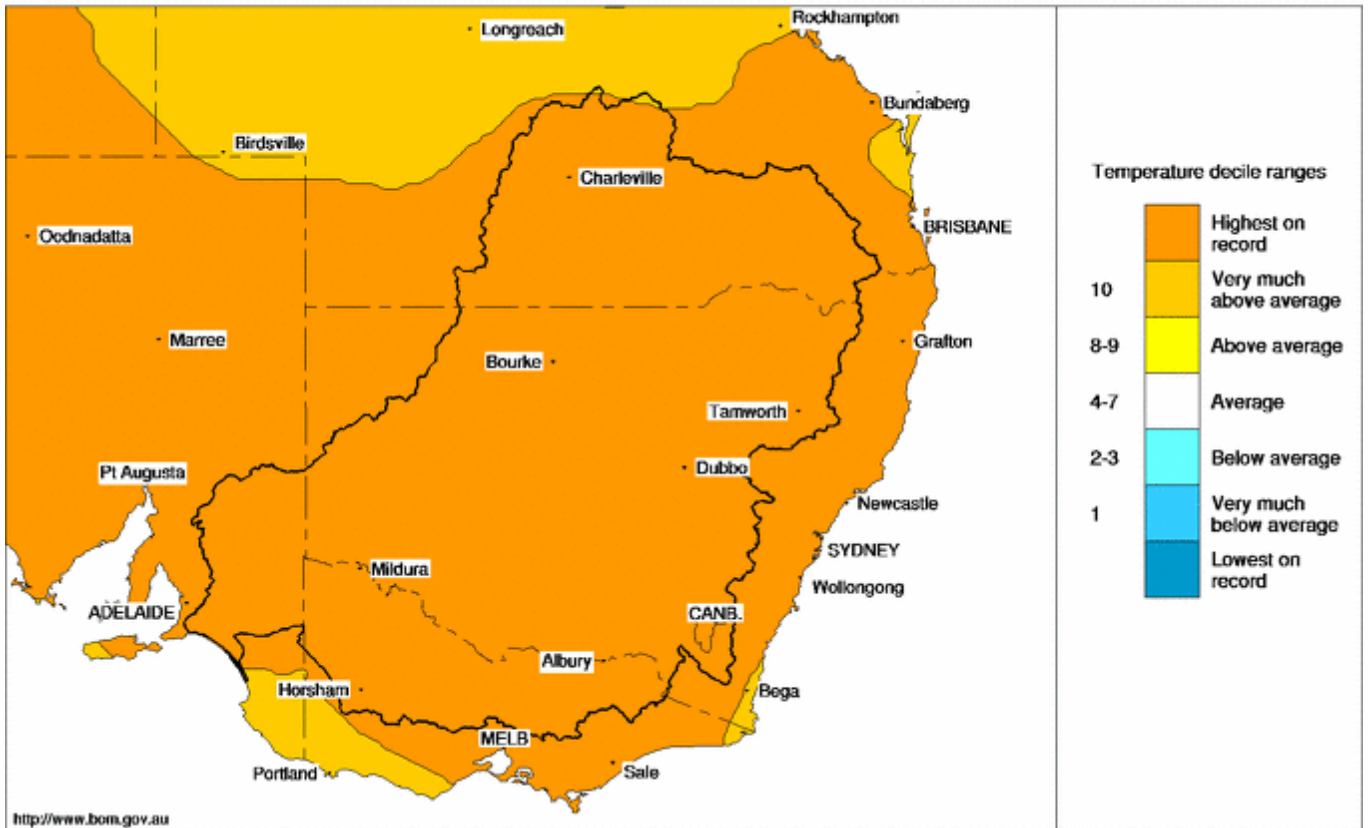
In conjunction with the low rainfall, temperatures for 2019 had been consistently warmer than average contributing to greater rates of drying and higher values of the drought factor.

In 2019, New South Wales had its warmest January to August period on record for overall mean temperature (1.85 °C above average), and Australia as a whole had its warmest on record such period for maximum (daytime) temperature (1.71 °C above average) and was second-warmest for mean temperature (1.30 °C above average, behind 2016).

The high fire dangers in September 2019 included areas of the Murray–Darling Basin. For the Murray–Darling Basin as a whole, the four overall warmest January to August periods on record since 1910, in order, have been in 2019, 2016, 2018, and 2017. Maximum temperature deciles for the January to August period from 2017 to 2019 are shown in Figure 7, with virtually the whole of the Murray–Darling Basin showing warmest on record. These high temperatures contribute to higher values of the drought factor and lower values of relative humidity, as well as directly raise the FFDI, which increases with temperature.

³ The drought factor is a component of the FFDI calculation. It indicated the state of the fuel—how ready it is to burn based on moisture content—and ranges in value from 0 to 10.

Max. temp. deciles (all avail. data) 1 January 2017 to 31 August 2019
 Distribution based on gridded data
 Australian Bureau of Meteorology



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Figure 7: Map of the Murray–Darling Basin (black outline) showing the mean maximum temperature deciles for the period January to August in 2017, 2018, and 2019 (based on all years since 1910).

2. Meteorological drivers

Large-scale climate drivers

Australia's climate was impacted by a positive Indian Ocean Dipole (IOD) in both 2018 and 2019, exerting a drying influence over many parts of the country. The IOD is characterised by cooler waters to the northwest of Australia and warmer waters further west towards Africa. The positive IOD contributed to low rainfall over southern and central Australia during winter⁴. It is unusual but not unprecedented to have successive positive IOD events (based on the Bureau of Meteorology's criteria, the last known occurrence of consecutive positive IOD events was in 1982 and 1983). While the IOD is a natural mode of variability, its behaviour is changing in response to climate change. Research suggests that the frequency of positive IOD events, and particularly the occurrence of consecutive events will increase as global temperatures rise.

While 2017 was not an official positive IOD, the pattern of ocean temperatures was like that during past IOD events. In other words, conditions in the Indian Ocean have been unfavourable for rainfall across Australia for each of the past three years.

In combination with reduced rainfall, positive IOD events also lead to reduced humidity across Australia. Recent months have seen notably low humidity, which enhances potential evaporation.

A positive IOD is likely to remain the dominant climate driver for Australia until late 2019. IOD events typically dissipate by early summer as the monsoon trough moves into the southern hemisphere.

In the tropical Pacific Ocean, the El Niño–Southern Oscillation (ENSO) was neutral, having little influence on Australian and global climate.

Synoptic evolution

On 4 and 5 September, a ridge of high pressure over eastern Australia combined with a dry, stable air mass resulted in sunny conditions throughout New South Wales and much of Queensland, with warmer than average maximum temperatures. The high pressure system weakened and drifted northwards over Queensland and by the 6th, extended a ridge along the Queensland coast. On the 6th, a cold front with a pre-frontal trough approached from the west, bringing strong northwesterly winds ahead of the change (Figure 8).

The strong winds generated areas of raised dust as well as elevated fire dangers through southeast Queensland, northeast New South Wales, and parts of northern inland New South Wales.

⁴ More information about the impacts of a positive IOD: <http://www.bom.gov.au/climate/iod/#tabs=Positive-IOD-impacts>

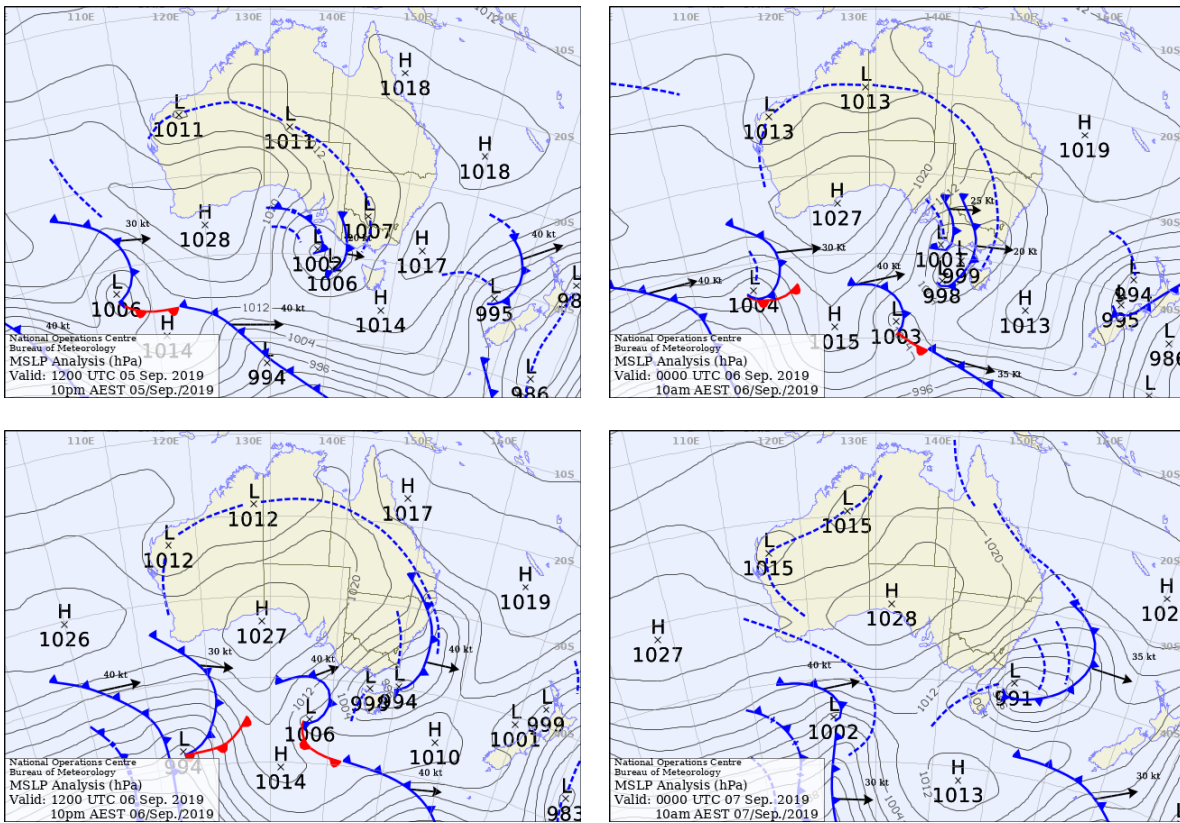


Figure 8: Mean sea level pressure analysis maps from 5 September 2019 12:00 UTC to 7 September 2019 00:00 UTC.

3. Temperature

Warmer than average days

This early in the season, the high daytime temperatures in southeast Queensland and northeast New South Wales on 5 and 6 September 2019 were generally second only to the exceptional winter heat of 23–24 August 2009⁵, meaning this would have been a record-breaking early season heatwave were it not for 2009. Some locations surpassed the observed temperatures from August 2009, particularly around Brisbane and further north along the Queensland coast, and in the Central Western Slopes and Plains of New South Wales where early season heat records were set.

Figures 9 and 10 show the daily maximum temperature anomalies for 5 and 6 September respectively, with large areas of northern New South Wales and southern Queensland having daytime temperatures more than 8 °C warmer than average (based on the 1961–1990 average).

⁵ See [Special Climate Statement 18: Exceptional winter heat over large parts of Australia](#)

Max. temp. anom. (1961-1990 clim.) 5th September 2019
Australian Bureau of Meteorology

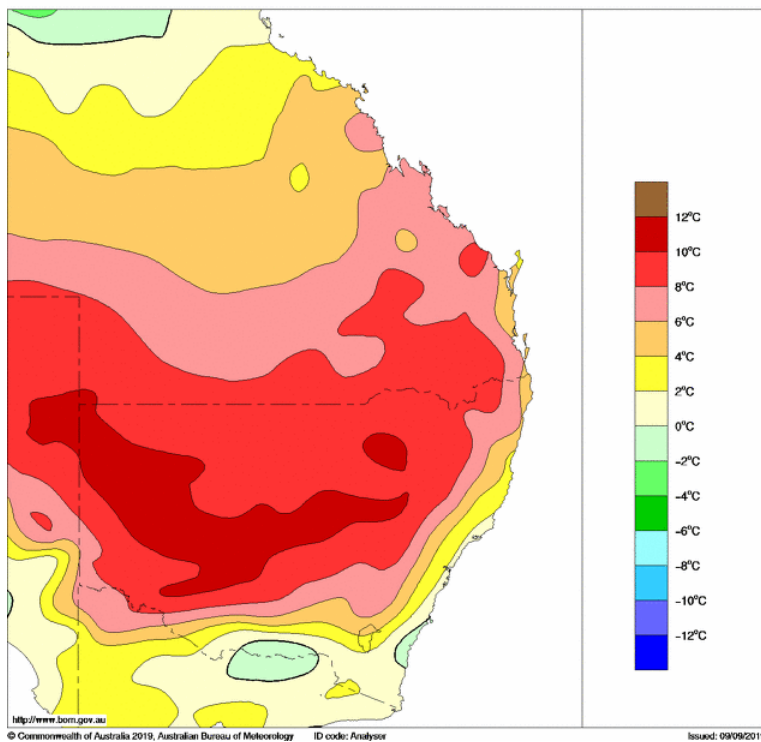


Figure 9: Daily maximum temperature anomalies for 5 September 2019 (based on the 1961–1990 average).

Max. temp. anom. (1961-1990 clim.) 6th September 2019
Australian Bureau of Meteorology

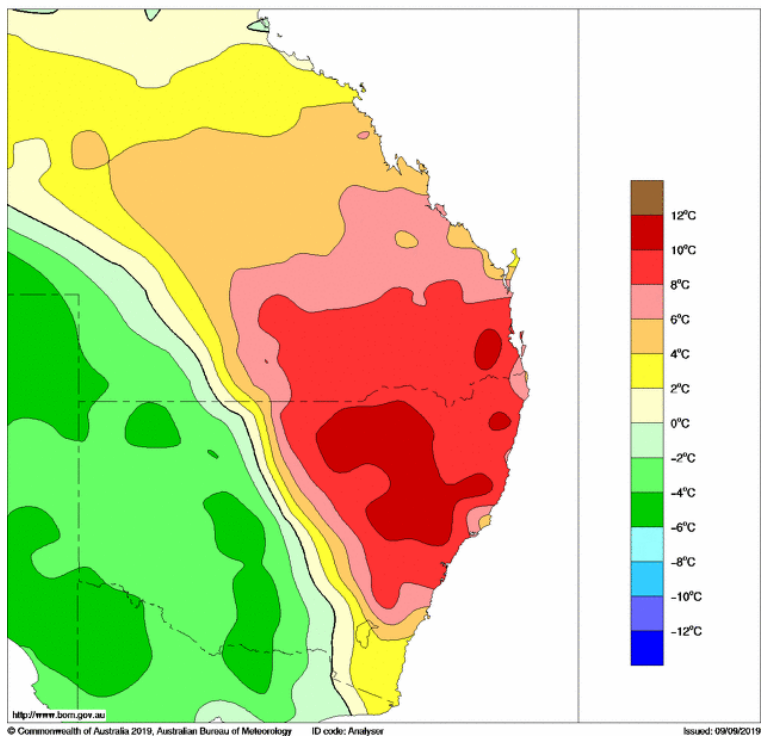


Figure 10: Daily maximum temperature anomalies for 6 September 2019 (based on the 1961–1990 average).

Low humidity

Dewpoint temperatures were very low at sites in southeast Queensland and northeast New South Wales. Most dewpoint temperatures were in the $-8\text{ }^{\circ}\text{C}$ to $-12\text{ }^{\circ}\text{C}$ range, although Brisbane Airport got down to $-12.7\text{ }^{\circ}\text{C}$. These dewpoint temperatures were below average, but well short of September records. The Brisbane Airport value has historically been about a 1-in-10 year event for September, and at Oakey in the Darling Downs a 1-in-2 to -3 year event.

Vapour pressure (an indication of humidity)⁶ was below average throughout the day on the 6th (Figure 11). Both the 9am and 3pm vapour pressure observations showed large areas more than 6 hPa below average in southeast Queensland and northeast New South Wales, indicating an intensely dry air mass.

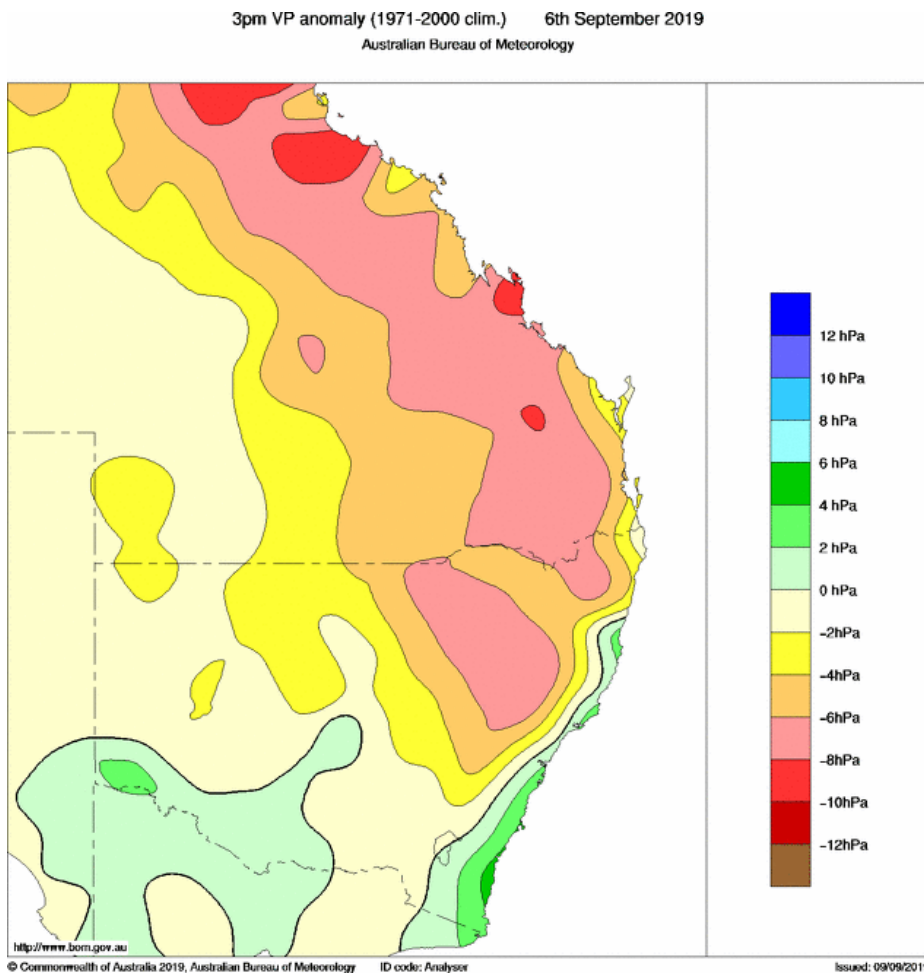


Figure 11: 3pm vapour pressure anomalies on 6 September 2019 (based on the 1961–1990 average).

⁶ For more information about vapour pressure see <http://www.bom.gov.au/climate/austmaps/about-vprp-maps.shtml>

Precipitable water provides an estimate of the amount of moisture in the atmosphere⁷. During the first week of September 2019, precipitable water values were consistently below average at Brisbane Airport, Moree, and Charleville. On the 6th and 7th, precipitable water values also dropped below average at sites further south, such as Sydney Airport and Williamtown RAAF.

4. Strong winds

Strong winds were observed over large areas of eastern New South Wales and southeast Queensland on the 6th. Numerous sites in New South Wales and southeast Queensland recorded maximum wind gusts of more than 80 km/h (see Figure 12).

Several sites in eastern New South Wales recorded their highest maximum wind gust in September for at least 10 years. The strong winds extended north into southeast Queensland, with Applethorpe recording its strongest maximum wind gust in September for more than 10 years (see Figure 13).

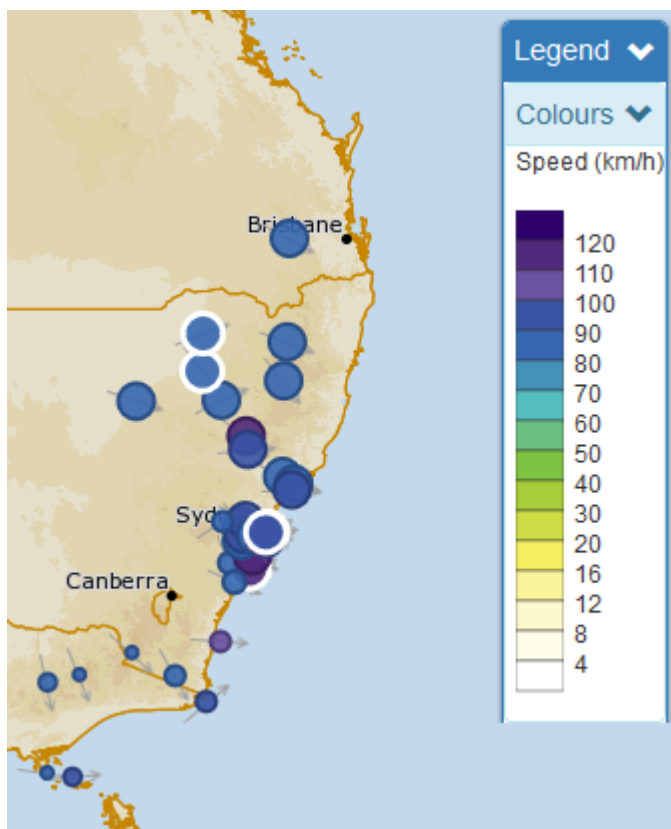


Figure 12: Map showing sites that had a maximum wind gust of more than 80 km/h on 6 September 2019. The white outlines indicate sites with 10 or more years of wind data that set a September record.

⁷ Precipitable water is the total water vapour contained in an atmospheric column of unit cross-section, expressed in terms of the depth of an equivalent mass of liquid water of the same cross-section. Further information available at <http://www.bom.gov.au/climate/updates/articles/a024.shtml>.

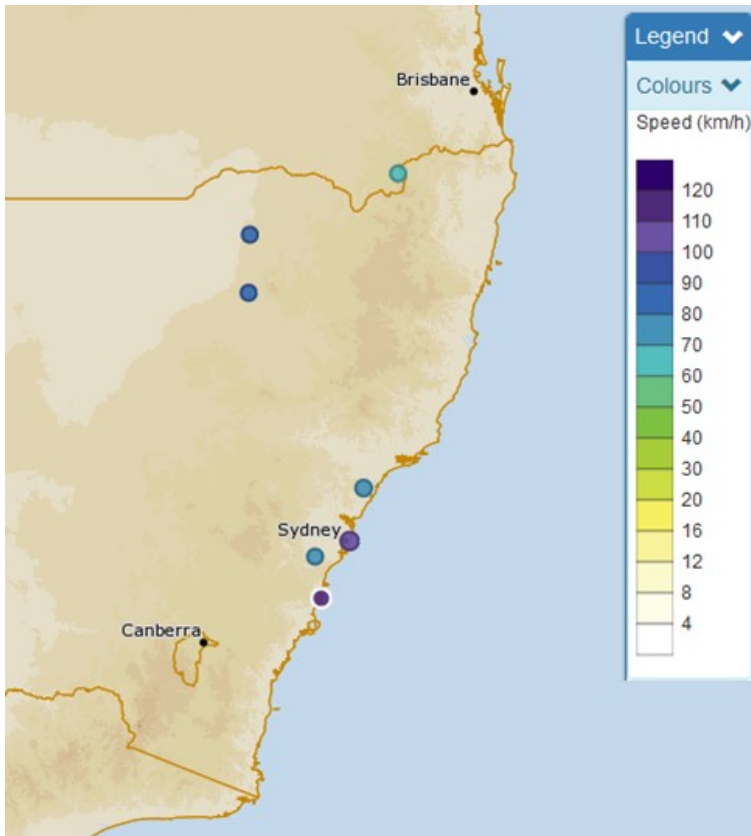


Figure 13: Map showing sites with 10 or more years of wind gust data that had their highest September maximum wind gust on record on 6 September 2019. The white outlines indicate sites that had their strongest wind gust for any month.

5. Fire weather

In coastal areas of southeast Queensland and northeast New South Wales, September has historically had the highest FFDI values of the year. Further inland, the highest FFDI values are typically later in the season, with most areas west of the ranges in New South Wales not having their peak fire weather until January (see Figure 14).

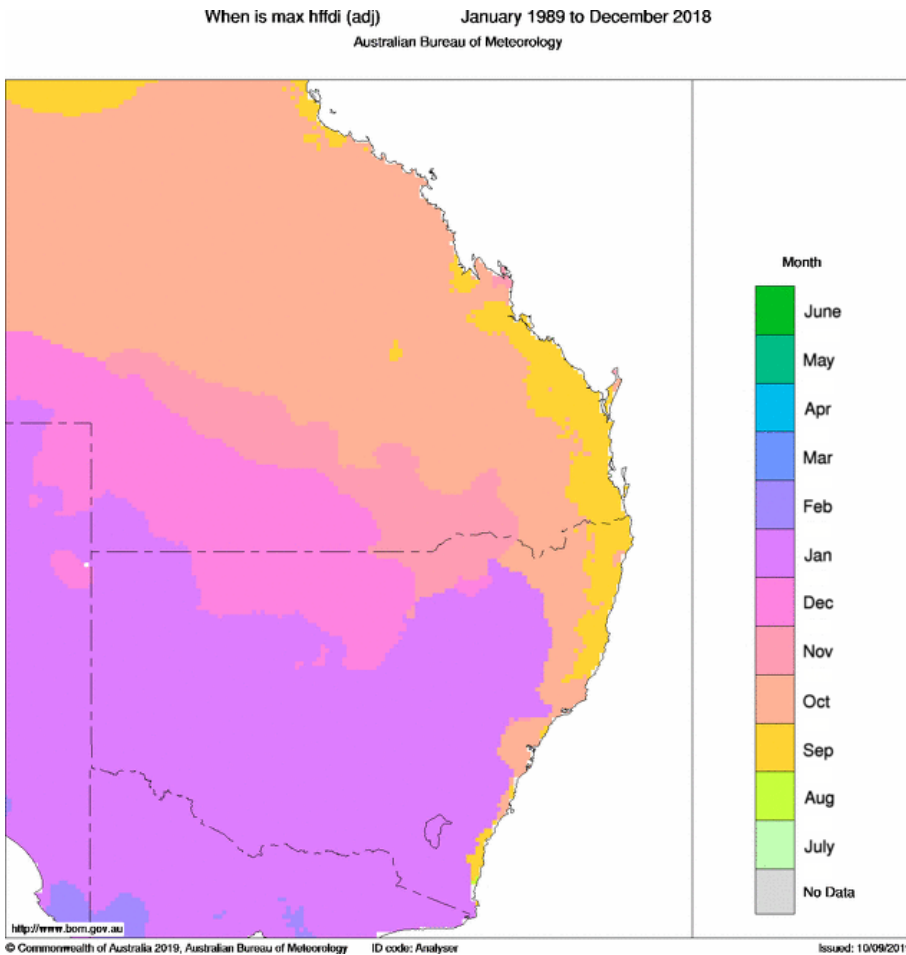


Figure 14: Map of eastern Australia showing the month of the highest climatological mean daily FFDI, using the base period 1989–2018.

The high fire dangers during this event followed on from very much above average accumulated FFDI values during winter 2019 over Australia. The only areas of the country that had average to below average accumulated FFDI values for winter (FFDI values summed across the season) were those areas of southern and western Victoria, western Tasmania, and northern inland Queensland that had average to the above average rainfall during the season (see Figure 15).

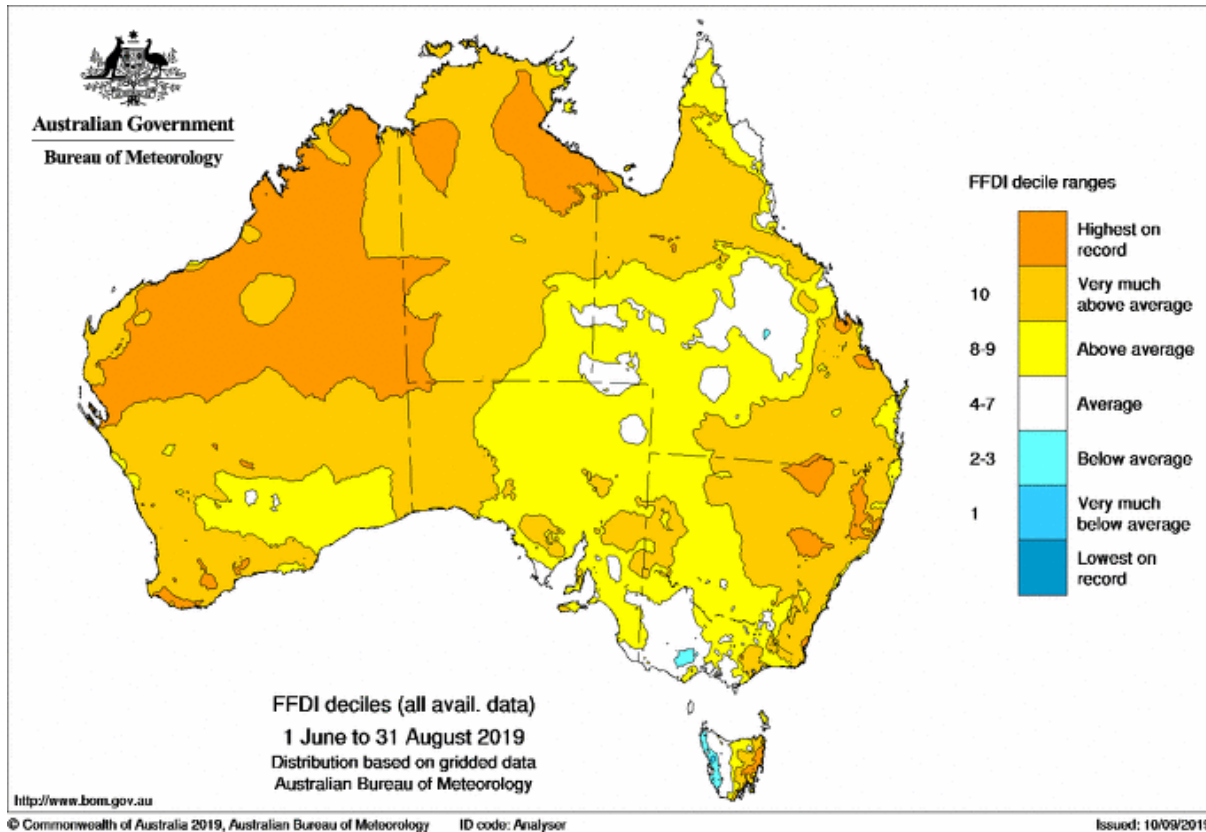


Figure 15: Accumulated FFDI deciles for winter (June to August) 2019, based on all years since from 1950.

In August 2019, the Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC)⁸ issued the [Australia Seasonal Bushfire Outlook: August 2019](#), reporting that northeast New South Wales and southeast Queensland were among those areas of Australia that faced above normal fire potential for the 2019–20 fire season.

From 6 September, high temperatures, low humidity, and strong winds, coupled with the dry conditions, led to elevated fire danger across southeast Queensland and northeast New South Wales. The measured FFDI values were in the extreme category (over 75) across large areas, reaching the catastrophic category (FFDI values of 100 or above) at some locations in New South Wales.

Figure 16 shows the location of sites with at least 10 years of data that had their highest FFDI in September on 6 September 2019, or highest so early in the season for at least 10 years. Figure 17 shows the areas of highest FFDI in September based on the daily gridded FFDI dataset (see Dowdy, 2018), which extends back to 1950.

⁸ <http://www.bnhcrc.com.au/>

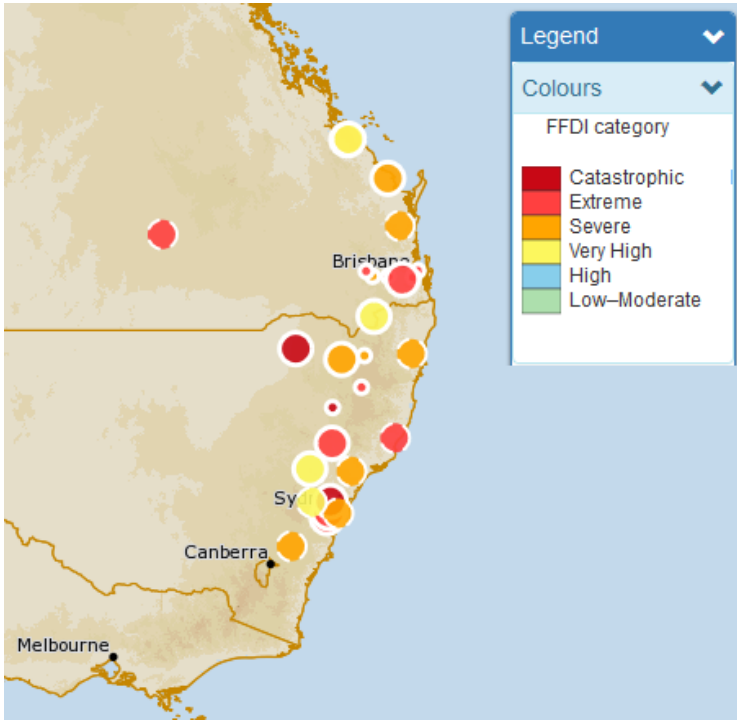


Figure 16: Map of eastern Australia for 6 September 2019 showing sites that had their highest daily FFDI in September for at least 10 years (white outline) or the highest so early in the season for at least 10 years (white dashed outline).

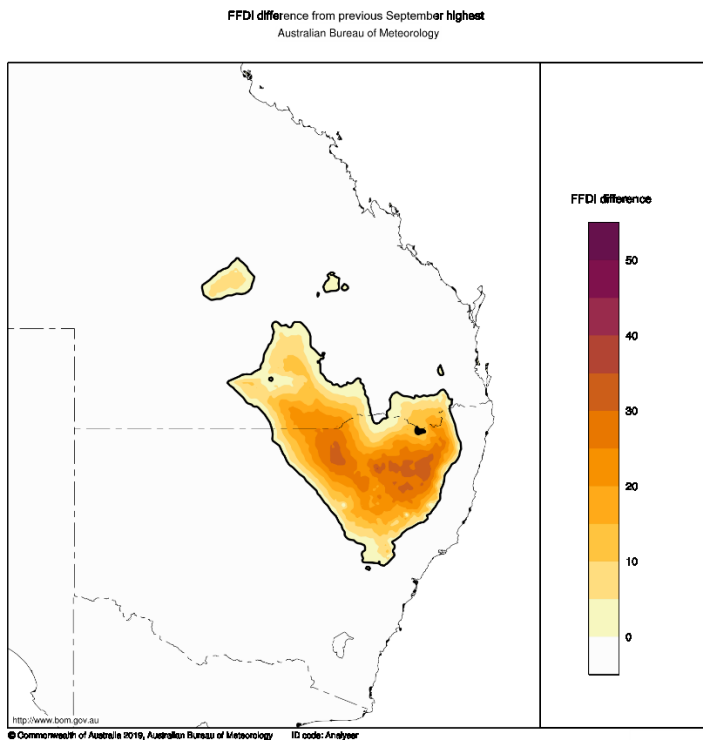


Figure 17: Highest daily FFDI values on 6 September 2019 compared with the previous highest September daily FFDI (1950–2018). Shaded areas indicate places where it was the highest FFDI on record for September.

In most districts of northeast New South Wales, 6 September 2019 had the highest regionally averaged daily FFDI in September, based on all years since 1950 (see Figure 18). East of the ranges though, the daily averaged FFDI for the North Coast was the third-highest in September, behind 27 September 1994 and 14 September 2017. For each of the first eight months of 2019, the highest regionally averaged daily FFDI was above average in all regions.

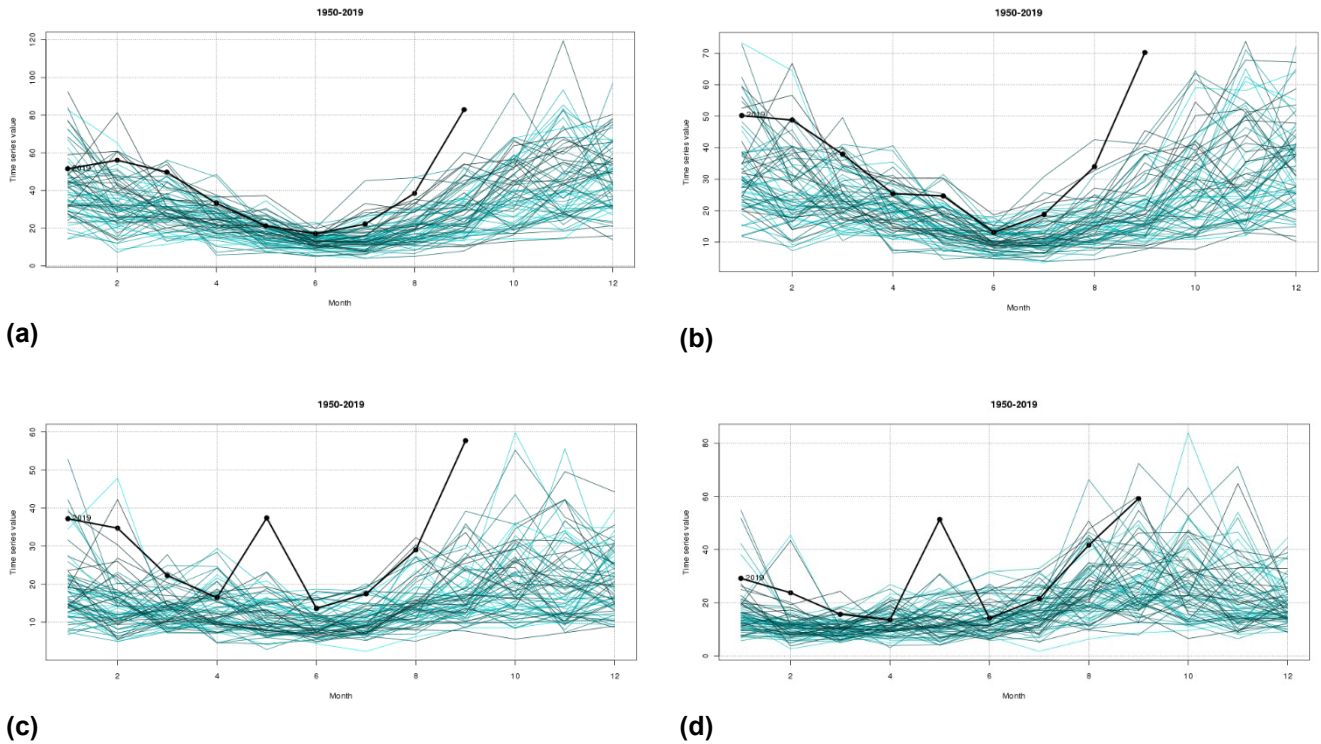


Figure 18: Regionally averaged highest daily FFDI for each month from 1950 to 2019, with 2019 shown by the black line. Values for 1950 to 2018 are shown in shades of green, with the most recent years a darker shade. Graphs shown for the following districts of northern New South Wales: (a) Northwest Plains; (b) Northwest Slopes; (c) Northern Tablelands; (d) North Coast district.

In southeast Queensland on 6 September 2019, the Darling Downs⁹ had its highest regionally averaged daily FFDI on record for September, based on all years since 1950 (see Figure 19). Closer to the coast, the Moreton district (including Brisbane) had its second-highest September FFDI value on record, behind 27 September 1994. North of Brisbane, the Port Curtis district had its third-highest regionally averaged daily FFDI value on record for September, behind both 27 September 1994 and 22 September 1969, the latter being a day when FFDI values reached the extreme category in areas around Biloela. We note that in most of those regions where the FFDI was not a September record, it was an early season record (i.e. the highest value so early in spring in most areas).

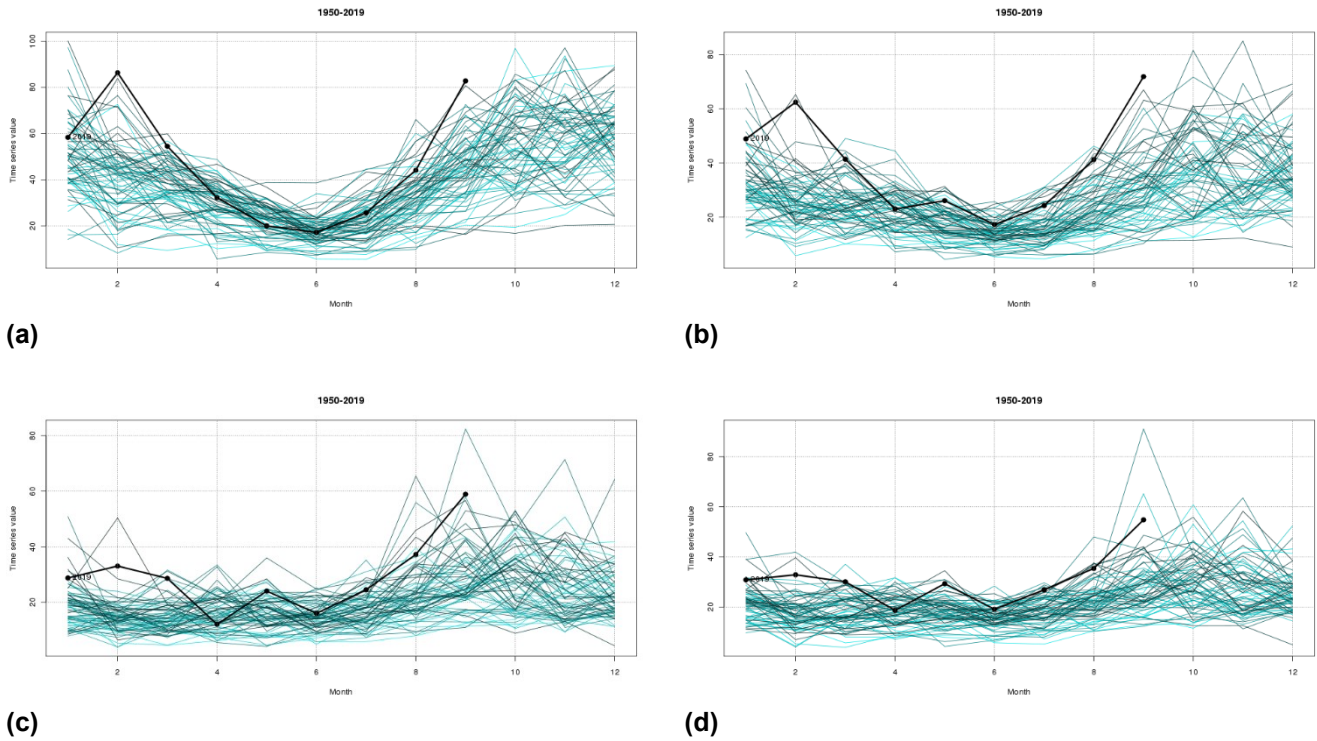


Figure 19: Regionally averaged highest daily FFDI for each month from 1950 to 2019, with 2019 shown by the black line. Values for 1950 to 2018 are shown in shades of green, with the most recent years a darker shade. Graphs shown for the following districts of southeast Queensland: (a) Maranoa and Warrego; (b) Darling Downs; (c) Moreton; (d) Port Curtis

⁹ Boundaries of districts referred to in this section can be found at <http://www.bom.gov.au/climate/cdo/metadata/maps/raindist.pdf>

Regionally, the FFDI conditions were slightly more unusual for this time of the year in northeast New South Wales than southeast Queensland. An average over a large region is more robust and can better show the unusual nature of conditions.

In northeast New South Wales, 6 September 2019 was the highest September daily FFDI averaged over the combined districts of the Northern Tablelands, Northwest Slopes, and Northwest Plains on record, based on all years since 1950 (Figure 20).

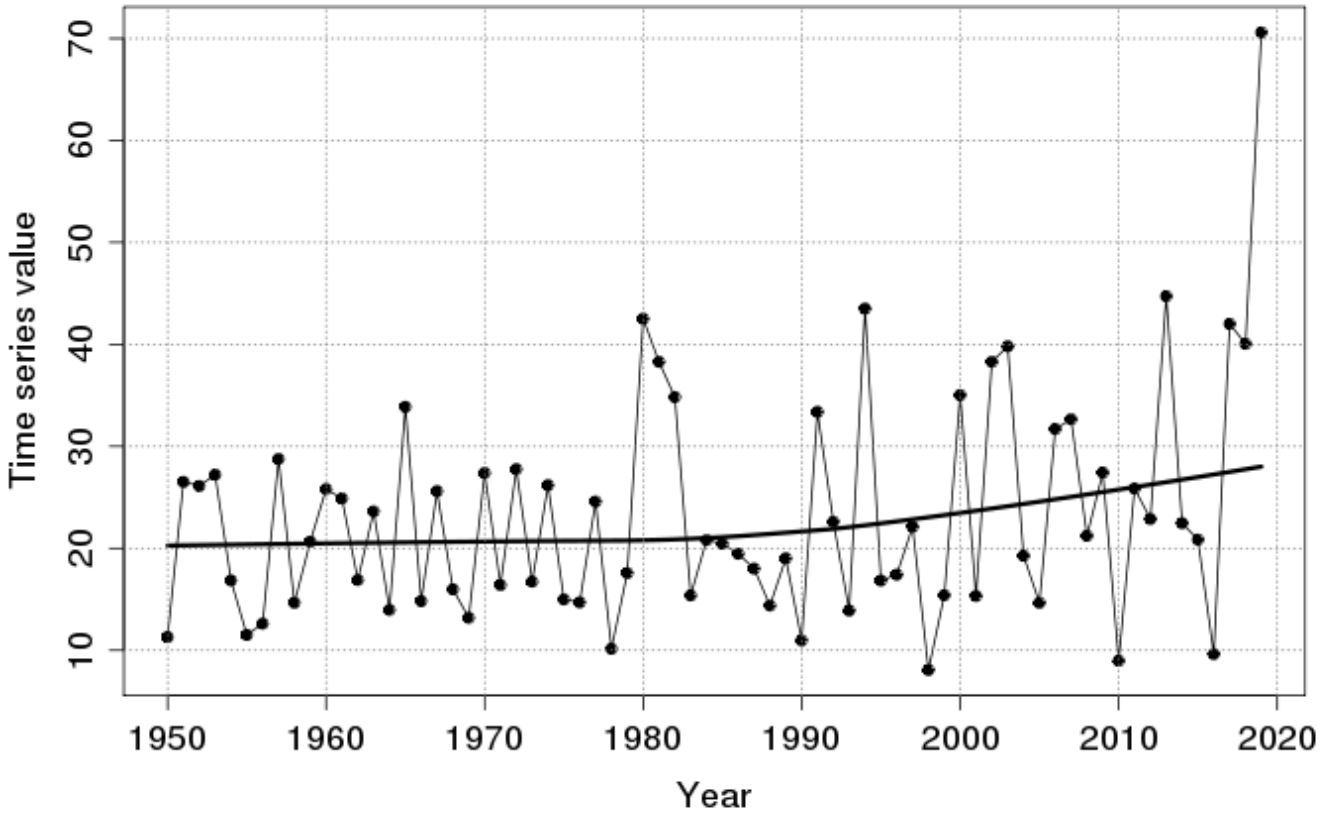


Figure 20: Regionally averaged highest September daily FFDI (1950–2019) across the combined Northern Tablelands, Northwest Slopes, and Northwest Plains districts of New South Wales, with a lowess regression superimposed (span parameter $f = 0.8$). The 2019 value is based on the highest averaged daily FFDI from 1 to 6 September.

6. Documented impacts of the conditions

Queensland

On 5 September, one home was lost in northern Queensland near Mareeba in the Atherton Tablelands. Properties were destroyed overnight on 6 September at Binna Burra and near Stanthorpe. By 7 September, more than 50 fires were burning across Queensland and this had increased to 80 by 9 September. Residents were evacuated from parts of Beechmont and Binna Burra in the Gold Coast hinterland, and Stanthorpe and Applethorpe in the Granite Belt.

By 11 September, there were 70 fires still burning across Queensland, and Queensland Fire and Emergency Services (QFES) confirmed there had been 17 homes lost across the region. Bushfires had scorched more than 33 000 hectares statewide, including 10 600 hectares at Hawkwood; 5 000 hectares at Sarabah; 2 000 hectares at Stanthorpe, and almost 1 000 hectares at Peregian Springs.

Details:

- On 2 September, a fire was burning in difficult terrain in Sarabah, southwest of Canungra in the Gold Coast hinterland, with people in Sarabah, Tamborine Mountain and Canungra affected by smoke. The fire continued for several days, then strong and dry west to northwesterly winds on Friday the 6th caused it to spread to Binna Burra, in mountainous terrain south of Canungra through the Lamington National Park. By 7 September, the fire stretched from Canungra to Binna Burra and was about 10 km long and 5 to 10 km wide, moving at a pace of around 2 km/h. The Binna Burra Lodge was engulfed on the morning of 8 September and fire caused extensive damage to the property. Fires near Sarabah were still active on the 10th, affecting Binna Burra, Canungra and Beechmont, where more than 3 600 hectares had burnt. Over 130 people and 47 vehicles were evacuated from O'Reilly overnight on the 9th, passing through a fire zone with Queensland Police helicopter (POLAIR) aerial support.
- From the 6th, fires took hold around Stanthorpe and Applethorpe, with homes destroyed overnight on the 6th. Fires were still burning on the 10th near Stanthorpe, including near Applethorpe and Amiens, where 2 000 hectares had burnt.
- Late on the 9th, a fast-moving fire at Peregian Beach in the Sunshine Coast was travelling in an east-northeast direction from Emu Mountain Road towards Pitta Street and Lorikeet Drive, and was heading towards Coolum State High School on Havan Road East. Peregian Beach residents were asked to evacuate either south towards Coolum or north towards Noosa. By 8pm, the fire was still travelling east-northeast towards Peregian Beach and Marcus Beach. Overnight on the 9th, at least one home was destroyed at Peregian Beach. A southerly wind change around midday on the 10th caused the fire to spread northwards, but the moist sea-breeze assisted with retarding the movement of the fire. By 11 September, the fire was under control, and residents returned to their homes.

New South Wales

By 9 September, more than 50 fires were active in New South Wales and by the morning of the 10th, several homes had been destroyed. On the morning of 9 September, five fires were burning out of control and three watch and act alerts were in place for blazes at Drake near Tenterfield, Ebor near Armidale, and Shark Creek in the Clarence Valley.

Details:

- By 9 September, several fires were burning in the Tenterfield Local Government Area (LGA), the largest of which was the Long Gully Road fire at Drake. The fire had burnt more than 32 100 hectares and was out of control, burning in bushland south of the Bruxner Highway and south of Drake and Tabulum, to the west of Clarence River in the Girard State Forest. It was burning in a northeasterly direction towards the villages of Drake and Tabulum. By the morning of 10 September, more than 40 000 hectares had burnt. In the afternoon, the fire breached containment lines and spread towards the Sandy Creek and Sandy Hill areas, and continued to burn to the west of Clarence River in the Girard State Forest. By 15 September, 53 200 hectares had been burnt.
- On 9 September, the Armidale fire at Bees Nest was burning north of Ebor and to the northwest of Dorrigo. The fire already covered more than 61 300 hectares and had a perimeter of more than 100 km. Up to 66 500 hectares had been burnt on multiple fronts by 10 September, and more than 90 100 hectares had been burnt by the 15th.
- On the morning of 9 September, a fire at Shark Creek in the Clarence Valley LGA was burning out of control, with more than 3 700 hectares burnt. The fire was burning in a northeasterly direction and crossed Brooms Head Road. By midday, the fire was burning in bushland in the Yuraygir National Park and Shark Creek area, south of Yamba, and more than 5 000 hectares had been burnt. In the afternoon, a southerly wind change pushed the fire towards Yamba and later in the evening the fire was burning on the north and south of Angourie and Wooleweyah. By 12 September, more than 10 100 hectares had been burnt



Figure 21: Map of eastern Australia showing the locations of some of the most significant fires (red triangles). There were more than 50 fires reported in Queensland and another 50 in New South Wales in the week after 6 September 2019.

7. Historical and future trends

While all exceptional climate events have proximate (local) causes in antecedent and concurrent weather conditions, long-term trends and slow variations also play a role.

As with surface air temperature, Australia has seen rising trends in fire danger indices in recent decades (see Dowdy, 2018)¹⁰. In particular, the annual accumulated FFDI (a sum of FFDI across the year) has been increasing across most of eastern Australia, including southeast Queensland and some areas of northeast New South Wales. The trend in accumulated FFDI captures both an increase in the frequency and severity of dangerous fire weather conditions. Figure 22 shows the change in highest daily FFDI for September from 1950 to 2018, with the largest increases in southeast Queensland, and western and southern coastal areas of New South Wales

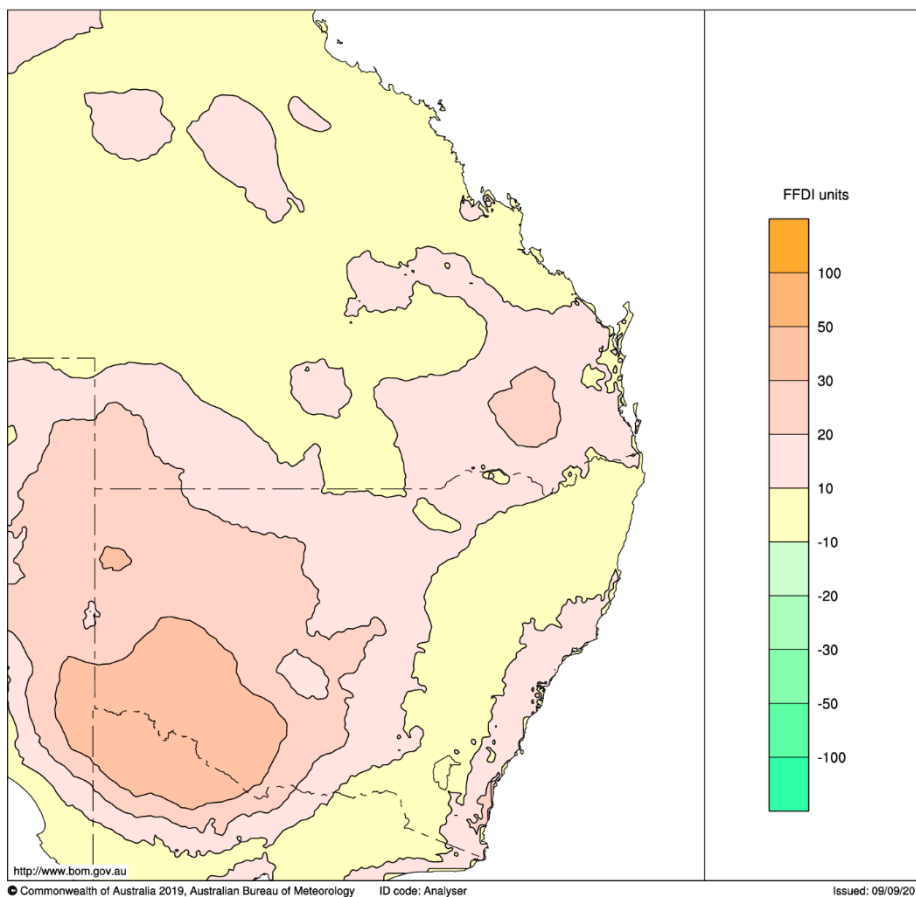


Figure 22: Map of eastern Australia showing the change in the highest daily FFDI for September from 1950 to 2018.

A measure of the onset of the fire season in a region is given by the first day when the FFDI passes 35 (other thresholds show similar outcomes). In the Northwest Slopes and Plains districts of New South Wales, the first day

¹⁰ See also [State of the Climate 2018](#).

has come forward by about a month since 1950, while noting a considerable degree of interannual variability (see Figure 23). In this context, both the very high FFDI values and their occurrence early in the season is consistent with the trend in these measures.

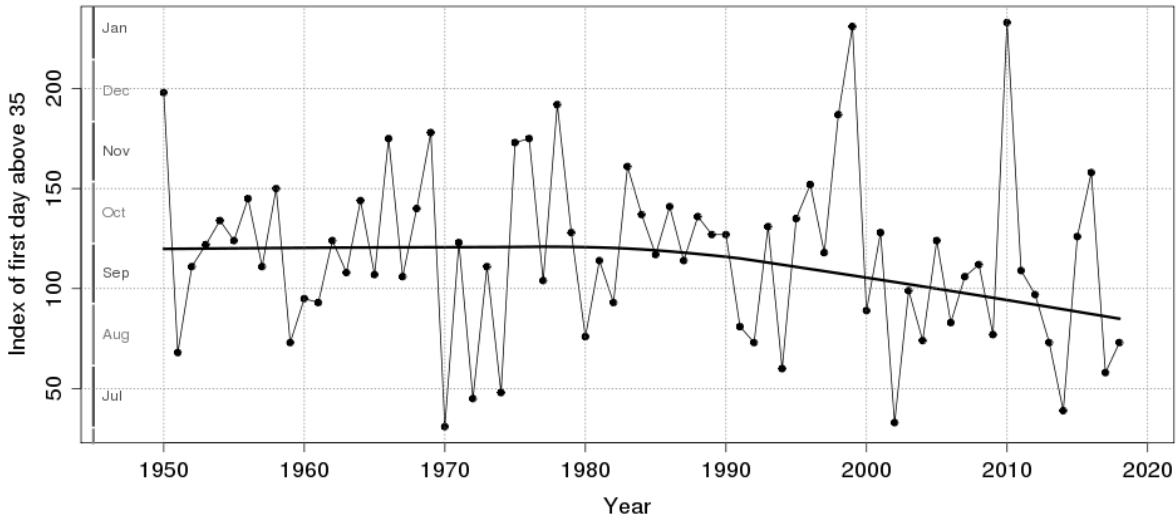


Figure 23: Date of the first day of each year after 31 May when FFDI values exceeded 35 in the Northwest Slopes and Plains districts (rainfall districts 52–55) of New South Wales. A lowess regression with span parameter $f = 0.8$ has been superimposed. Smaller values indicate an earlier start to the fire season.

Model projections into the future continue to show an increase in FFDI values due to increasing greenhouse emissions over the course of the century, including throughout the areas where the September 2019 fires occurred. This is a robust result across a range of different methods and metrics (for details see Figure 6 of Dowdy et. al. 2019).

8. Previous notable events

Spring is the peak of the fire weather season in much of southeast Queensland and northeast New South Wales. When antecedent conditions are dry, September days with strong winds and warm temperatures can result in severe fire weather.

September 1991

August and September 1991 were exceptionally dry months in Queensland, at the peak of a significant drought that affected much of southeast Queensland over the preceding year.

Severe fire weather was a regular feature of September 1991 in southeast Queensland; there were major fires on the 1st, 10th, 14–15th, 19th–22nd, and 29th. In the second half of the month, this extended to eastern New South Wales. The events of the 10th and 14–15th in particular were associated with high temperatures and gusty winds. There was one loss of life associated with the fires in the Sunshine Coast hinterland.

This proved to be the drought's peak in the southeast of the State, with average to above-average rainfall returning from October onwards, although dry conditions persisted through the summer in northern Queensland and in the tropics more generally.

Figure 24 shows large areas of southeast Queensland and northern New South Wales with very much above average monthly accumulated FFDI values for September 1991.

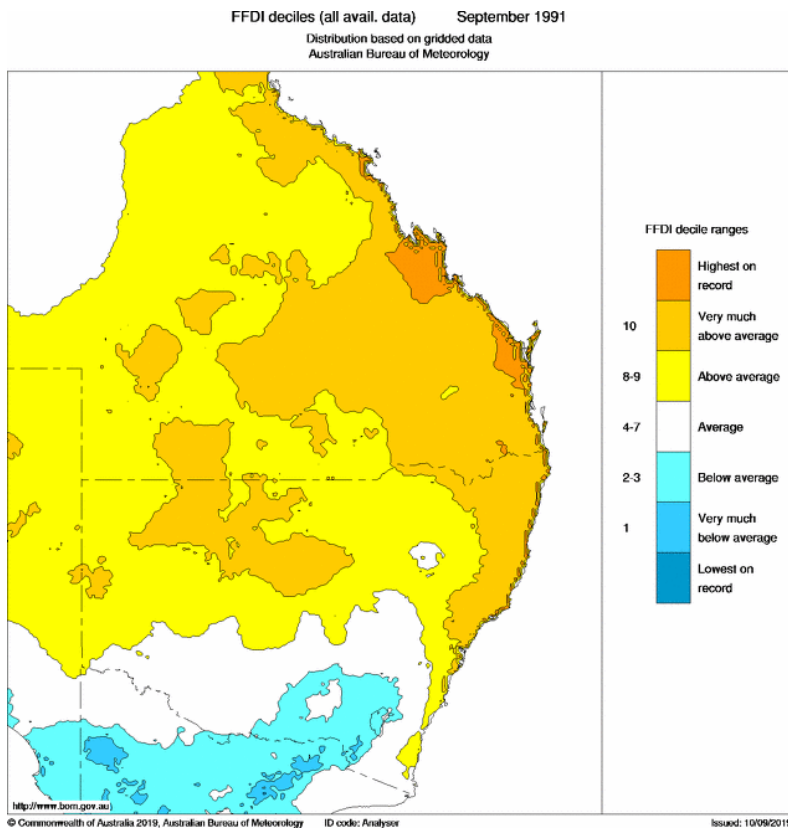


Figure 24: Accumulated FFDI deciles for September 1991 (based on all years since 1950).

Spring 1994

There were numerous fires in southeast Queensland during the final week of September 1994, with property losses near Toowoomba and in the Gold Coast hinterland. Further fires in early November caused some property loss and extensive damage to commercial forests around Beerburrum.

April to September 1994 was extremely dry through southeast Queensland and in eastern Australia more generally, with rainfall for the period at or near record-low levels in many inland regions. October rainfall was generally close to average. The worst fire weather days in late September and in early November also saw strong winds; in particular, the strong winds in early November were associated with an intense low pressure system near Tasmania that also caused widespread wind damage in southeast Australia.

In coastal areas, 27 September 1994 had the highest regionally averaged September daily FFDI for the North Coast district of New South Wales and Moreton district of Queensland since at least 1950.

October 2002

In late October 2002, fires in southeast Queensland burnt 40 000 ha, with one reported death, and 10 houses, 11 buildings, and 30 structures destroyed or damaged in the Stanthorpe district, Toowoomba Range and Tara. This is the fire event that is most directly comparable with the 2019 event in the Southern Downs Region.

2002 was a consistently dry year, with many areas of southern Queensland having January to September rainfall 40 to 60% below average. The weeks leading up to the fires were especially dry in the Southern Downs, with less than 20 mm falling at most locations between 1 September and 27 October. Temperatures were also well above average, particularly on the 19th and 26th, when it reached 33.0 °C at Applethorpe¹¹, an October record, which was subsequently broken in 2014.

September 2017

The earliest in the season that extreme category FFDI values (FFDI > 75) have been recorded in northern New South Wales was 3 September 2017. The highest values on the day were in the Central Western Plains district, with extreme FFDI values at Coonamble and Trangie.

Prior to September 2019, the highest FFDI values on record in southern Queensland west of the ranges were on 23 September 2017, with FFDI values on the day reaching the catastrophic category (FFDI > 100) at numerous sites in southwest Queensland, including Thargomindah, and western New South Wales, including Cobar, Coonamble, and Broken Hill.

September 2018

Prior to September 2019, the most recent occurrence of an FFDI value in the extreme category (FFDI > 75) in September in northern New South Wales was at Walgett on 15 September 2018. The day also had extreme category FFDI values at places such as Wollongong and Bega in the Illawarra and South Coast districts of New South Wales.

¹¹ There were no temperature observations at Stanthorpe in October 2002.

Tables

Table 1: January–August 2019 rainfall totals at selected locations in southeast Queensland and the New South Wales Northern Tablelands district.

Site number(s)	Location	Jan – Aug 2019 total (mm)	% below average	Rank (if in lowest 10)	Existing record (mm)
Northern Tablelands					
56002/56037	Armidale	193.0	–60	1	207.3 (1874)
56011/56243	Glen Innes	238.8	–57	1	243.6 (1922)
56032	Tenterfield	138.6	–77	1	190.4 (1888)
Southern Downs/Granite Belt					
41095	Stanthorpe	136.7	–77	1	180.0 (1902)
41111/41525	Warwick	156.6	–65	1	168.0 (1902)
41103/41529	Toowoomba	281.4	–56	6	167.9 (1902)
Scenic Rim region					
40094	Harrisville	185.6	–67	3	115.7 (1902)
40490	Carneys Creek	239.6	–66	1	334.0 (2005)
Gold Coast hinterland					
40197	Mt Tamborine	581.6	–53	8	438.4 (1932)
40534	Wunburra	529.1	–56	2	329.9 (1986)
40607	Springbrook Road	883.9	–47	3	559.6 (1986)
Gold Coast					
40490	Miami	559.6	–48	4	421.0 (1986)

Table 2: Sites that had a maximum wind gust > 80 km/h on 6 September 2019.

Station number	Station name	State	Max wind gust (km/h)	Point direction of max wind gust
68242	Kiama (Bombo Headland)	NSW	115	WSW
61392	Murrurundi Gap AWS	NSW	111	NW
68228	Bellambi AWS	NSW	111	WNW
68253	Port Kembla NTC AWS	NSW	109	W
69017	Montague Island Lighthouse	NSW	107	W
68241	Albion Park (Wollongong Airport)	NSW	106	W
66037	Sydney Airport AMO	NSW	102	WSW
66196	Sydney Harbour (Wedding Cake West)	NSW	100	WSW
67113	Penrith Lakes AWS	NSW	100	NW
67108	Badgerys Creek AWS	NSW	96	NNW
61363	Scone Airport AWS	NSW	94	W
61425	Gosford AWS	NSW	94	W
66043	Kurnell AWS	NSW	94	W
67105	Richmond RAAF	NSW	93	WNW
61055	Newcastle Nobbys Signal Station AWS	NSW	91	W
66022	Fort Denison	NSW	91	W
63292	Mount Boyce AWS	NSW	89	WSW
68072	Nowra RAN Air Station AWS	NSW	89	WNW
61078	Williamtown RAAF	NSW	87	WNW
61250	Paterson (Tocal AWS)	NSW	87	WNW
61430	Singleton Defence AWS	NSW	87	NW
71032	Thredbo AWS	NSW	87	NW
54038	Narrabri Airport AWS	NSW	85	NW
66137	Bankstown Airport AWS	NSW	85	WSW
66161	Holsworthy Aerodrome AWS	NSW	85	WSW
66208	Wattamolla AWS	NSW	85	W
41359	Oakey Aero	QLD	83	WNW
47048	Broken Hill Airport AWS	NSW	83	WSW
53115	Moree Aero	NSW	83	WSW
56238	Armidale Airport AWS	NSW	83	NW
68192	Camden Airport AWS	NSW	83	NNW
68239	Moss Vale AWS	NSW	83	NNW
51161	Coonamble Airport AWS	NSW	81	WNW
56243	Glen Innes Airport AWS	NSW	81	WNW
66194	Canterbury Racecourse AWS	NSW	81	WSW
75019	Hay Airport AWS	NSW	81	WNW

Table 3: Sites with more than 30 years of data that set new or equalled early season records for maximum temperature on 6 September 2019.

Station number	Station name	State	Years of data	New early season record (°C)	Previous highest temperature this early (°C)	Date of previous highest temperature	Earliest higher temperature (°C)	Date of higher temperature
39123	Gladstone Radar	QLD	61	33.0	31.6	2009-08-30	33.8	2013-09-11
39128	Bundaberg Aero	QLD	41	32.4	31.1	2009-08-30	32.4	2003-09-12
40004	Amberley AMO	QLD	78	36.4	36.4	2009-08-24	39.2	1943-09-22
40068	Double Island Point Lighthouse	QLD	59	30.9	28.2	2009-08-24	31.4	2003-09-12
55049	Quirindi Post Office	NSW	54	31.2	29.3	1982-09-02	31.4	2017-09-13
56229	Guyra Hospital	NSW	38	25.4	25.2	2009-08-24	25.4	2017-09-23
60085	Yarras (Mount Seaview)	NSW	50	34.1	34.1	2009-08-24	35.3	2003-09-22
61051	Murrurundi (Haydon Street)	NSW	53	30.4	27.3	1995-08-22	30.4	2017-09-13
61078	Williamtown RAAF	NSW	69	31.2	30.5	2012-08-23	31.7	1980-09-08
61250	Paterson (Tocal AWS)	NSW	49	32.3	30.7	2017-09-03	32.4	1980-09-08
64009	Dunedoo Post Office	NSW	54	31.2	29.5	1982-09-02	32.3	2003-09-22

Table 4: Sites that recorded a maximum FFDI ≥ 75 (extreme category) on 6 September 2019.

Station number	Station name	District	State	Maximum FFDI
40004	Amberley AMO	Moreton	QLD	86
40082	University of Queensland Gatton	Moreton	QLD	78
40211	Archerfield Airport	Moreton	QLD	81
40842	Brisbane Aero	Moreton	QLD	78
41359	Oakey Aero	Darling Downs	QLD	87
41522	Dalby Airport	Darling Downs	QLD	91
43091	Roma Airport	Maranoa	QLD	75
43109	St George Airport	Maranoa	QLD	84
44021	Charleville Aero	Warrego	QLD	77
51161	Coonamble Airport AWS	Central Western Plains	NSW	104
52088	Walgett Airport AWS	Northwest Plains	NSW	106
53115	Moree Aero	Northwest Plains	NSW	109
54038	Narrabri Airport AWS	Northwest Slopes	NSW	111
55202	Gunnedah Airport AWS	Northwest Slopes	NSW	99
55325	Tamworth Airport AWS	Northwest Slopes	NSW	127
56238	Armidale Airport AWS	Northern Tablelands	NSW	75
60141	Taree Airport AWS	Manning	NSW	76
61287	Merriwa (Roscommon)	Hunter	NSW	92
61363	Scone Airport AWS	Hunter	NSW	95
61392	Murrurundi Gap AWS	Hunter	NSW	174
62101	Mudgee Airport AWS	Central Tablelands	NSW	90
64017	Coonabarabran Airport AWS	Central Western Slopes	NSW	87
67105	Richmond RAAF	Metropolitan	NSW	109
67108	Badgerys Creek AWS	Metropolitan	NSW	90
67113	Penrith Lakes AWS	Metropolitan	NSW	89
68192	Camden Airport AWS	Metropolitan	NSW	92

References and further information

National gridded rainfall analyses are for the period since 1900 and national gridded temperature analyses are for the period since 1910. Gridded FFDI analyses are for the period since 1950.

This Statement in general covers information available as of 12 September 2019.

Links to further information

Australia's changing climate:

[State of the Climate 2018](#)

Climate information:

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

Australian Landscape Water Balance:

<http://www.bom.gov.au/water/landscape>

References

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