

## A warm autumn with bursts of heavy rainfall

<b>Temperature</b>	Autumn 2021 was the 10 <sup>th</sup> -warmest autumn in 112 years of records. Temperatures were above average (+0.51°C to +1.20°C of average) for most of Aotearoa New Zealand. Pockets of well above average temperatures (>1.20°C above average) were recorded in eastern Canterbury. Near average ( $\pm 0.50^\circ\text{C}$ of average) temperatures were recorded in most of Northland, parts of Auckland, parts of Waikato, parts of Bay of Plenty, most of Marlborough and Tasman, and scattered portions of Southland, Otago and West Coast. No areas experienced below average temperatures.
<b>Rainfall</b>	Autumn rainfall was below normal (50-79% of normal) across Northland, Auckland, parts of Waikato, parts of Manawatū-Whanganui, Gisborne, Hawke's Bay, Wairarapa, eastern Southland and most of Otago. Above normal rainfall (120-149% of normal) was observed in parts of Taranaki, northern Tasman, Nelson, northern Marlborough, and parts of eastern Canterbury. Pockets of well above normal rainfall (>149% of normal) was observed around Ashburton. Most of the total autumn rainfall that was recorded in the Canterbury region fell in the last two-to-three days of the season. Near normal rainfall (80-119% of normal) was observed elsewhere.
<b>Soil moisture</b>	At the end of autumn, soil moisture levels were drier than normal for northern Northland, Auckland, parts of Waikato, southern Hawke's Bay, the Tararua district, the Wairarapa, much of the Otago and southern parts of the Canterbury. Soil moisture levels were wetter than normal spanning from the Nelson/Marlborough region through to much of eastern Canterbury.

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### Overview

Autumn 2021 was characterised by long dry spells and warmth, interspaced by bursts of heavy rainfall. This was because La Niña began its transition to ENSO-neutral in March and the dominant climate driver became the Madden-Julian Oscillation (an eastward moving “pulse” of cloud and rain in the tropics). The MJO lingered over the western Indian Ocean, leading to higher than normal pressures over Aotearoa New Zealand. As a result, much of Aotearoa experienced warm days, but chilly overnight temperatures. However, on the occasions when the MJO quickly pulsed across the Pacific, this led to several notable rain and storm outbreaks, including the Canterbury flood event at the end of May.

The nationwide average temperature for autumn 2021 was 14.0°C (0.7°C above the 1981-2010 average from NIWA's seven station temperature series which begins in 1909), making it the 10<sup>th</sup>-warmest autumn on record. No areas of New Zealand experienced below average temperatures during autumn. Autumn 2021 temperatures were above average (+0.51°C to +1.20°C of average) for

most of New Zealand. Pockets of well above average ( $>1.20^{\circ}\text{C}$  above average) were recorded in eastern Canterbury while near average ( $\pm 0.50^{\circ}\text{C}$  of average) temperatures were recorded in most of Northland, parts of Auckland, Waikato and Bay of Plenty, most of Marlborough and Tasman, and scattered portions of Southland, Otago and West Coast. Although there were some cool spells, summer-like heat lingered well into autumn. Notably, parts of Canterbury and Hawke's Bay observed several days of temperatures above  $30^{\circ}\text{C}$  during March, and notably a  $30.8^{\circ}\text{C}$  day in Timaru on 4 April. This warmth was still felt well into May, where 29 locations observed record or near-record high daily maximum May temperatures during the month.

Autumn rainfall was below normal (50-79% of normal) across parts of Waikato as well as most northern and eastern North Island locations, including Northland, Auckland, parts of Manawatū-Whanganui, Gisborne, Hawke's Bay, and the Wairarapa. In the South Island, below normal rainfall was also observed in eastern Southland and most of the Otago region. Above normal autumn rainfall (120-149% of normal) was observed in parts of Taranaki, northern Tasman, Nelson, northern Marlborough, and parts of eastern Canterbury. Pockets of well above normal rainfall ( $>149\%$  of normal) was observed in eastern Canterbury. Near normal (80-119% of normal) was observed elsewhere. For most of the season, there was a clear east-west divide of rainfall, with fronts bringing rain to western areas but eastern areas missing out. However, bursts of sub-tropical and tropical moisture transported over New Zealand ahead of low pressure systems led to significant rainfall in some areas. Of most note was the Canterbury rainfall event which occurred in the final three days of autumn. Prior to this event, it had been a very dry season, with most of the region tracking towards less than half of its normal rainfall for autumn.

**Further highlights for autumn 2021:**

- The highest temperature was  $31.9^{\circ}\text{C}$ , observed at Waiau on 14 March.
- The lowest temperature was  $-10.8^{\circ}\text{C}$ , observed at Tara Hills on 27 May
- The highest 1-day rainfall was 209 mm, recorded at Milford Sound on 8 May.
- The highest wind gust was 178 km/h, observed at South West Cape on 4 April.
- Of the six main centres Auckland was the warmest, Dunedin was the coolest and driest, Hamilton was the wettest, Christchurch was the sunniest, and Hamilton was the least sunny.

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## Temperature: Widespread warmth and pulses of extreme heat

The nationwide average temperature for autumn 2021 was 14.0°C (0.7°C above the 1981-2010 average from NIWA's seven station temperature series which begins in 1909), making it the 10<sup>th</sup>-warmest autumn on record.

Twenty-two locations ranked within their top-four warmest mean maximum (i.e. daytime) autumn temperature records, while ten locations ranked within their top-four warmest autumn mean temperature records.

There were several days throughout autumn during which pulses of warm air resulted in temperatures in excess of 30°C. See the *Highlights and extreme events* section below for more details.

### Record<sup>1</sup> or near-record mean air temperatures for autumn were recorded at:

Location	Mean air temp. (°C)	Departure from normal (°C)	Year records began	Comments
High records or near-records				
Motueka	14.5	1.6	1956	Highest
Wairoa	16.3	1.6	1964	2nd-highest
Kaikōura	14.5	1.4	1963	2nd-highest
Medbury	12.9	1.1	1927	2nd-highest
Cheviot	13.4	1.6	1982	2nd-highest
Rangiora	13.0	1.2	1965	3rd-highest
Akaroa	14.8	1.8	1978	3rd-highest
Le Bons Bay	13.4	1.2	1984	3rd-highest
Campbell Island	8.2	0.7	1991	3rd-highest
Dunedin ( <a href="#">Musselburgh</a> )	12.8	1.3	1947	4th-highest
Low records or near-records				
None observed				

### Record or near-record mean maximum air temperatures for autumn were recorded at:

Location	Mean maximum air temp. (°C)	Departure from normal (°C)	Year records began	Comments
High records or near-records				
Cheviot	20.8	2.7	1982	Highest
Rangiora	20.1	2.6	1965	Highest
Wairoa	22.0	2.3	1964	Highest
Medbury	20.1	2.0	1927	Highest

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<sup>1</sup> The rankings (1st, 2nd, 3rd etc.) in all Tables in this summary are relative to climate data from a group of nearby stations, some of which may no longer be operating. The current climate value is compared against all values from any member of the group, without any regard for homogeneity between one station's record, and another. This approach is used due to the practical limitations of performing homogeneity checks in real-time.

Campbell Island	10.3	0.7	1991	Highest
Hanmer Forest	20.1	2.5	1906	2nd-highest
Waiau	20.2	2.0	1974	2nd-highest
Kaikoura	18.3	1.9	1963	2nd-highest
Akaroa	19.9	1.9	1978	2nd-highest
Waipawa	20.5	1.8	1945	2nd-highest
Christchurch	19.2	1.8	1863	2nd-highest
Timaru	18.1	1.4	1885	2nd-highest
Porirua	18.6	0.9	1968	2nd-highest
Ohakune	17.7	2.0	1962	3rd-highest
Dunedin (Musselburgh)	17.0	1.9	1947	3rd-highest
Waipara West	20.2	1.6	1973	3rd-highest
Motueka	20.2	1.5	1956	3rd-highest
Middlemarch	18.0	1.5	2000	3rd-highest
Whangarei	22.0	1.3	1967	3rd-highest
Le Bons Bay	16.6	1.2	1984	3rd-highest
Whitianga	21.6	1.5	1962	4th-highest
Ngawi	19.1	1.0	1972	4th-highest
Low records or near-records				
None observed				

#### Record or near-record mean minimum air temperatures for autumn were recorded at:

Location	Mean minimum air temp. (°C)	Departure from normal (°C)	Year records began	Comments
High records or near-records				
Le Bons Bay	10.2	1.1	1984	2nd-highest
Low records or near-records				
Middlemarch	2.6	-0.9	2000	4th-lowest

### Rainfall: Extended periods of dryness and bursts of heavy rain

There were periods of extended dry spells for many parts of New Zealand, as well as significant rainfall events. The last three days of autumn saw widespread rainfall totals of at least 100 mm in the Canterbury region, leading to some areas receiving 2-3 times their May normal within a 72-hour period. See the *Highlights and extreme events* section below for more details.

**Record or near-record autumn rainfall totals were recorded at:**

Location	Rainfall total (mm)	Percentage of normal	Year records began	Comments
<b>High records or near-records</b>				
None observed				
<b>Low records or near-records</b>				
Auckland (Western Springs)	166	57	1948	Lowest
Tara Hills	72	57	1949	2nd-lowest
Tiwai Point	194	63	1970	3rd-lowest
Auckland (Airport)	182	67	1959	4th-lowest

## Autumn in the six main centres

Mean autumn temperatures were above average in all main centres except Hamilton, where the mean temperature was near average. Auckland, Tauranga and Dunedin all experienced below normal rainfall, while near normal rainfall was observed at Hamilton and Wellington. Christchurch was the only centre to have above normal rainfall, but this was largely due to the extreme rain during the last three days of autumn. Of the six main centres in autumn 2021, Auckland was the warmest, Dunedin was the coolest and driest, Hamilton was the wettest, Christchurch was the sunniest, and Hamilton was the least sunny.

### Autumn 2021 main centre climate statistics:

Temperature			
Location	Mean temp. (°C)	Departure from normal (°C)	Comments
Auckland <sup>a</sup>	16.9	+0.6	Above average
Tauranga <sup>b</sup>	16.5	+0.8	Above average
Hamilton <sup>c</sup>	14.7	+0.4	Near average
Wellington <sup>d</sup>	14.3	+0.6	Above average
Christchurch <sup>e</sup>	12.9	+0.9	Above average
Dunedin <sup>f</sup>	12.8	+1.3	Well above average
Rainfall			
Location	Rainfall (mm)	% of normal	Comments
Auckland <sup>a</sup>	185	66	Below normal
Tauranga <sup>b</sup>	193	59	Below normal
Hamilton <sup>c</sup>	306	110	Near normal
Wellington <sup>d</sup>	273	97	Near normal
Christchurch <sup>e</sup>	208	141	Above normal
Dunedin <sup>f</sup>	83	46	Well below normal
Sunshine			
Location <sup>2</sup>	Sunshine (hours)		
Auckland <sup>a</sup>	518		
Tauranga <sup>b</sup>	545		
Hamilton <sup>g</sup>	472		
Wellington <sup>d</sup>	582		
Christchurch <sup>e</sup>	594		
Dunedin <sup>f</sup>	498		

<sup>a</sup> Māngere <sup>b</sup> Tauranga Airport <sup>c</sup> Hamilton Airport <sup>d</sup> Kelburn <sup>e</sup> Christchurch Airport <sup>f</sup> Musselburgh <sup>g</sup> Ruakura

<sup>2</sup> Tauranga, Wellington and Christchurch record sunshine use Campbell-Stokes manual sunshine recorders, whereas Auckland, Hamilton and Dunedin record sunshine with high-precision electronic sensors.

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## Highlights and extreme events

This section contains information pertaining to some of the more significant highlights and extreme events that occurred during autumn 2021. Note that a more detailed list of significant weather events for autumn 2021 can be found in the *Highlights and extreme events* section of NIWA's monthly Climate Summaries. These monthly summaries are available online, and may be viewed at the following website: <https://niwa.co.nz/climate/monthly>

### Temperatures

The highest temperature during autumn 2021 was 31.9°C, observed at Waiau on 14 March.

The lowest temperature during autumn 2021 was -10.8°C, observed at Tara Hills on 27 May.

During autumn, several spells of intense heat affect eastern areas of the North and South Island. This included:

- 2 March: Hastings and Napier both recorded temperatures over 30°C and their hottest March day in 5 years.
- 4-5 April: numerous record and near-record temperatures occurred in the South Island, including a maximum temperature of 30.8°C in Timaru on 4 April, New Zealand's 4th-highest April temperature on record, and 30.7°C in Bromley (Christchurch) on 5 April, New Zealand's equal-5<sup>th</sup> highest April temperature on record.
- 9-11 May: exceptionally high daily maximum and minimum temperatures, including 28.3°C in Rangiora on 11 May, New Zealand's 3rd-highest May temperature on record.

On 26 and 27 May, severe frosts were observed in many South Island areas. Most notable was Tara Hills (Omarama), which recorded -10.8°C on 27 May. Dunedin Airport's maximum temperature on 27 May was just 3.2°C, which was that location's lowest daily maximum air temperature for May on record.

### Record or near-record daily maximum air temperatures for autumn were recorded at:

Location	Extreme maximum (°C)	Date of extreme temperature	Year records began	Comments
High records or near-records				
Le Bons Bay	29.0	Apr-5th	1984	Highest
Campbell Island	18.8	Mar-1st	1991	Highest
Waiau	31.9	Mar-14 <sup>th</sup>	1974	3rd-highest
Low records or near-records				
Dunedin (Airport)	3.2	May-27th	1972	Lowest

### Record or near-record daily minimum air temperatures for autumn were recorded at:

Location	Extreme minimum (°C)	Date of extreme temperature	Year records began	Comments
Low records or near-records				
Tara Hills	-10.8	May-27th	1949	Lowest
Middlemarch	-10.1	May-27th	2000	Lowest
Timaru	-7.8	May-26th	1885	Lowest
Dunedin (Airport)	-8.8	May-27th	1962	Equal lowest

Rangiora	-5.2	May-27th	1965	2nd-lowest
Clyde	-7.8	May-27th	1978	3rd-lowest
Appleby	-3.9	May-26th	1932	3rd-lowest
Ranfurlly	-9.3	May-26th	1897	Equal 3rd-lowest
Puysegur Point	2.7	May-25 <sup>th</sup>	1978	4th-lowest
<b>High records or near-records</b>				
Clyde	19.1	Apr-5th	1978	Highest
Alexandra	18.6	Apr-5th	1930	Highest
Campbell Island	12.8	Mar-2nd	1991	Highest
Middlemarch	18.4	Apr-5th	2000	2nd-highest
Akaroa	19.5	Apr-5th	1978	3rd-highest
Cheviot	18.0	Apr-5th	1982	3rd-highest
Motu	16.4	Apr-12 <sup>th</sup>	1990	3rd-highest
Le Bons Bay	17.5	Apr-5th	1984	4th-highest
Palmerston	15.7	Mar-2nd	1972	4th-highest
Windsor	15.2	Mar-2nd	2000	4th-highest

### Rain and slips

The highest 1-day rainfall was 209 mm, recorded at Milford Sound on 8 May.

On 28 April, the government added the Mid Canterbury, South Canterbury, and Otago areas to a large-scale adverse event classification for drought, while support for the large-scale adverse event classification for drought was extended for Marlborough, North Canterbury, and the Chatham Islands. This was due to an extended period of dryness for these areas.

From 29-31 May, a prolonged and heavy rainfall event struck Canterbury. A state of emergency was declared across the region, with severe flooding occurring in many areas east of the eastern foothills. The government declared a medium-scale adverse event, unlocking funding for recovery measures. Damage caused by flooding was widespread, with numerous roads closed, bridges damaged and impassable, and farms suffering considerable impacts to infrastructure and stock. Hundreds of residents from several settlements were forced to evacuate, including the entire town of Springfield. There were several reports of people getting caught by the floodwaters and requiring rescue, including people becoming trapped after driving into floodwaters, and two individuals who were rescued from trees after being swept away in the floods.

### Record or near record autumn extreme 1-day rainfall totals were recorded at:

Location	Extreme 1-day rainfall (mm)	Date of extreme rainfall	Year records began	Comments
Opouriao	159	Apr-20th	1962	Highest
Waipara West	75	May-29th	1973	2nd-highest
Lake Tekapo	107	May-29th	1925	3rd-highest

### Wind

The highest wind gust was 178 km/h, observed at South West Cape 4 April.



On 4 April, strong northwesterly winds caused damage and power outages in parts of the lower North Island and South Island.

From 23-24 May, a low pressure system east of the North Island generated strong winds and large swells, generating extensive coastal erosion around Northland and parts of the Bay of Plenty.

**Record or near record autumn extreme wind gusts were recorded at:**

Location	Extreme wind gust (km/h)	Date of extreme gust	Year records began	Comments
Mt Cook (Airport)	145	Apr-5th	2000	Highest
South West Cape	178	Apr-4th	1991	Equal highest
Diamond Harbour	102	May-30th	1980	Equal highest
Secretary Island	148	Mar-5th	1994	2nd-highest
Gore	117	Apr-4th	1987	2nd-highest
Puysegur Point	154	Apr-4th	1986	Equal 3rd-highest
Mt Ruapehu (Chateau)	107	May-24th	2000	4th-highest
Dannevirke	89	May-18th	1961	4th-highest
Tara Hills	83	Apr-4th	1985	4th-highest
Oamaru	87	Apr-4th	1984	Equal 4th-highest

**Snow and ice**

On 18 May, snow fell to low elevations over much of the South Island, particularly in Southland. This resulted in road closures.

Canterbury's heavy rainfall event from 29-31 May also resulted in significant snowfalls at high elevations. *Mount Hutt* ski area reported snow depths of 4 metres at the summit of their ski area along the wind fence (~2,080 metres above sea level), tapering to just 5 cm at the bottom of their triple chair (~1,440 metres above sea level).

**Lightning and hail**

Several periods of thunderstorm activity affected the North Island during March. Along with heavy rainfall rates, marble-sized hail was reported around Waitomo caves on 11 March with a severe thunderstorm. During 27 – 31 March, isolated daily thunderstorms erupted in parts of the North Island, with over 2500 lightning strikes recorded over or near land during this period. And power outages in Rotorua attributed to these thunderstorms.

**Cloud and fog**

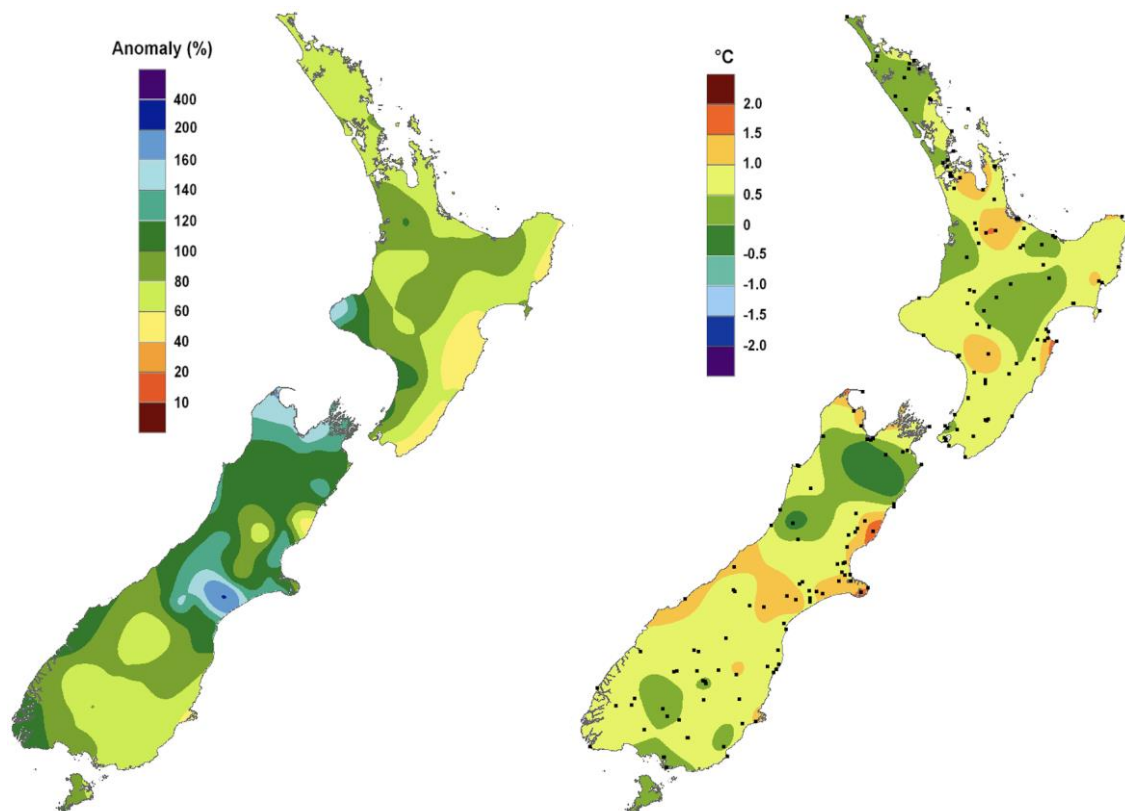
Heavy fog was attributed to a six-vehicle pile-up on the Hawke's Bay Expressway during the morning of 15 March.

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### Autumn rainfall

Expressed as a percentage of the 1981-2010 normal. Note, at the time of writing we have identified missing data from a climate station at Cheviot. This has resulted in an inaccurate illustration of autumn rainfall for an area of coastal north Canterbury. An updated map was not ready in time for publication of this summary.

### Autumn temperature

Expressed as a departure from the 1981-2010 average in degrees Celsius.

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

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