Aotearoa New Zealand Climate Summary: **February 2023** Issued: 3 March 2023

Gabrielle has a historic impact in the north, warm in the south

Rainfall	February rainfall was nothing short of exceptional in the North Island. Above normal (120-149% of normal) or well above normal (>149% of normal) rainfall was observed across most of the North Island, eastern Marlborough, northern and middle Canterbury, and parts of the central and lower West Coast, and inland Otago. Parts of southern Northland, Auckland, Gisborne, Hawke's Bay, and coastal Wairarapa received at least 400% of the normal February rainfall. Rainfall was below normal (50-79% of normal) along parts of the northern West Coast, inland Canterbury, and coastal Otago, with an area of well below normal rainfall (<50% of normal) in Fiordland.
Temperature	Temperatures were above average (0.51-1.20°C above average) or well above average (>1.20°C above average) across the majority of the South Island and the western and lower North Island. For the Mackenzie Basin, North Canterbury, and the northern and eastern North Island, temperatures were generally near average (±0.50°C of average).
Soil Moisture	At the end of February, soil moisture levels were well above normal across most of the North Island and in parts of Marlborough and Canterbury for the time of year. Soil moisture levels in the northern West Coast, western Tasman, the Mackenzie Basin, and Southland were below normal. Near normal soil moisture was found elsewhere.

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Overview

February 2023 will go into the record books as a month during which Aotearoa New Zealand experienced one of its worst weather disasters in modern history, by way of an ex-tropical cyclone.

On 13-14 February, Cyclone Gabrielle (Figure 3) passed just offshore of the northern North Island, exposing much of the island to extreme rainfall and river flooding not seen in many years, catastrophic wind damage, and substantial storm surge. Unfortunately, this culminated in widespread destruction to agricultural and horticultural lands, dozens of impassable roads, severe coastal erosion, the country's third-ever national state of emergency declaration, and loss-of-life. The most significant damage occurred in Northland, Auckland, the Coromandel Peninsula, Gisborne, Hawke's Bay, and east-coastal Manawatū-Whanganui. The recovery from this storm is expected to take years and be very costly, particularly along the North Island's east coast.

Among other storms, Cyclone Gabrielle will be remembered alongside Cyclone Bola (1988), Gisele (1968), and the "Cyclone of 1936" for its historically significant impact. The available meteorological data supports this comparison. In addition to the numerous rainfall records and near-records contained within this summary, 14 February, the day on which Gabrielle was closest to New Zealand, was the North Island's second lowest "pressure day[1]" on record (using all available climate station data since 1960). At 4:00 a.m. on 14 February, NIWA's climate station at Whitianga reported a minimum mean sea level pressure of 968 hPa (Figure 4), which, since at least 1960, was surpassed only by pressure observations during the 26 July 2008 storm in the North Island. This low air pressure reading helps contextualise the strength of the cyclone, which reintensified as it approached the northern North Island. As with Gabrielle, reintensification can happen when former tropical cyclones interact with the mid-latitude jet stream and/or other atmospheric disturbances, leading to a widening of the zone of impact.

As a point of comparison, Bola had a minimum central pressure around 980 hPa[2], Gisele 964 hPa[3], and "Cyclone of 1936" 970 hPa[4] based on available records. While Bola wasn't as intense as Gabrielle from a pressure perspective, it came with an impact that was drawn out over several days whereby the storm's southward progression was blocked by a ridge of high pressure. The worst of Gabrielle's rain, wind, and surge was confined to a 24-hour window for most regions. Figure 5 (in *Highlights and extreme events* section) shows the air pressure patterns that were associated with Gabrielle, Bola, and Gisele in the Southwest Pacific. Based on this analysis, guided by ECMWF ERA5, Gabrielle was one of the most intense storms to pass near New Zealand's coastlines since at least 1950[5].

Gabrielle occurred amidst a unique set of climate drivers – specifically, a "triple dip" (third consecutive) La Niña, which, although its strength was waning, continued to have a meaningful influence on New Zealand's weather patterns. Notably, seasonal sea surface temperature (SST) anomalies in the Coral Sea, where Gabrielle formed, were 0.5˚C to 1.5˚C above average. Sub-surface waters were unusually warm by a similar magnitude. This abnormally warm water sat along the periphery of La Niña's "West Pacific Warm Pool" and was fuel for Gabrielle's development. In the atmosphere, a pulse of the Madden-Julian Oscillation, or area of cloud and thunderstorm activity that circumnavigates the globe every 30-60 days, was active over the warm waters of the west-central Pacific during the first half of February. This contributed to more favourable environmental conditions for tropical cyclone development in the Southwest Pacific.

Monthly mean sea level pressure, as shown in Figure 1, was below normal across the country, producing frequently cyclonic air flows from the easterly quarter. This was consistent with the

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[1] The lowest air pressure observed on any given day

[2] From NIWA's New Zealand Historic Weather Events Catalogue

[3] Michael J. Revell & Richard M. Gorman (2003) The "Wahine storm": Evaluation of a numerical forecast of a severe wind and wave event for the New Zealand coast, New Zealand Journal of Marine and Freshwater Research, 37:2, 251-266, DOI: 10.1080/00288330.2003.9517163

[4] Stephens, S.A., Reeve, G., Bell, R.G. (2009) Modelling of the 2 February 1936 Storm tide in Wellington Harbour. NIWA Client Report HAM-2009-014.

[5] Reanalysis combines model data with observations from across the world into a globally complete and consistent dataset using the laws of physics.

widespread heavy rainfall and excess cloud cover that was experienced in the North Island and northern South Island.

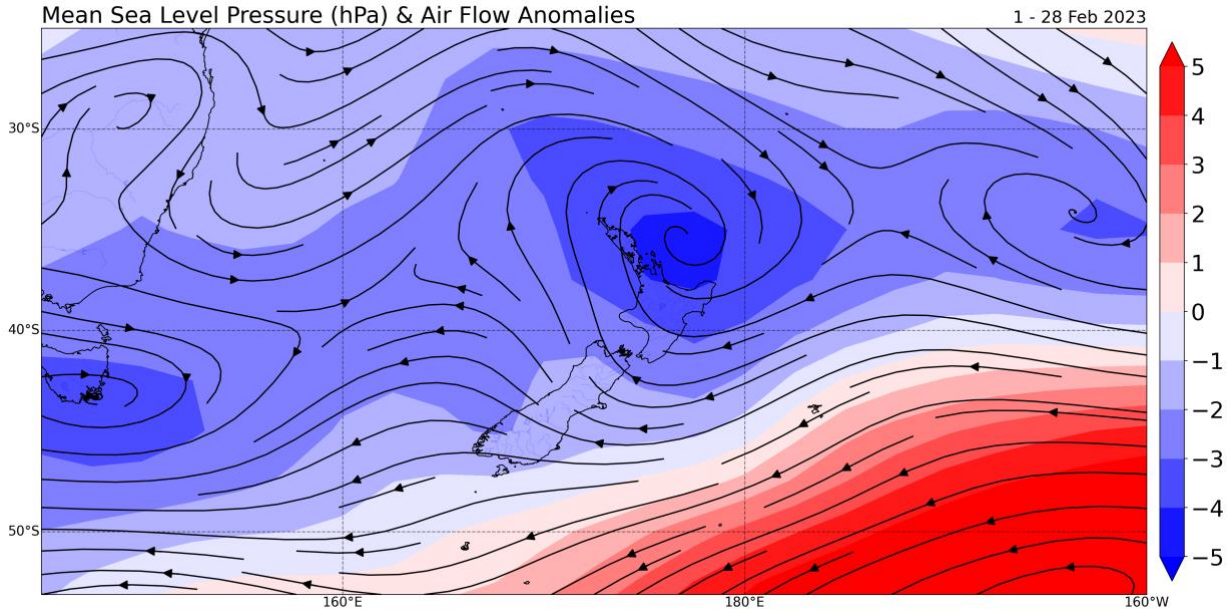

Figure 1: Mean sea level pressure anomalies (shaded) and air flow anomalies during February (data: NCEP).

A marine heatwave persisted near the South Island during February (Figure 1). Monthly SSTs were record breaking (since at least 1982) in the west of the South Island, with a regional anomaly of +2.9˚C. SSTs around the North Island were above average, ranging from +0.4˚C in the east to 1.2˚C in the west.

NIWA scientists are contributing to an attribution study on the influence that climate change had on Gabrielle. More details will likely become available in the next month or two.

The highlights and extreme events section details Gabrielle's journey from a severe tropical cyclone in the Coral Sea to an ex-tropical cyclone that passed near New Zealand's coast.

NZ 30-day coastal SST anomalies (to 28 February 2023)

North NI	+0.49˚C
West NI	+1.15˚C
East NI	+0.36˚C
North SI	+1.65˚C
West SI	+2.88˚C
East SI	+2.20˚C

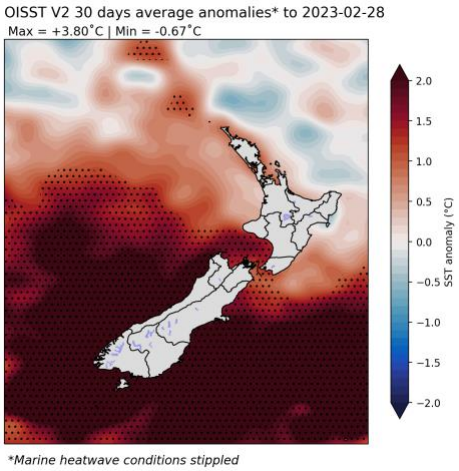

Figure 2: 30-day SST anomalies and marine heatwave conditions (stippled), calculated with respect to the 1991-2020 climatological period.

Although Cyclone Gabrielle was the weather focal point of the month, Aucklanders awakened to another round of flooding on 1 February, just days after the record floods of late-January.

Meanwhile, parts of the South Island saw dryness intensify, in direct contrast to the sodden north. During mid-February, meteorological drought developed in south-east Otago according to NIWA's New Zealand Drought Index. At the time, parts of Tasman, the West Coast, the rest of Otago, Southland, Rakiura Stewart Island, South Canterbury, Banks Peninsula, and inland Marlborough were all experiencing moderately to extremely dry conditions. Although a cold front brought heavy rain to these regions on 21-22 February, more rain was needed to fully alleviate the dryness and drought.

Adding insult to injury, the month finished with yet another round of flooding in the northern and eastern North Island. In southern Northland and northern Auckland on 24 February, a stalled front contributed to an environment that was conducive to slow-moving downpours and thunderstorms. Then, on 28 February, a sub-tropical low caused further flooding in Gisborne and Hawke's Bay.

Similar to January, rainfall extremes were in abundance during February 2023. There were several events that delivered more than a typical month's worth of rain to multiple regions. Parts of southern Northland, Auckland, Gisborne, Hawke's Bay, coastal Wairarapa, and parts of Canterbury all received at least 400% of the normal February rainfall.

Rainfall was below normal (50-79% of normal) along parts of the northern West Coast, inland Canterbury, and coastal Otago, with an area of well below normal rainfall (<50% of normal) in Fiordland.

Temperatures were above average (0.51-1.20°C above average) or well above average (>1.20°C above average) across the majority of the South Island and the western and lower North Island. The nationwide average temperature in February 2023 was 18.5°C. This was 1.1°C above the 1991-2020 February average from NIWA's seven station temperature series which begins in 1909, and New Zealand's 10th-warmest February on record.

Further Highlights[6]:

- The highest temperature was 35.6°C, observed at Middlemarch on 4 February.
- The lowest temperature was -0.4°C, observed at Manapouri (Airport) on 24 February.
- The highest 1-day rainfall was 316 mm, recorded at Tūtira (Hawke's Bay) on 13 February.
- The highest wind gust was 150 km/h, observed at Mokohinau on 12 February.
- Of the six main centres in February 2023, Auckland was the warmest, Tauranga was the wettest, Wellington was the least sunny, and Dunedin was the coolest, driest and sunniest.
- Of the available, regularly reporting sunshine observation sites, the sunniest four locations so far in 2023 are Central Otago (562.6 hours), West Coast (548.6 hours), Mackenzie Basin (545.4 hours), and Queenstown Lakes District (526.7 hours).

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[6] From stations available in NIWA's National Climate Database.

Rainfall: Remarkably wet in the North Island, parts of the eastern South Island

Eighteen North Island locations and six South Island locations observed a record or near-record wet February. Of these, nine locations measured at least four times the February monthly normal.

Hawke's Bay was particularly hard-hit by heavy rainfall, with Napier receiving over six times its February normal. In fact, the rainfall total of 359 mm at Napier is approximately equal to 45% of the annual normal – it was the town's third wettest month overall on record since records began in 1870. Much of this rain fell on 13 February, the town's fifth-wettest day on record.

In Gisborne, the monthly rainfall total of 358 mm was over five times the monthly normal and about 36% of the annual normal.

The monthly rainfall total of 397 mm at Whangārei was nearly five times the monthly normal and about 31% of the annual normal. On 13 February, the 216 mm rain that fell made it Whangārei's fourth-wettest day since records began in 1943.

For Auckland (Western Springs), the February monthly normal rainfall was exceeded on two separate days: 13 and 24 February.

No locations observed near-record or record low rainfall during February.

Record[7,8] or near-record February rainfall totals were recorded at:

Location	Rainfall total (mm)	Percentage of normal	Year records began	Comments
High records or near-records				
Warkworth	311	364	1966	Highest
Auckland (Western Springs)	295	437	1948	Highest
Whitianga	349	312	1961	Highest
Napier	359	664	1870	Highest
Whakatu	257	534	1965	Highest
Waipawa	221	401	1945	Highest
Gisborne	358	526	1905	Highest
Whangārei	397	477	1937	2nd-highest
Leigh	274	381	1966	2nd-highest
Auckland (North Shore)	269	411	1966	2nd-highest
Mt Ruapehu (Chateau)	420	268	2000	2nd-highest
Kaikōura	246	625	1898	2nd-highest
Waiau	139	271	1974	2nd-highest
Akaroa	182	345	1977	2nd-highest
Le Bons Bay	104	292	1984	2nd-highest
Port Taharoa	145	255	1973	3rd-highest

[7] 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.
[8] Comparisons to normals in all Tables in this summary are relative to the 1991-2020 baseline.

Castlepoint	248	404	1902	3rd-highest
Wairoa	315	359	1964	3rd-highest
Waiouru	127	212	1950	3rd-highest
Cheviot	178	337	1982	3rd-highest
Whangaparāoa	203	316	1946	4th-highest
Masterton	159	329	1926	4th-highest
Wellington (Kelburn)	198	356	1928	4th-highest
Hanmer Forest	195	331	1905	4th-highest
Low records or near-records				
None observed				

Temperature: another very warm month in the south; near average north

February temperatures were above or well above average across most of the South Island except for the Mackenzie Basin and parts of North Canterbury.

Temperatures in the West Coast were particularly noteworthy, where a record marine heatwave, frequent easterly winds, drier than normal soils, and abundant sunshine contributed to the warmest February on record for Greymouth, Westport, and Arapito. Greymouth recorded seven days with a daily maximum temperature above 25˚C, the most days above 25˚C during February since at least 1972. As a point of comparison, between 1972-2000, Greymouth only had six total February days during which the temperature exceeded 25˚C[9]. The story was similar in nearby Westport, where six days exceeded 25˚C, the most February days above 25˚C on record since at least 1966.

Farther south in Milford Sound, there were three days on which the temperature exceeded 25˚C, including one day (4 February) when the settlement reached 29.4˚C, its highest temperature since records began in 1934. In the far southwestern corner of Fiordland National Park, Secretary Island reached 28.3˚C on 15 February, its highest temperature on record. This maximum temperature was 1.2˚C warmer than the highest observed at Auckland (Māngere) this summer.

Temperatures were generally near average across the North Island, except for around Wellington and parts of Manawatū-Whanganui. Plenty of cloud, rain, and wetter than usual soils generally prevented daytime temperatures from being above average. This pattern did allow for elevated overnight temperatures, with Upper Hutt experiencing its second highest February mean minimum temperature on record (14.0˚C, which was 2.4˚C above average).

Record or near-record mean air temperatures for February were recorded at:

Location	Mean air temp. (°C)	Departure from normal (°C)	Year records began	Comments
High records or near-records				
Westport	19.9	3.1	1937	Highest
Arapito	19.0	2.3	1978	Highest
Greymouth	19.0	2.7	1947	Highest

[9] Data from February 1985 is unavailable.

Secretary Island	17.8	2.7	1985	Highest
Oban (Stewart Island)	15.8	2.3	1975	Highest
South West Cape	15.7	2.5	1991	Highest
Haast	17.2	2.2	1949	2nd-highest
Waipounamu	16.5	1.9	1980	2nd-highest
Ōkārito	17.6	1.3	1982	3rd-highest
Franz Josef	17.6	2.1	1953	3rd-highest
Milford Sound	17.0	1.8	1934	3rd-highest
Rangiora	18.2	1.7	1965	3rd-highest
Christchurch (Botanic Gardens)	19.0	1.9	1863	3rd-highest
Windsor	16.5	1.5	2000	3rd-highest
Dunedin (Musselburgh)	17.5	2.4	1947	3rd-highest
Oamaru	16.5	2.3	1967	3rd-highest
Tautuku	15.7	1.7	1976	3rd-highest
Akaroa	19.1	1.4	1978	Equal 3rd-highest
Te Anau	16.7	2.3	1963	4th-highest
Manapouri (West Arm Jetty)	16.2	2.0	1971	4th-highest
Five Rivers	16.3	2.2	1982	4th-highest
Gore	16.6	2.3	1907	4th-highest
Balclutha	16.5	2.0	1964	4th-highest
Low records or near-records				
Mokohinau	20.0	-0.6	1994	4th-lowest

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

Location	Mean maximum air temp. (°C)	Departure from normal (°C)	Year records began	Comments
High records or near-records				
Westport	23.4	2.7	1937	Highest
Arapito	24.3	2.7	1978	Highest
Greymouth	23.4	3.6	1947	Highest
Secretary Island	21.7	3.4	1985	Highest
Oban (Stewart Island)	19.9	2.4	1975	Highest
South West Cape	18.8	2.8	1991	Highest
Ōkarito	22.3	1.8	1982	2nd-highest
Franz Josef	23.3	3.0	1953	2nd-highest
Haast	21.6	2.8	1949	2nd-highest
Oamaru	22.0	2.7	1967	2nd-highest
Waipounamu	23.2	2.7	1980	2nd-highest
Chatham Island	21.3	1.9	1878	2nd-highest
Windsor	23.1	2.5	2000	3rd-highest
Middlemarch	24.7	2.4	2000	3rd-highest
Gore	23.4	4.2	1907	3rd-highest
Milford Sound	21.8	2.1	1934	4th-highest
Orari Estate	23.9	2.9	1972	4th-highest
Dunedin (Airport)	23.5	2.6	1962	4th-highest
Dunedin (Musselburgh)	21.4	2.7	1947	4th-highest
Manapouri (West Arm Jetty)	21.5	2.4	1971	4th-highest
Manapouri (Airport)	22.5	2.0	1963	4th-highest

Lumsden	22.4	2.0	1982	4th-highest
Balclutha	22.6	3.0	1964	4th-highest
Tautuku	20.1	1.6	1976	4th-highest
Low records or near-records				
Mokohinau	21.8	-1.2	1994	2nd-lowest
Matamata	23.4	-1.6	1999	4th-lowest

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

Location	Mean minimum air temp. (°C)	Departure from normal (°C)	Year records began	Comments
High records or near-records				
Westport	16.5	3.6	1937	Highest
Secretary Island	14.0	2.1	1985	Highest
Oban (Stewart Island)	11.7	2.2	1975	Highest
Nugget Point	12.3	1.9	1970	Highest
Tautuku	11.3	1.8	1976	Highest
South West Cape	12.7	2.4	1991	Highest
Upper Hutt (Trentham)	14.0	2.4	1939	2nd-highest
Rangiora	12.9	1.9	1965	2nd-highest
Akaroa	14.2	1.6	1978	2nd-highest
Dunedin (Musselburgh)	13.6	2.1	1947	2nd-highest
Te Anau	11.6	3.4	1963	2nd-highest
Waipounamu	9.9	1.3	1980	2nd-highest
Roxburgh	12.0	1.7	1950	2nd-highest
Tākaka	13.4	1.8	1978	3rd-highest
Waiau	12.2	1.4	1974	3rd-highest
Cheviot	12.2	2.0	1982	3rd-highest
Le Bons Bay	13.7	1.8	1984	3rd-highest
Oamaru	11.8	1.3	1967	3rd-highest
Five Rivers	10.6	2.2	1982	3rd-highest
Gore	10.9	1.5	1907	3rd-highest
Chatham Island	14.6	1.9	1878	3rd-highest
Ngawi	16.4	1.6	1972	4th-highest
Waipara West	12.7	1.5	1973	4th-highest
Christchurch (Botanic Gardens)	13.9	2.0	1863	4th-highest
Tiwai Point	12.4	1.5	1970	4th-highest
Low records or near-records				
None observed				

February climate in the six main centres

February rainfall was well above normal in all main centres except for Dunedin, where it was well below normal. Dunedin was also the most unusually warm (third-warmest on record) and sunniest (second-highest sunshine hours on record) main centre, an atypical feat for the southern city (records began in 1947).

Of the six main centres in February 2023, Auckland was the warmest, Tauranga was the wettest, Wellington was the least sunny, and Dunedin was the coolest, driest and sunniest.

February 2023 main centre climate statistics:

Temperature			
Location	Mean temp. (°C)	Departure from normal (°C)	Comments
Auckland[a]	20.1	-0.1	Near average
Tauranga[b]	20.0	-0.1	Near average
Hamilton[c]	19.2	+0.1	Near average
Wellington[d]	18.0	+0.7	Above average
Christchurch[e]	18.3	+1.4	Well above average
Dunedin[f]	17.5	+2.4	3rd-highest on record

Rainfall			
Location	Rainfall (mm)	% of normal	Comments
Auckland[a]	190	327	Well above normal
Tauranga[b]	231	278	Well above normal
Hamilton[c]	127	176	Well above normal
Wellington[d]	198	356	4th-highest on record
Christchurch[e]	94	235	Well above normal
Dunedin[f]	34	48	Well below normal

Sunshine	
Location	Sunshine (hours)
Auckland[a]	188
Tauranga[b]	186
Hamilton[g]	177
Wellington[d]	170
Christchurch[e]	216
Dunedin[f]	243

[a] Māngere [b] Tauranga Airport [c] Hamilton Airport [d] Kelburn [e] Christchurch Airport [f] Musselburgh [g] Ruakura

Highlights and extreme events

Rain and slips

Cyclone Gabrielle

On 8 February, Tropical Cyclone Gabrielle formed in the Coral Sea. On 10 February, Gabrielle strengthened into a severe category 3 with wind gusts reaching 185 km/h. At the time, the tropical cyclone's remnants were predicted to track near the northern North Island early in the week of 13 February, putting New Zealand on guard. Late in the evening of 11 February, the centre of Gabrielle passed near Norfolk Island. The Australian Bureau of Meteorology's weather station reported a minimum mean sea level pressure of 958 hPa and winds gusted in excess of 100 km/h. On 12 February, Gabrielle began impacting Northland and Auckland. Although it was no longer designated as a tropical cyclone, Gabrielle's interaction with the sub-tropical jet stream, a more baroclinic environment (energy related to temperature differences), and an area of mid-atmosphere vorticity (spin) from the Tasman Sea were associated with the storm restrengthening. This also saw Gabrielle slow down and briefly track south-westward toward Aotea/Great Barrier Island and the Coromandel Peninsula during the night of 13 February. Around this time, a MetService analysis indicated a central pressure of 967 hPa. NIWA's climate station at Whitianga recorded a mean sea level pressure reading of 968.3 hPa at 4:00 a.m. on 14 February, the lowest pressure in the country during the cyclone and the North Island's eighth-lowest daily minimum air pressure on record, surpassed only by readings on 26 July 2008. In central Auckland, the air pressure fell to 971.5 hPa, surpassing that which was observed during the Cyclone of 1936 (973.5 hPa). On 14 February, Gabrielle's centre of circulation drifted eastward toward East Cape, passing just kilometres offshore during the evening. A MetService analysis indicated a central pressure of 965 hPa. Gabrielle then moved away from the mainland and passed north of Chatham Island on 15 February.

The following is a non-exhaustive list of impacts in New Zealand caused by Gabrielle:

12 February

- Auckland Council sourced tens of thousands of sandbags for locals to help protect their homes.
- MetService issued red weather warnings for rain and/or wind in Northland, Auckland, the Coromandel Peninsula, East Cape, and Taranaki.
- At 6:00 p.m., SH1 was closed between Brynderwyn and Waipu due to large slips.
- Northland was reporting numerous downed trees and flooding, particularly in the Whāngarei area; Whāngarei recorded 216 mm between 9:00 a.m. 12 February – 9:00 a.m. 13 February, its wettest February day on record and over 2.5 times the February monthly normal.
- Auckland's Harbour Bridge was closed around 3:30 p.m. on 12 February until early morning 13 February due to strong winds; many ferry services were also cancelled.
- Mercury Energy said that Lake Taupō and the Waikato River may reach record high levels, causing flooding along their shores.
- Air New Zealand announced numerous flight cancellations for 13 February.
- KiwiRail service was suspended in the upper North Island for 13 February.

13 February

- Over 20,000 households were reported to have lost power in both Northland and Auckland between 12-13 February; Northlanders were warned that power outages could last for days.

- SH25 in the Coromandel Peninsula was briefly closed between Thames and Whitianga due to slips, fallen trees and debris, before reopening between Thames and Coromandel; SH16 was closed between Kaukapakapa and Wellsford due to fallen trees and powerlines; SH35 was closed between Ōpōtiki and Gisborne due to concerns for flooding and slips; SH5 was closed from Napier to Taupō; numerous other road closures occurred.
- Between 13-14 February, states of emergency were declared in numerous districts ahead of Cyclone Gabrielle or immediately following its worst effects.
- During the early afternoon high tide in Whitianga, storm surge reached 0.7 metres, leading to flooding along the coastal road in the town.
- In the evening, a large slip blocked Piha Rd, restricting access to Auckland's west coast.
- In the evening, homes in west Auckland's Karekare and Muriwai were brought down by slips; one responding fire fighter became tragically became trapped and died and another was seriously injured and later died.

14 February

- In the morning, it was reported that the Coromandel was largely cut off from neighbouring regions due to numerous slips and flooding.
- In the morning, tens of thousands of homes were without power across several North Island regions with Coromandel, Taranaki, and Hawke's Bay among the worst affected; by afternoon, the number had ballooned to 225,000 across the country.
- In the morning, the Hikuwai River north of Tolaga Bay reached at least 14 m, prompting the evacuation of at least two dozen residents; communications were largely cut off in much of the Gisborne region following the severe impact from the cyclone.
- In the morning, the Waipāoa River breached its banks and flooded numerous homes in the settlement of Te Karaka, inland of Gisborne; about 500 people were stuck on top of a hill for 27 hours.
- In the morning, exceptional flooding was reported in Hawke's Bay, particularly Esk Valley, Hastings, where floodwater levels reached nearly to the roofs of homes and trapped at least 40 people.
- In the morning, a series of slips in Port Waikato caused over 50 evacuations.
- In the morning of 14 February, a national state of emergency was declared for only the third time in New Zealand's history.
- All Cook Strait ferries were cancelled due to high seas and strong winds from Cyclone Gabrielle.
- 200 defence force personnel were deployed to assist with the cyclone-related emergency with more on standby.
- In the afternoon, the Tararua District Council said that river levels were expected to reach record highs and urged people in low-lying areas to evacuate and move to higher ground.
- In the afternoon, Auckland airport announced the cancellation of all domestic and international flights for the rest of the day due to high winds.
- In the afternoon, flooding of the Wairoa River in Dargaville prompted evacuations.
- In Rotorua, hundreds of trees came down and local roads and biking trails were closed due to slips.

- In the afternoon, the Hawke's Bay town of Wairoa was isolated after the Wairoa River burst its banks, flooding the homes of about half the town's population; communications were also largely cut off and food and water was said to be running low.
- Hawke's Bay agricultural, horticultural, and viticultural lands were severely affected by the cyclone with reports of apples floating in the floodwater, fields of corn flattened, strawberry rows decimated, grape vines severely damaged and buried in silt, and drowned livestock.
- Fire and Emergency New Zealand recorded over 1800 incidents related to the cyclone on 13-14 February.
- In the evening, a person was found deceased on the shore in Bay View, Napier; a second death in Hawke's Bay was also reported on 15 February.

15 February

- In the early morning, 20 homes were evacuated in Piha due to land instability.
- At least 400 people had been rescued by helicopter following the cyclone, most of which occurred in Hawke's Bay.
- A helicopter was deployed to Tararua's cut-off coastal communities, carrying urgent medical supplies.
- The early afternoon high tide caused coastal flooding in the Napier suburb of Te Awa; several streets were completely submerged.
- The fourth death related to Cyclone Gabrielle was reported – a young child from Eskdale, Hawke's Bay.
- Police said that 1442 people have been registered as uncontactable, but believed that it was mostly related to communication lines being down.
- Two navy ships were deployed to cut-off communities in Hawke's Bay and Gisborne – for many communities in these regions, there was still no power, no cell coverage, little remaining water and food, and no fuel, with the only way in or out by air travel.

16 February

- 250,000 people were still without power across the North Island.
- The water situation in Gisborne had reached critical status according to their mayor, with residents asked to urgently minimise their use of water.
- During the morning, Central Hawke's Bay residents in the settlement of Ōtāne were urged to evacuate due to rising Tukituki River levels.
- Sadly, Gabrielle's death toll had risen to seven, including two volunteer firefighters in Auckland who were involved in a slip, a toddler in Eskdale, Hawke's Bay, a woman whose body was recovered at Bay View, Napier, a woman north of Napier who was involved in a slip, a man in Waiohiki, Hawke's Bay, and a man from Gisborne who was overtaken by floodwaters.

17 February

- During the morning, the Gisborne water plant failed and residents were asked to stop using water immediately.
- In Muriwai, residents along Domain Crescent were asked to evacuate immediately.

As the response shifted to recovery in the days and weeks following Gabrielle, the death toll sadly continued to rise in the eastern North Island. As of the end of February, there were 11 fatalities reported to be associated with the cyclone.

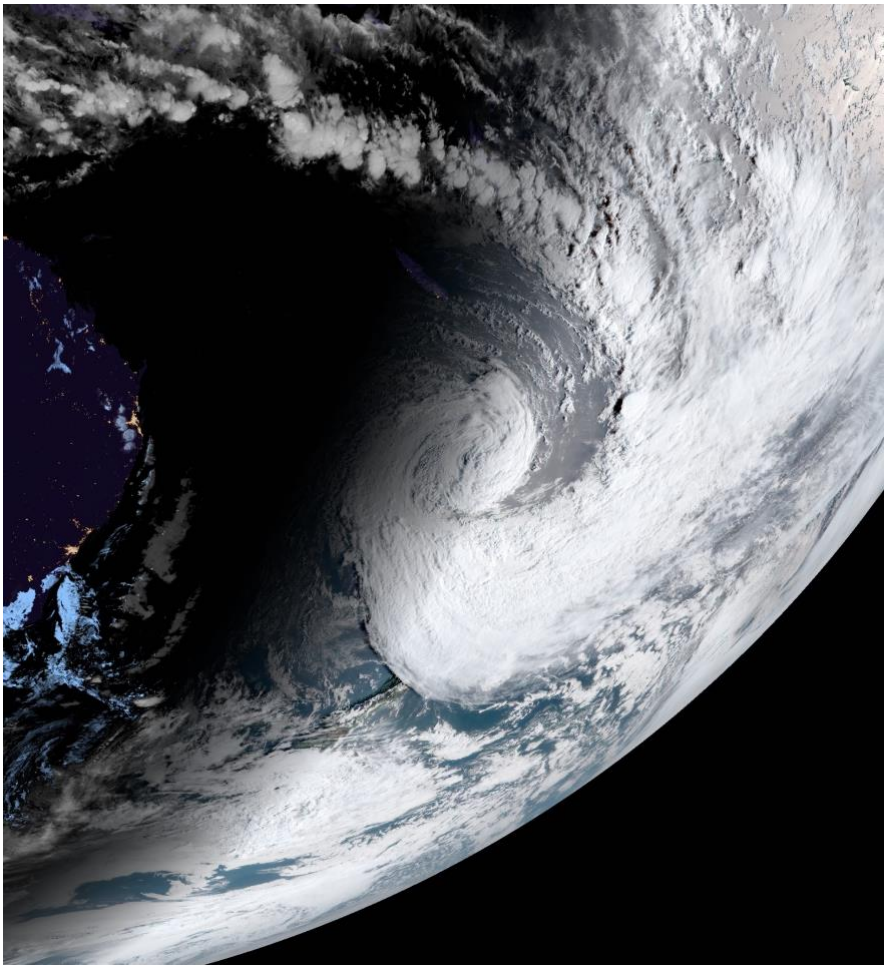


Figure 3: Cyclone Gabrielle bearing down on New Zealand, 12 February 2023; image credit: Himawari-8 via NCEP.

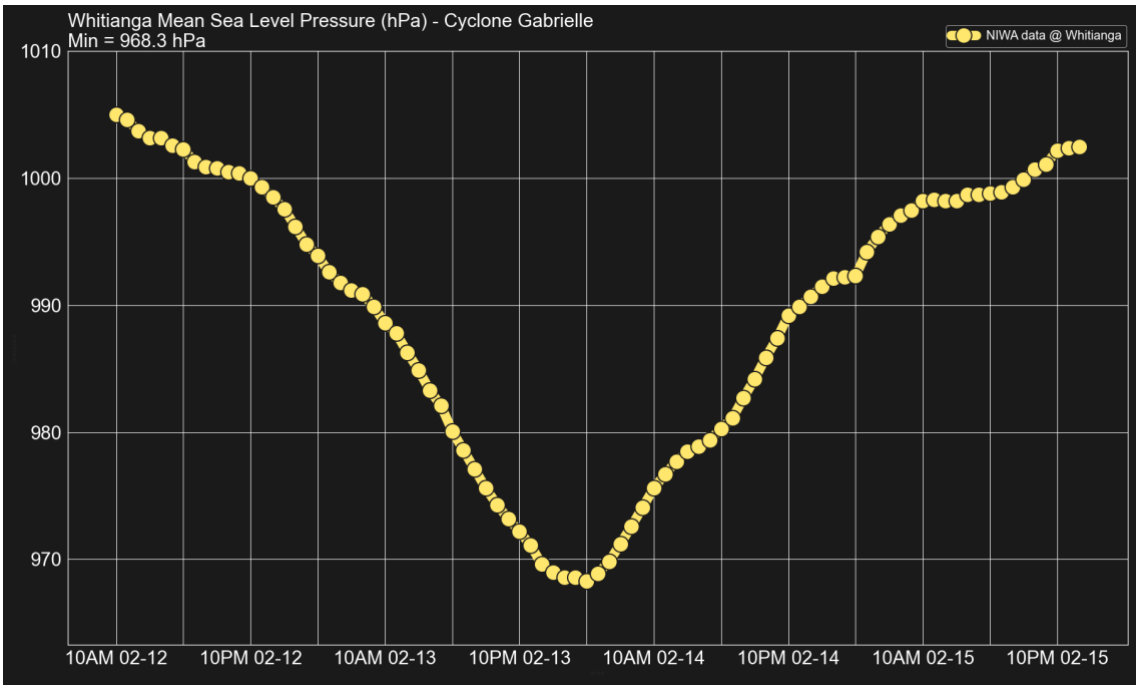


Figure 4: Mean sea level pressure readings at Whitianga from 12-15 February; the centre of Gabrielle made its closest approach in the early morning hours of 14 February, seeing the pressure dip to 968 hPa.

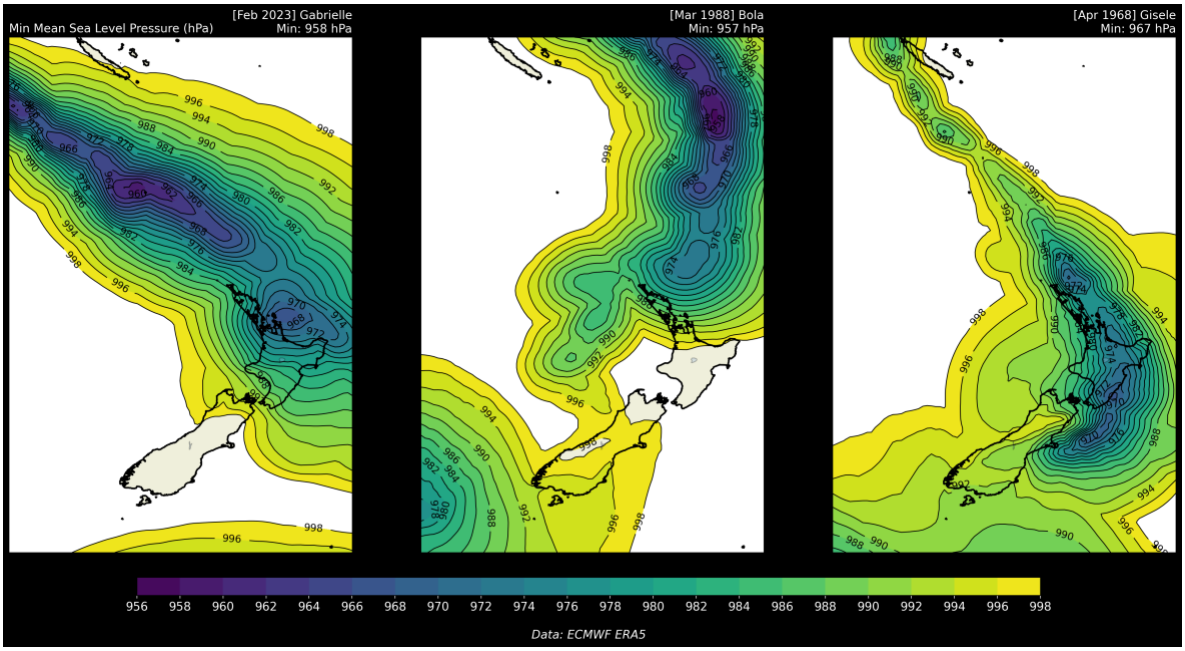


Figure 5: Minimum mean sea level pressure "swathes" associated with Gabrielle (left), Bola (centre), and Gisele (right), showing the approximate track and strength of each of the cyclones; data: ECMWF ERA5 (atmospheric reanalysis).

On 1 February, Aucklanders awakened to yet more heavy rain and flooding, following another deluge that was caused by an atmospheric river. The following lists some of the impacts additional to those of the January flooding:

- Floodwaters were suitable for kayaks in Pt Chevalier, reached over the bonnet of cars in Onehunga, caused some motorway sections to become impassable shortly after 6:00 a.m., and led to a dam burst in Oratia.

- Fire and Emergency reported that it responded to 93 weather-related calls between 6:00 – 8:30 a.m.
- At 10:00 a.m., Vector said that about 3,000 homes and businesses were without power.
- Numerous slips were reported across the region, particularly in the west, including a severe event in Titirangi which saw an unoccupied car carried off a cliff and into the bay below. Another slip in Manukau Heads hit a bach and caused serious injuries.
- In the Coromandel Peninsula, the Department of Conservation announced that all of its huts, campsites, and the walkway to Cathedral Cove were closed due to the weather. In Thornton Bay north of Thames, three houses were evacuated following a landslide. Whitianga became cut-off by rising floodwaters as only trucks and four-wheel drive vehicles could pass a key bridge.

For more information, see the January climate summary, in which the Auckland flood event was covered extensively.

On 2 February, the government unlocked $700,000 in support for regions that were badly affected by recent flooding, including Auckland, Waikato, Coromandel, Northland, and Bay of Plenty.

On 5 February, heavy rain caused slips, fallen trees, and flooding along the West Coast and in the Tasman District. State Highway 6 in Westland was closed from Ross to Haast from the afternoon of 5 February until 6 February.

On 21-22 February, a cold front moved northward across the South Island, bringing much needed rain to these regions. On the morning of 22 February, flooding near Arrowtown trapped around 110 athletes, leading to a mass rescue and the hospitalisation of six people. One-day rainfall from 9:00 a.m. 21 February – 9:00 a.m. 22 February was 29.8 mm at Queenstown, making it the wettest day since 3 November 2022. On the same day Dunedin recorded 23.8 mm rainfall, making it the wettest day since 27 July 2022.

On 24 February, a front became stalled across Auckland and southern Northland. Converging winds associated with this feature, as well as an upper level low pressure system, allowed it to become the focal point of widespread heavy rain and thunderstorms. Early in the afternoon, a thunderstorm led to intense downpours near Mangawhai, a town in southern Northland, leading to flooding, road closures, and serious property damage. Due to the flooding, 40 to 50 people were placed in a temporary shelter at the Mangawhai golf course. A Northland Regional Council rain gauge “Hakaru at Tara” recorded an incredible 24-hour rainfall total of 380 mm between the morning of 24 February and the morning of 25 February. Based on available climatological data, that amount of rain would constitute over 670% of the February normal in nearby Mangawhai. About 20 students and their parents were stranded overnight at Kaiwaka school in Northland. In Dairy Flat, Auckland, a group of people had to be rescued from their cars by boats because of rising floodwaters. Kayaks were used to navigate the flooding in Riverhead, Auckland. Fourteen people were trapped at Silverdale school in Auckland. Farther south, Esk Valley, Hawke’s Bay, was evacuated as a precaution due to the forecast for heavy rain.

On 28 February, a sub-tropical low caused heavy rain and surface flooding in Gisborne and Hawke’s Bay, leading to some evacuations in the suburb of Mangapapa. A 30-metre section of the Napier-Taupō Rd also dropped away. On 27-28 February, Gisborne received 51 mm and Wairoa 105 mm of rain or 77% and 119% of the monthly normal, respectively.

Drought and dryness

During mid-February, meteorological drought emerged in pockets of eastern Otago, with very to extremely dry conditions occurring across the rest of Otago, much of Southland, South Canterbury, Banks Peninsula, northern West Coast, and inland Tasman.

On 16 February, level 1 water restrictions were implemented in Invercargill, with level 3 restrictions in place for Gore and Mataura. The Gore District Council had to start pumping water from the Mataura River to supply Mataura residents due to a lack of water flowing into the Pleura Dam.

On 23 February, residents across the Southland district were being urged to conserve water. Across Southland, 70 consent holders were forced to cease abstraction of water. One of the water bores that supplies the township of Mossburn had been dry for five weeks.

On 27 February, the *GODZONE* adventure race had to alter their course for one of the river sections, as the river flow of the Oreti River (Southland) was too low to facilitate paddling.

On 21-22 February, a cold front moved northward across the South Island, bringing much needed rain to these regions. On the morning of 22 February, flooding near Arrowtown trapped around 110 athletes, leading to a mass rescue and the hospitalisation of six people. One-day rainfall from 9:00 a.m. 21 February – 9:00 a.m. 22 February was 29.8 mm at Queenstown, making it the wettest day since 3 November 2022. On the same day Dunedin recorded 23.8 mm rainfall, making it the wettest day since 27 July 2022.

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

Location	Extreme 1-day rainfall (mm)	Date of extreme rainfall	Year records began	Comments
Whangārei	216	12th	1943	Highest
Leigh	165	13th	1967	Highest
Auckland (Western Springs)	147	13th	1948	Highest
Mt Ruapehu (Chateau)	154	12th	2000	Highest
Tūtira	316	13th	1894	Highest
Napier	176	13th	1870	Highest
Hastings	126	13th	1967	Highest
Whakatu	122	13th	1967	Highest
Waipawa	117	13th	1945	Highest
Mokohinau	75	13th	1994	2nd-highest
Warkworth	130	13th	1967	2nd-highest
Takapau Plains	105	13th	1962	2nd-highest
Akaroa	80	15th	1977	2nd-highest
Russell	133	12th	1919	3rd-highest
Auckland (North Shore)	102	13th	1966	3rd-highest
Whitianga	149	13th	1961	3rd-highest
Auckland (Māngere)	106	13th	1959	3rd-highest
Gisborne	131	13th	1937	3rd-highest
Wairoa	102	27th	1967	3rd-highest
Le Bons Bay	48	15th	1984	3rd-highest
Kaikohe	143	12th	1956	4th-highest
Whangaparāoa	90	13th	1946	4th-highest
Auckland (Whenuapai)	129	24th	1943	4th-highest

Whatawhata	115	13th	1952	4th-highest
Gisborne	82	27th	1937	4th-highest
Ōkārito	131	5th	1981	4th-highest
Lauder	46	21st	1924	4th-highest

Temperatures

The highest temperature was 35.6°C, observed at Middlemarch on 4 February.

The lowest temperature was -0.4°C, observed at Manapouri (Airport) on 24 February.

From 1-7 February, very hot temperatures occurred across the lower and eastern South Island. The air pressure setup involved strong low pressure over eastern Australia and a strong high pressure system to the east of New Zealand, which directed a hot, humid flow from Queensland.

- On 4 February, Middlemarch observed New Zealand's hottest temperature of the summer, reaching 35.6˚C.
- On 4 February, Milford Sound observed its hottest temperature on record, reaching 29.4˚C. This was the first time the location exceeded 29˚C. Records in Milford Sound date back to 1934.

On 20 February, a very warm air mass streamed across the Tasman Sea from southern Australia, seeing temperatures rise into the low 30s across Otago and Canterbury. From 21-23 February, a strong southerly change moved up the country. The daily maximum temperature of 12.2˚C (12.5˚C) at Queenstown (Wānaka) was the town's lowest maximum temperature since 6 October 2022.

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

Location	Extreme maximum (°C)	Date of extreme temperature	Year records began	Comments
High records or near-records				
Haast	28.3	15th	1949	Highest
Milford Sound	29.4	4th	1934	Highest
Secretary Island	28.3	15th	1985	Highest
Middlemarch	35.6	4th	2000	Highest
Lumsden	31.2	4th	1982	Highest
Gore	34.1	4th	1907	Highest
Waipounamu	31.7	4th	1980	Equal highest
Arapito	28.5	4th	1978	2nd-highest
Windsor	33.6	3rd	2000	2nd-highest
Invercargill	32.0	4th	1905	2nd-highest
Akaroa	35.1	4th	1978	Equal 2nd-highest
Westport	27.7	15th	1937	3rd-highest
Ranfurly	33.0	4th	1897	3rd-highest
Tapanui	33.4	4th	1900	3rd-highest
Whangaparāoa	28.9	20th	1982	4th-highest
Westport	27.5	4th	1937	4th-highest
Pukaki	33.7	4th	1972	4th-highest
Chatham Island	25.2	8th	1878	4th-highest

Five Rivers	30.3	4th	1982	Equal 4th-highest
Oban (Stewart Island)	26.2	3rd	1975	Equal 4th-highest
Low records or near-records				
Cape Reinga	17.7	13th	1971	Lowest
Pururua	18.3	13th	1983	Lowest
Whangaparāoa	17.7	13th	1982	Lowest
Whakatāne	18.0	27th	1975	Lowest
Pukekohe	16.4	24th	1969	Lowest
Kerikeri	17.5	13th	1952	2nd-lowest
Kaikohe	17.0	12th	1973	2nd-lowest
Mokohinau	18.9	12th	1994	2nd-lowest
Te Puke	17.4	27th	1973	2nd-lowest
Kaitaia	18.6	13th	1948	3rd-lowest
Dargaville	17.4	13th	1951	3rd-lowest
Whangārei	18.2	13th	1967	3rd-lowest
Matamata	17.6	24th	1999	3rd-lowest
Port Taharoa	17.5	24th	1974	3rd-lowest
Cheviot	12.6	23rd	1982	3rd-lowest
Waipounamu	12.6	22nd	1980	Equal 3rd-lowest
Kerikeri	18.2	13th	1952	4th-lowest
Kawerau	17.9	27th	1954	4th-lowest
New Plymouth	16.1	24th	1944	4th-lowest
Waiau	11.6	23rd	1974	4th-lowest
Tara Hills	9.8	22nd	1949	4th-lowest
Middlemarch	11.2	22nd	2000	4th-lowest
Stratford	14.0	24th	1972	Equal 4th-lowest

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

Location	Extreme minimum (°C)	Date of extreme temperature	Year records began	Comments
High records or near-records				
Paraparaumu	20.7	5th	1972	Highest
Westport	22.4	3rd	1966	Highest
Franz Josef	18.4	5th	1953	Highest
Secretary Island	20.0	5th	1988	Highest
Appleby	20.9	5th	1941	Highest
Dunedin (Musselburgh)	20.2	5th	1947	Highest
Te Anau	19.2	5th	1973	Highest
Gore	20.9	5th	1907	Highest
Oban (Stewart Island)	18.4	5th	1975	Highest
Nugget Point	17.8	5th	1972	Highest
Tautuku	18.7	5th	1976	Highest
South West Cape	18.5	5th	1991	Highest
Milford Sound	18.3	5th	1935	Equal highest
Windsor	17.6	3rd	2000	Equal highest
Waipounamu	17.8	2nd	1980	Equal highest
Paraparaumu	20.6	5th	1972	2nd-highest

Tākaka	20.2	5th	1978	2nd-highest
Greymouth	19.1	4th	1972	2nd-highest
Haast	18.6	3rd	1949	2nd-highest
Nelson	21.2	5th	1862	2nd-highest
Brothers Island	18.5	2nd	1997	2nd-highest
Akaroa	22.8	5th	1978	2nd-highest
Le Bons Bay	21.0	4th	1984	2nd-highest
Ranfurly	19.1	5th	1897	2nd-highest
Oamaru	18.9	3rd	1972	2nd-highest
Manapouri (West Arm Jetty)	17.7	5th	1972	2nd-highest
Manapouri (Airport)	19.0	5th	1973	2nd-highest
Alexandra	21.3	5th	1930	2nd-highest
Gore	19.7	5th	1907	2nd-highest
Invercargill	20.3	5th	1905	2nd-highest
Tiwai Point	18.4	5th	1972	2nd-highest
Balclutha	17.7	5th	1972	2nd-highest
Kaitaia	22.2	3rd	1948	Equal 2nd-highest
Arapito	19.9	5th	1978	Equal 2nd-highest
Ōkārito	18.5	4th	1983	Equal 2nd-highest
Blenheim	21.8	5th	1947	Equal 2nd-highest
Auckland (Western Springs)	21.8	4th	1971	3rd-highest
Ngawi	23.0	5th	1972	3rd-highest
Palmerston North	20.5	5th	1940	3rd-highest
Levin	21.0	5th	1950	3rd-highest
Wellington (Kelburn)	19.9	5th	1931	3rd-highest
Motueka	20.0	5th	1972	3rd-highest
Nelson	21.1	5th	1862	3rd-highest
Winchmore	22.3	5th	1949	3rd-highest
Ashburton	22.3	5th	1928	3rd-highest
Lincoln	21.2	5th	1881	3rd-highest
Dunedin (Airport)	18.7	5th	1972	3rd-highest
Oamaru	17.9	3rd	1972	3rd-highest
Roxburgh	20.8	5th	1950	3rd-highest
Paraparaumu	20.5	5th	1972	Equal 3rd-highest
Cromwell	21.1	5th	1949	Equal 3rd-highest
Port Taharoa	21.1	4th	1974	4th-highest
Wellington (Airport)	20.6	4th	1972	4th-highest
Hāwera	19.8	4th	1977	4th-highest
Whanganui	20.8	5th	1972	4th-highest
Westport	19.7	3rd	1966	4th-highest
Arthurs Pass	15.8	5th	1973	4th-highest
Rangiora	19.8	3rd	1972	4th-highest
Middlemarch	16.7	5th	2000	4th-highest
Queenstown	19.6	5th	1871	4th-highest
Alexandra	20.1	5th	1930	4th-highest
Balclutha	17.0	5th	1972	4th-highest
Purerua	20.9	3rd	1983	Equal 4th-highest
New Plymouth	20.9	4th	1944	Equal 4th-highest

Stratford	18.7	4th	1972	Equal 4th-highest
Low records or near-records				
None observed				

Wind

The highest wind gust was 150 km/h, observed at Mokohinau on 12 February. Numerous wind gust records and near-records occurred during the passage of Cyclone Gabrielle.

Record or near-record February extreme wind gusts were recorded at:

Location	Extreme wind gust (km/h)	Date of extreme gust	Year records began	Comments
Kaitaia	109	13th	1972	Highest
Dargaville	128	13th	1997	Highest
Whangārei	102	13th	1973	Highest
Mokohinau	150	12th	1994	Highest
Auckland (Western Springs)	82	14th	1994	Highest
Taupō	107	14th	1982	Highest
Tūrangi	96	14th	1973	Highest
Mt Ruapehu	124	13th	2000	Highest
Whakatu	89	13th	1997	Highest
Kaitaia	109	13th	1972	Highest
New Plymouth	128	14th	1972	Equal highest
Oamaru	85	5th	1984	Equal highest
Te Puke	70	13th	1987	2nd-highest
Gisborne	91	13th	1972	2nd-highest
Mt Kaukau (Wellington)	146	14th	1969	2nd-highest
Clyde	63	5th	1983	Equal 2nd-highest
Alexandra	70	5th	2001	Equal 2nd-highest
Cape Reinga	141	12th	1974	3rd-highest
Tauranga	91	13th	1973	3rd-highest
Rotorua	95	13th	1972	3rd-highest
Pukekohe	72	14th	1986	3rd-highest
Māhia	91	13th	1991	3rd-highest
Hāwera	98	14th	1986	3rd-highest
Stratford	78	14th	2002	Equal 3rd-highest
Whitianga	76	12th	1991	4th-highest
Rotorua	85	13th	1972	4th-highest
Hamilton	76	14th	1978	4th-highest
Napier	89	14th	1973	4th-highest
Whanganui	98	14th	1977	4th-highest
Reefton	52	5th	1999	Equal 4th-highest

Lightning, hail, and tornadoes

On the afternoon of 1 February, thunderstorms rattled eastern Southland and southern Otago. Fifteen lightning strikes were detected between Gore and the small town of Lawrence in the Clutha District.

In the early morning hours of 6 February, a tornado was reported to have damaged at least four houses in Cobden, near Greymouth, on the West Coast.

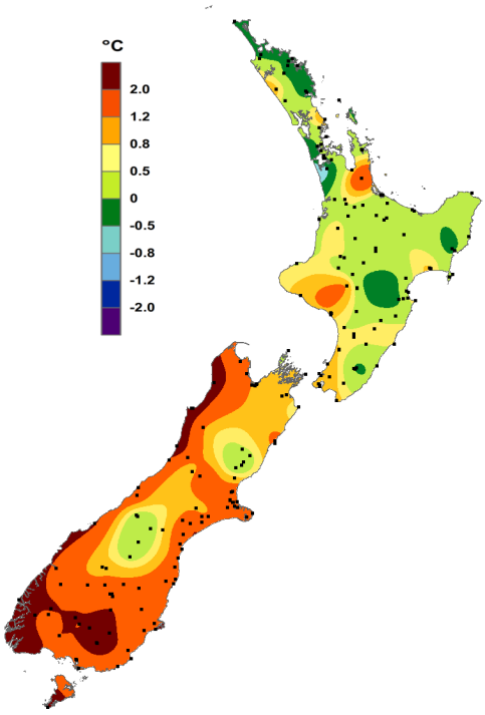
On the morning of 25 February around 9:00 a.m., a tornado was spotted in Waihi Beach, damaging homes, cars, trees, and cutting power to nearly 2500 properties. Based on photo evidence, it initially appeared to be a waterspout (tornado over the water) before moving onto land, thus becoming a tornado.

On 26 February, a waterspout was spotted offshore from Ōhope, Bay of Plenty.

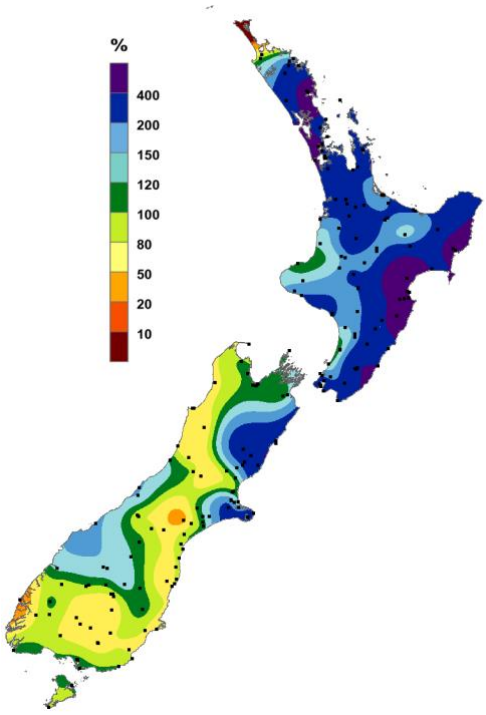
Snow and ice

On 22 February, a strong southerly change resulted in sub-freezing temperatures and snow across the tops of the Southern Alps. Mueller Hut (Aoraki/Mt Cook National Park) observed its first sub-freezing temperatures since 3 December. More than 30 centimetres fell at Mt Hutt, Canterbury, which saw visitors skiing and snowboarding during the mountain's open day on 25 February.

For further information, please contact:
Ben Noll | Meteorologist, NIWA Auckland | Tel. 09 375 6334



February temperature
Expressed as a departure from the 1991-2020 average in degrees Celsius.



February rainfall
Expressed as a percentage of the 1991-2020 normal.

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