Aotearoa New Zealand National Monthly Fire Danger Outlook (2023/2024 season)

Issue: March 2024

Current fire danger situation

Most of February's fire indices were high to extremely high across the lower North Island and eastern South Island, although much lower values were generally observed elsewhere. However, higher values began to emerge across Northland and Auckland during February as well. See Figures 8-11 for more detail.

El Niño continued during February and has around an 80% chance of persisting through April. There is then a 70% chance that ENSO-neutral conditions will develop during May-July 2024.

Current fuel and soil moisture status

As of 12 March (see Figure 4, left), soil moisture levels are below normal across most of the upper, eastern, and lower North Island, along with the upper and eastern South Island. Meanwhile, soil moisture levels are above normal in the western North Island and Southland.

Fuel moistures have remained relatively steady over recent weeks with little significant rain for most of that part of the country which was already fairly dry. Exceptions being parts of the West Coast of the South Island, Southland, and the Chatham Islands. For forests, as fuel moisture decreases, more medium and heavy fuel (sticks, logs, and ground fuels) become available to burn, and with greater fuel available, fire intensity increases along with the fire danger. Medium and heavy fuel availability is represented by the BUI, as depicted in Figure 1, which shows that for many areas along the eastern South Island and at either end of the North Island there is considerable fuel available to burn.

The parts of the country that are drying out will also have increased curing (browning of grass). As the curing increases, the moisture content decreases making the grass easier to ignite and likely to burn with higher rates of spread and intensities.

Lower fine fuel moisture content (represented by higher FFMC) increases the ease of ignition and spread rates. Fine fuel moisture varies greatly over short periods (days or even hours) and is represented in the Fire Weather System by the fine fuel moisture code (FFMC). Through February we saw elevated FFMC, but over the past week or more we have seen the FFMC come down because of slightly higher humidity and lower temperatures. This means that although things are not wet due to rainfall, the fine fuels are able to absorb some moisture from the atmosphere, therefore making them not so easy to ignite. Be mindful however that fine fuels will dry again very quickly with a return of lower humidity and higher temperatures, along with wind.

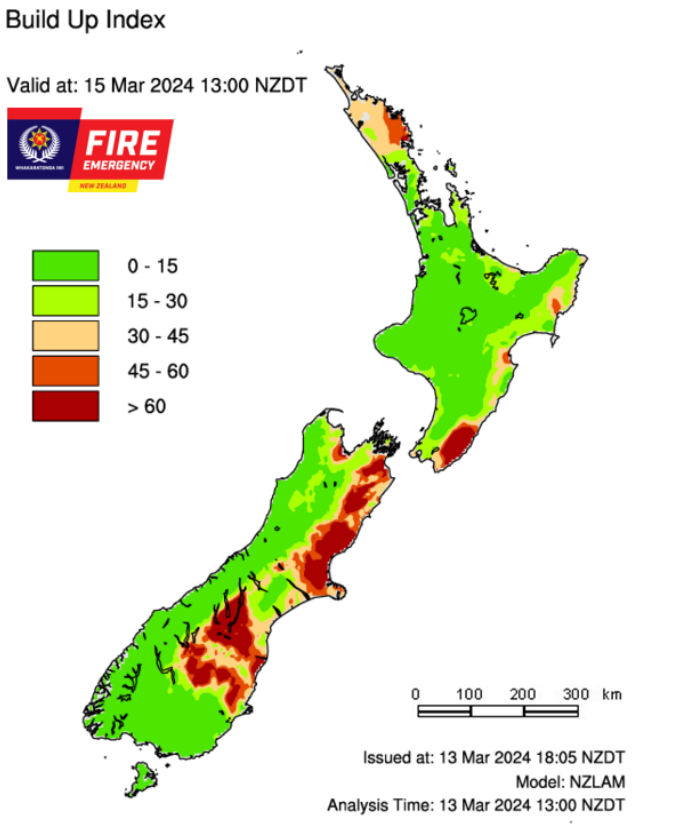


Figure 1: Map of Buildup Index (BUI) values (indicator the total amount of fuel available for combustion) as of 15th March.

Forecast climate and weather

The remainder of March is expected to feature dominant high pressure for a time, although there is a possibility that an area of low pressure could affect the country in the last few days of the month.

For April, high pressure is favoured for at least the first half of the month, bringing drier than normal conditions to parts of the North Island. The chance for rainfall may increase to an extent in late April, with the wettest areas favoured to be the western and lower South Island. Above average temperatures and stronger than normal winds are forecast across the country in April.

April-June will likely exhibit more northwest winds than usual. These winds may be strong at times, especially in the South Island and lower North Island. Wetter than normal conditions will be favoured for much of western New Zealand, although drier than normal conditions may occur in parts of the upper and eastern North Island. Temperatures overall look to be above average, along with a chance for stronger than normal winds.

For more information, see pages 4 and 5.

The El Niño climate pattern

El Niño has around an 80% chance of continuing through the end of April, followed by a 70% chance that ENSO-neutral conditions will develop during May-July. Despite the likelihood that ENSO-neutral conditions will emerge in the coming months, El Niño-like patterns are favoured to continue at times during late autumn and into early winter.

No two El Niño events are the same, and each event can produce different effects on weather conditions and therefore fire dangers across New Zealand depending on its timing, strength, and duration. In general, however, El Niño events bring a northward shift of the paths of high and low pressure systems as they cross New Zealand and stronger westerly winds, which result in wetter conditions in the west and drier conditions in the east of both islands.

It is important to remember that ENSO events such as El Niño and La Niña only explain around 25% of the variability in New Zealand's weather. The last strong El Niño event in 2015/16 brought very mixed weather and fire danger conditions, due largely to the impact of other climate drivers which can also have significant effects. The strong 1997/98 El Niño event however did bring very dry conditions to eastern areas.

What to watch for

The areas to watch will be:

- Northern and eastern parts of the North Island.
- Wairarapa, Marlborough, Canterbury, and Otago are currently exhibiting moisture codes showing extremely dry conditions, highly cured grass areas and occasional strong winds which are likely to continue for the coming months.

Areas of cured (dead or browned off) grass can ignite easily and result in very fast-moving fires with surprisingly high fire intensities. These grass fires can exceed 8 km per hour on the flat and travel even faster uphill, so can easily outrun people including firefighters and result in fatalities.

Cured grasses should be removed from areas where an ignition could occur and from near vulnerable assets such as buildings. This should occur ahead of periods of elevated fire danger, or during the cooler parts of the day, as things like mowing can cause fires.

Be aware of forecast periods of elevated fire danger due to strong winds and/or low humidity. During these periods consideration should be given to:

- Avoiding or postponing activities that can generate sparks, such as mowing or grinding – especially during the heat of the day.
- Having a plan in place to ensure your safety in the event of a wildfire.
- Fire agencies and land managers consider increasing availability of firefighting resources.
- Issue warnings and if required use legislative tools for temporary activity restrictions.

Forest fuels in many areas are becoming drier, meaning that wildfires are more likely and when they do occur will have greater intensities. Under these conditions they are likely to be more destructive than fires in the wetter conditions we have seen over recent years. These forests will also remain relatively dry with elevated fire danger even after small to moderate amounts of rain. The risk will not reduce significantly until they have received substantial and sustained rain.

Drought codes in many areas are higher than they have been in past years and are likely to continue to climb. This means fires are more likely to burn deep into the ground. Fires burning deep can result in controlled burns resurfacing days, weeks, or occasionally months later, and it is likely to make full extinguishment of fires considerably more difficult than has been the case in recent years.

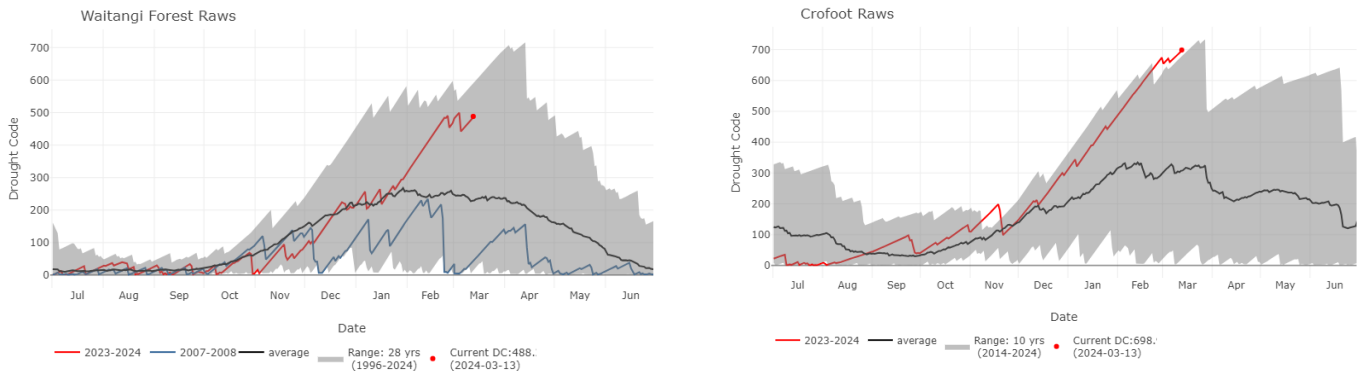


Figure 2: Trend in the Drought Code (DC) for Waitangi Forest Raws and Crofoot Raws, showing the elevated values as of 14 March.

The likelihood of El Niño conditions continuing through autumn and potentially El Niño-like patterns continuing at times into winter could mean an extended fire season.

Restricted or prohibited fire seasons remain in place over much of the country. There may be pressure to lift restrictions and allow burning when there is still a fire risk, especially if autumn remains dry as expected. Elevated drought codes indicate drying of deep organic material and heavy fuels (large logs and branches), both of which require extended wet periods before they are not a fire risk. Also cured grass takes time to green up after rains. In both cases a short period of rain can provide a false sense of security. People are reminded to check the conditions before they light, and if a permit is required via the "Check it's Alright" website.

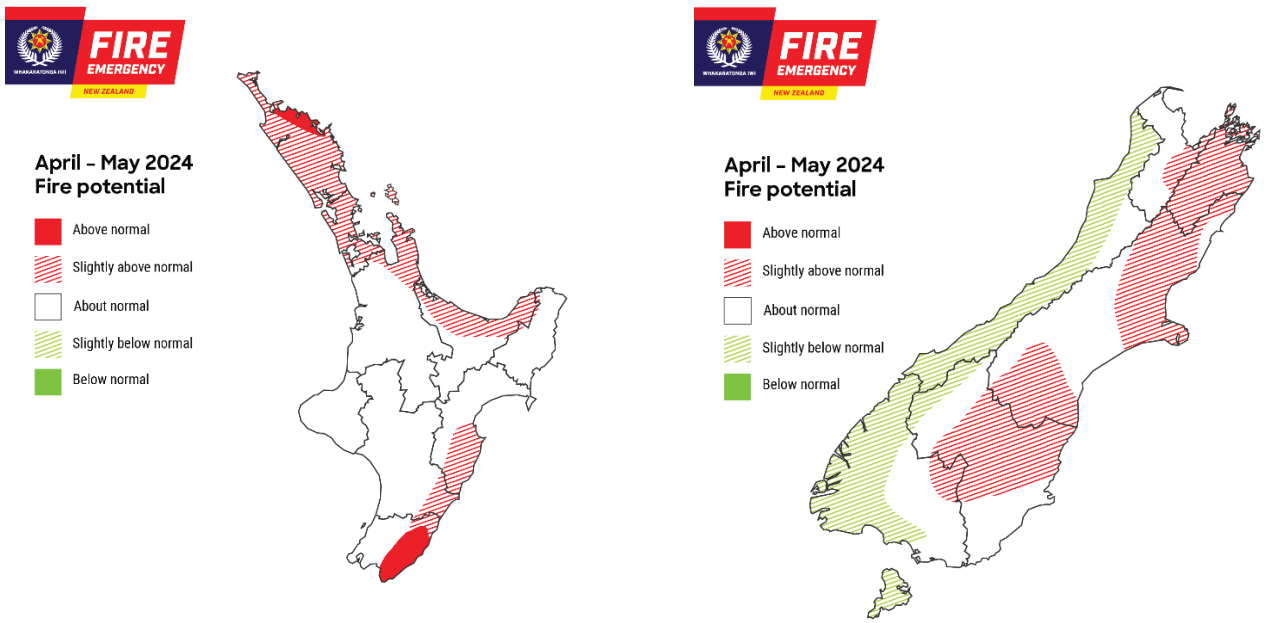


Figure 3: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

Current climate

In February, temperatures were near average (±0.50°C of average) in many areas, although above average temperatures (0.51-1.20°C above average) were observed in parts of Northland, Coromandel Peninsula, Bay of Plenty, Gisborne, northern Hawke's Bay, Wairarapa, southern Marlborough, Canterbury, and north-east Otago. Below average temperatures (0.51-1.20°C below average) covered parts of western Auckland, Waikato, Taranaki, West Coast, and northern Fiordland. So far in March, temperatures have been near average to below average across a majority of New Zealand (Figure 4, right).

February rainfall was below normal (50-79% of normal) or well below normal (<50% of normal) in most regions of the country. However, near normal (80-119% of normal) rainfall was observed in parts of central Waikato, inland Manawatū-Whanganui, West Coast, and inland Southland. The remainder of Southland, Fiordland, and Stewart Island observed above normal (120-149% of normal) or well above normal (>149% of normal) rainfall. So far in March, rainfall has been below normal in many regions, but well above normal in the western North Island (Figure 4, middle).

As of 12 March (see Figure 4, left), soil moisture levels are below normal across most of the upper, eastern, and lower North Island, along with the upper and eastern South Island. Meanwhile, soil moisture levels are above normal in the western North Island and Southland (Figure 4, left).

Climate drivers

The NINO3.4 Index sea surface temperature (SST) anomaly (which covers the west-central equatorial Pacific) over the last month (through 27 February 2024) was +1.58˚C, within the range of a strong El Niño (classified when the NINO3.4 Index is greater than +1.5˚C).

The Southern Oscillation Index (SOI) was in the El Niño range during February (-1.2) and neutral during December-February (-0.4). This suggests that El Niño's reflection in the atmosphere has been atypical, particularly considering the oceanic intensity.

Of the models monitored by NIWA, there's around an 80% chance of El Niño continuing through April and around a 70% chance for ENSO-neutral conditions to develop during May-July.

At the end of February, the subsurface equatorial Pacific was cooler than average below 100 m depth across most of the basin. Above average temperatures were confined to the upper 50-100 m. Upper-oceanic heat content returned to near normal values in the equatorial Pacific aside from the far eastern part of the Pacific, suggesting that 'cool pool' of sub-surface water had significantly eroded warmth associated with El Niño.

Trade wind strength was slightly below normal across most of the equatorial Pacific during February and greatly reduced from normal in the off-equatorial South Pacific, where winds blew from the west. This westerly wind anomaly may have assisted with the eastward progression of a sub-surface cool pool. During March, an area of enhanced trade winds is forecast around the International Date Line, a reversal of February's pattern and the one that dominated over recent months.

During February, convective forcing favoured the central and eastern Pacific with subsidence over the Maritime Continent and western Pacific, strongly aligned with El Niño conditions. It marked an important change compared to previous months where convective forcing favoured the area around the International Date Line. As a result, New Zealand's weather patterns over the last month were more typical of El Niño.

Late in March and into April, the MJO looks likely to migrate into the eastern Pacific and Africa, which may result in a return to westerlies and dryness in northern and eastern areas of both islands. High pressure could be a key climatic feature for New Zealand during April, particularly if the MJO spends a meaningful amount of time in the Indian Ocean.

Critically, a cell of sinking air is forecast to strengthen in the western Pacific to the north of New Zealand during April and May, which would reduce tropical moisture availability to the country during mid and late autumn.

Marine heatwave conditions became much less widespread during February and were confined to the northern and eastern North Island at the end of the month. This owes to stronger than normal winds, which encouraged ocean mixing, particularly near the South Island.

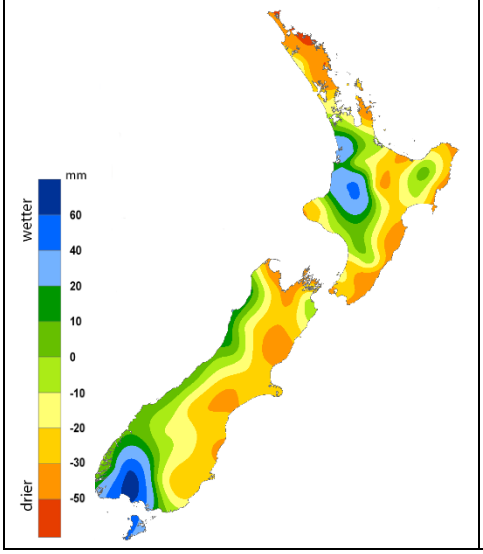
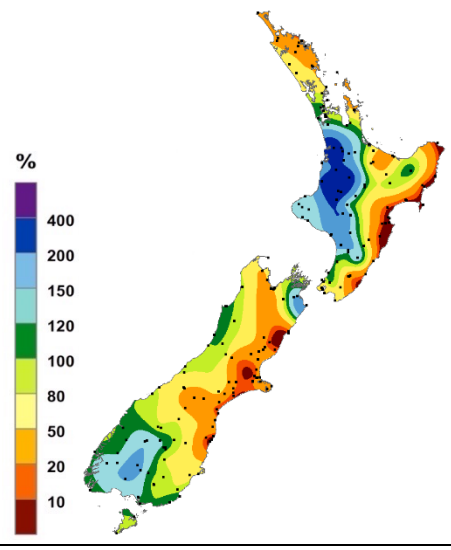
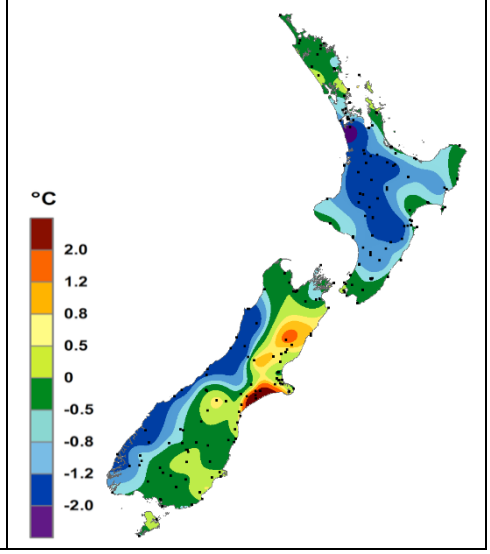
Soil moisture anomaly: 12/3	Rainfall anomaly: 1/3 – 12/3	Temperature anomaly: 1/3 – 12/3
		

Figure 4: Maps showing the current soil moisture anomaly, as well as rainfall and temperature differences from normal since the start of the month.

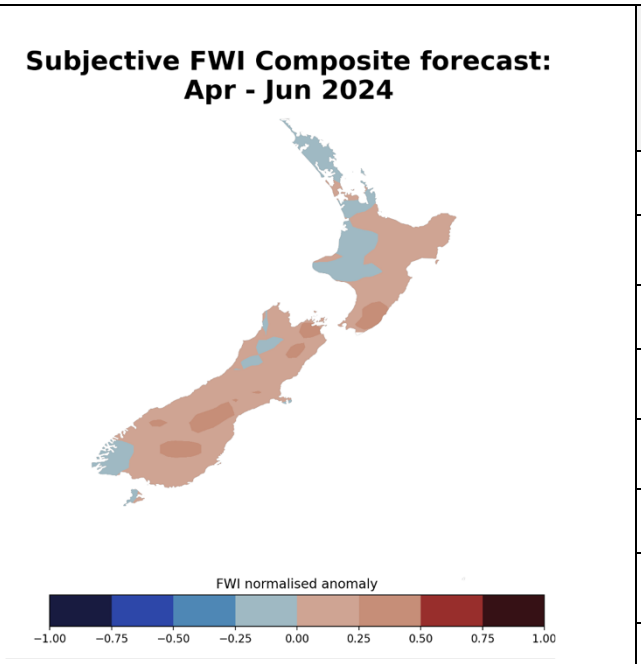
Images from the Nenthorn fire near Macraes Mine, Otago, March 2024.

Fire season analogues

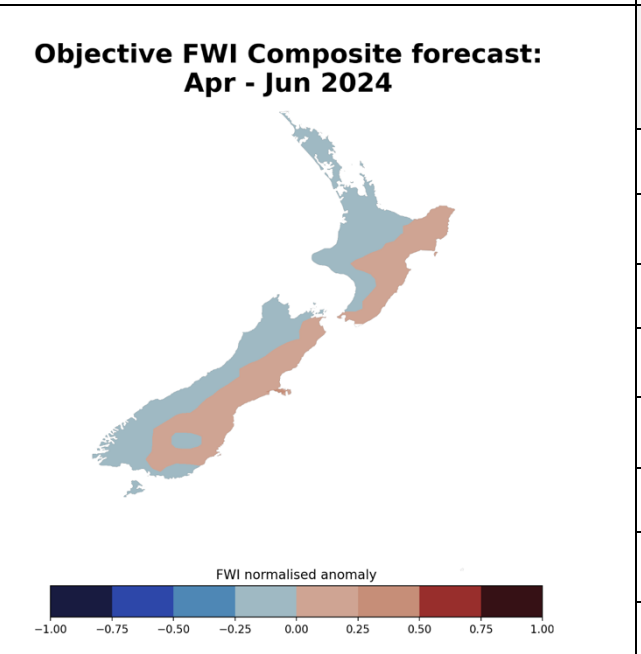
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

This season's analogue years featured historical years that had weakening El Niño patterns in the ocean and/or atmosphere that transitioned either to ENSO-neutral or La Niña later in the year (Figure 5). The subjective analogue seasons are selected with expert interpretation from NIWA. The objective analogue seasons are automatically selected via a computer analysis. Where the two methods agree, confidence tends to be higher. The current situation favours a mix of the two analogue sets.

The expectation for near normal to above normal rainfall in the west of both islands in the coming months should lessen the fire weather threat in those regions. However, drier conditions may become more likely in the east of both islands along with stronger than normal winds at times, potentially increasing the fire weather threats there.



Forecaster-selected analogue season - Apr to Jun
1995
2020
1988
2018
2003
2002
1994
1984



Machine-selected analogue season - Apr to Jun
2004
2001
2000
2013
1981
2011
2007
1990

Figure 5: Analogue fire seasons as selected with expert interpretation from NIWA (top) and automated computer analysis (bottom). The Fire Weather Index (FWI) is a combination of the Initial Spread Index and Buildup Index, and is a numerical rating of the potential frontal fire intensity. In effect, it indicates fire intensity by combining the rate of fire spread with the amount of fuel being consumed. Here, the Fire Weather Index anomaly is calculated by averaging historical analogue years together and comparing to the average FWI between 1991-2020 for the relevant season.

Climate outlook: April 2024

April's air flows are expected to be westerly overall, although high pressure looks to be favoured at least early in the month. This will bring a chance for near normal or above normal rainfall for much of the South Island (especially the West Coast), although drier conditions are possible in the upper and eastern North Island. Wind speeds are expected to be above normal across most of the country, but especially in the South Island and lower North Island. Above average temperatures are favoured for much of the country (Figure 6).

Climate outlook: April – June 2024

A northwest air flow anomaly will be favoured across the country during the season. Temperatures are expected to be above average overall (Figure 7). Rainfall is generally favoured to be above normal in western New Zealand (especially the West Coast), although drier conditions will be possible in parts of the North Island. Slightly below normal relative humidity is expected in the east of both islands. Wind speeds are expected to be higher than normal in the South Island and lower North Island.

The tropical cyclone season for the Southwest Pacific runs through April. In the current El Niño pattern, the tropical cyclone risk for New Zealand is forecast to be slightly below average through the rest of the season, although cyclone formation may occur in the tropics in the coming weeks.

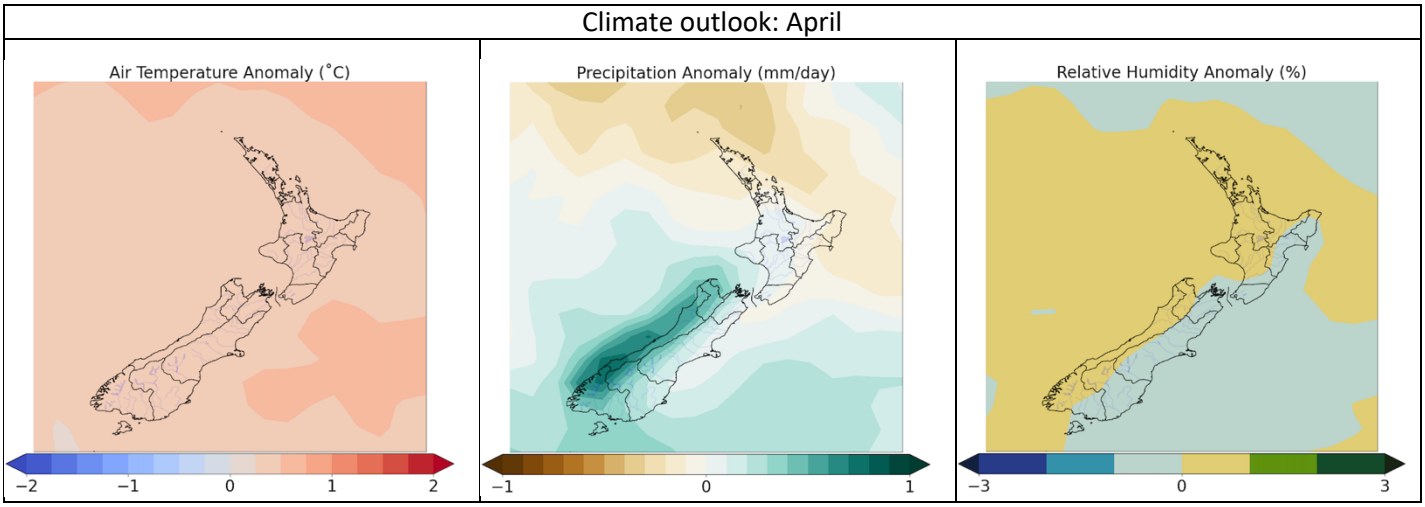


Figure 6: Climate outlook for April showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

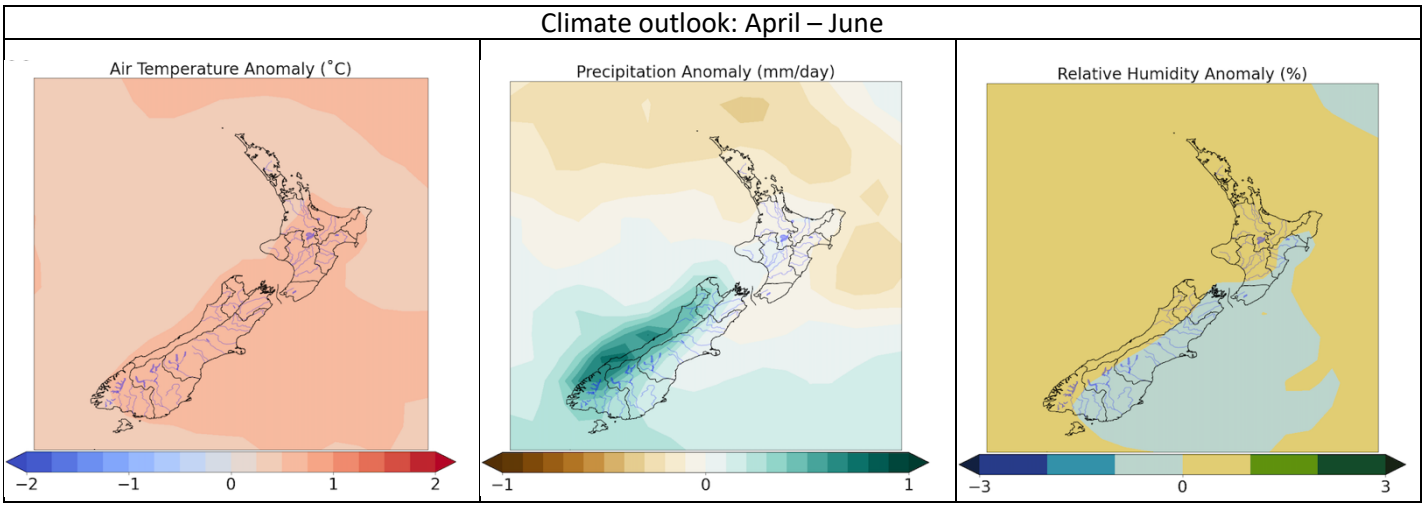


Figure 7: Climate outlook for April-June showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

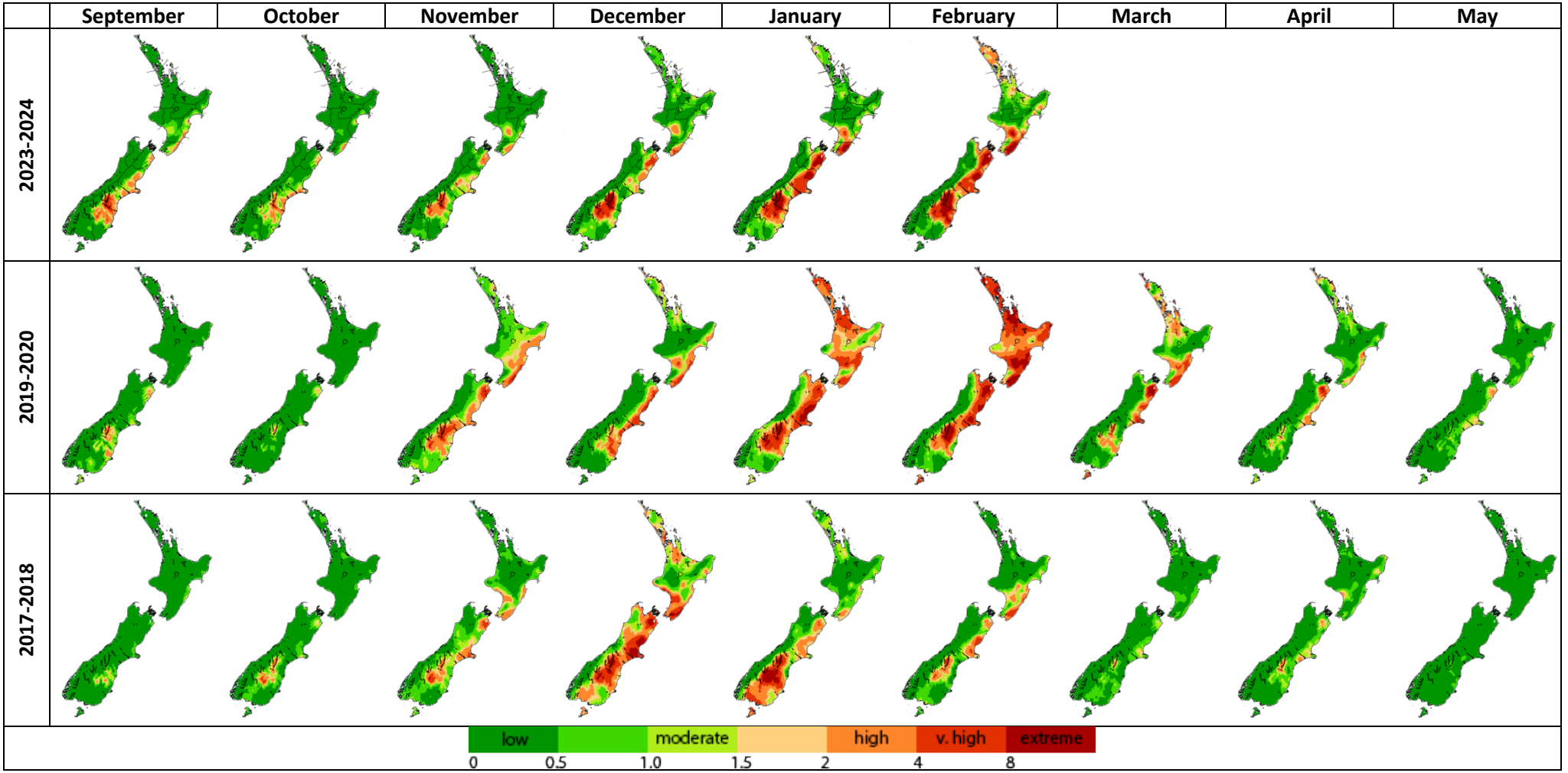


Figure 8: Monthly average severity rating for the current year 2023/2024 and the comparative years of 2019/2020 and 2017/2018. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

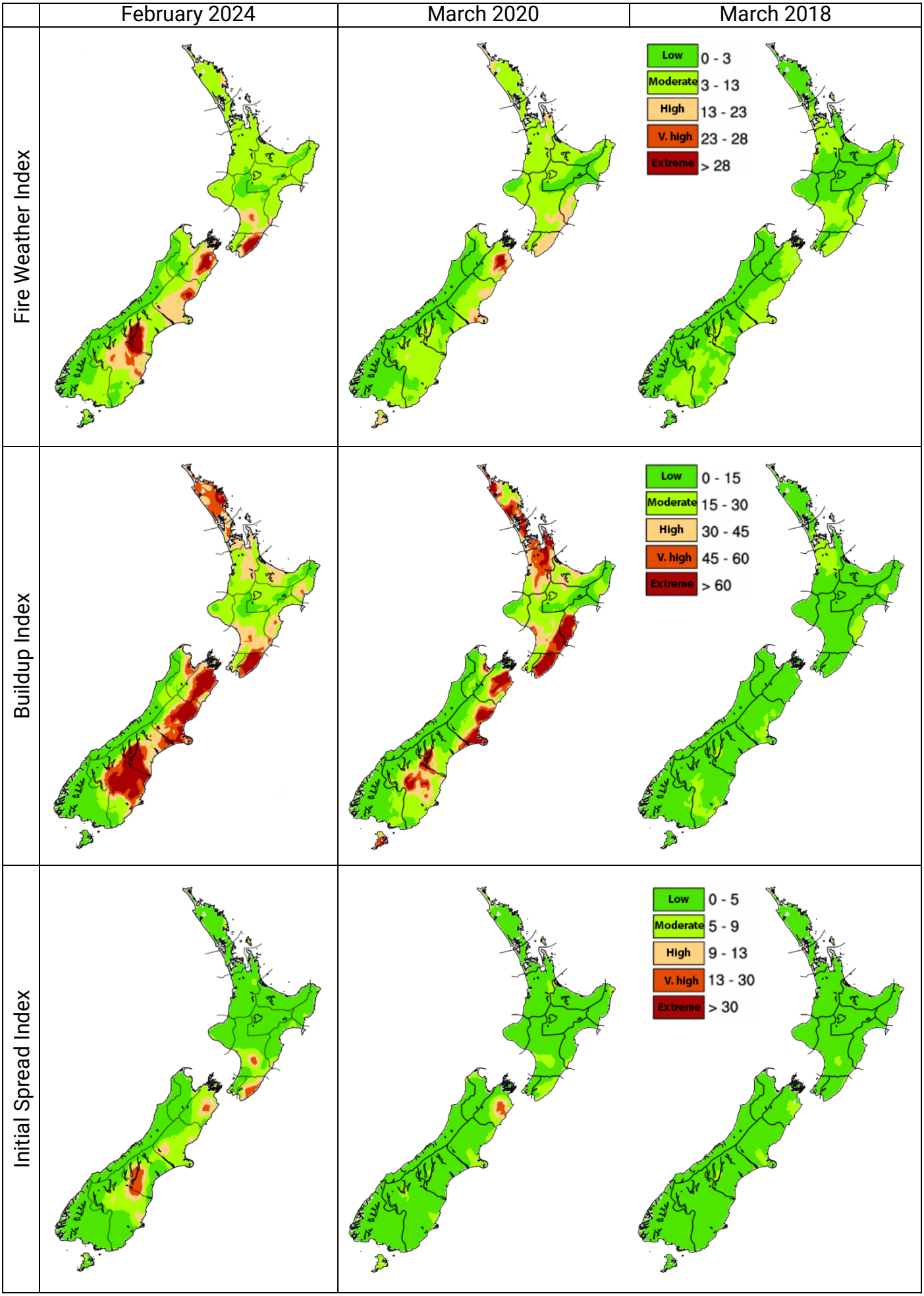


Figure 9: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

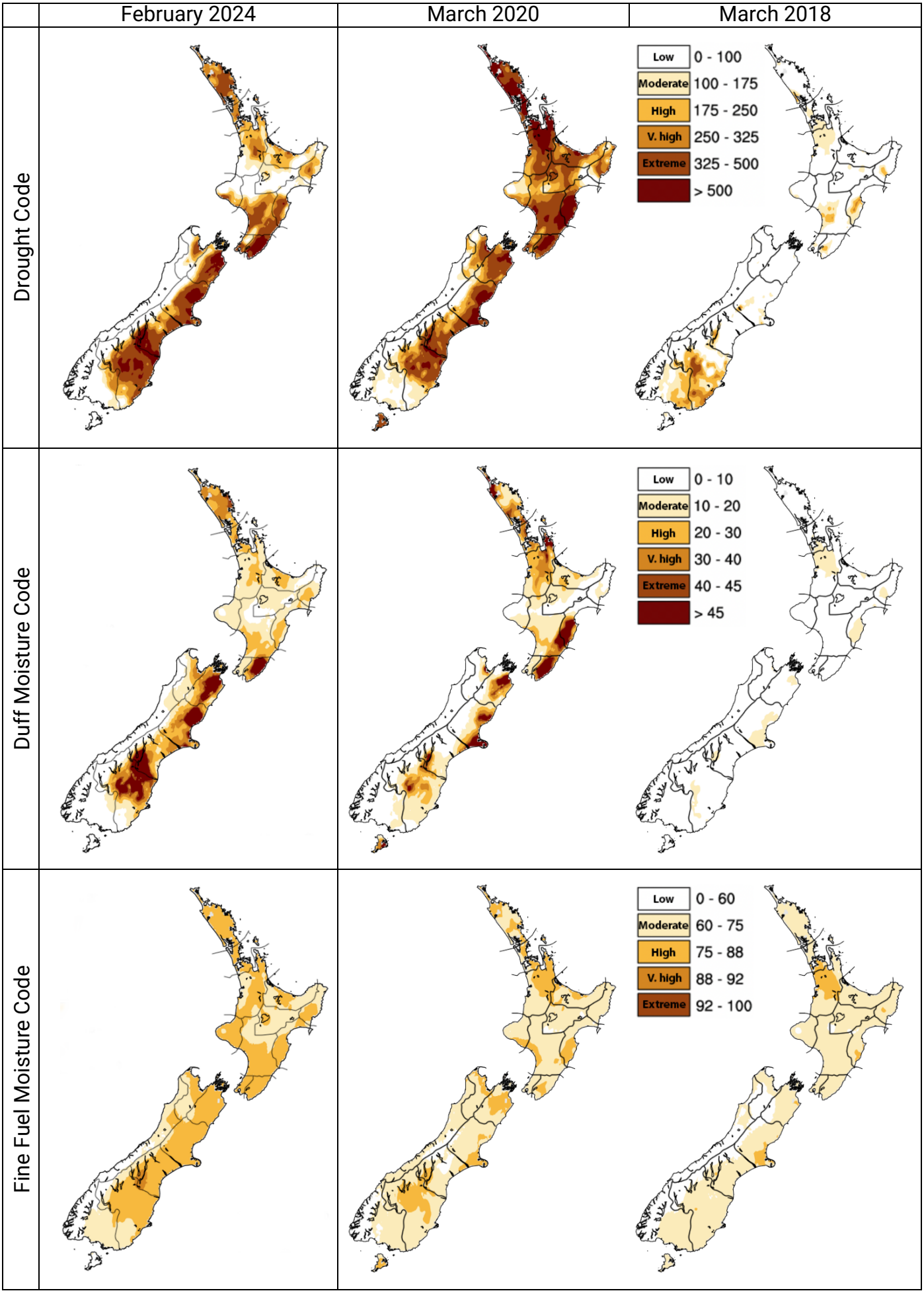


Figure 10: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

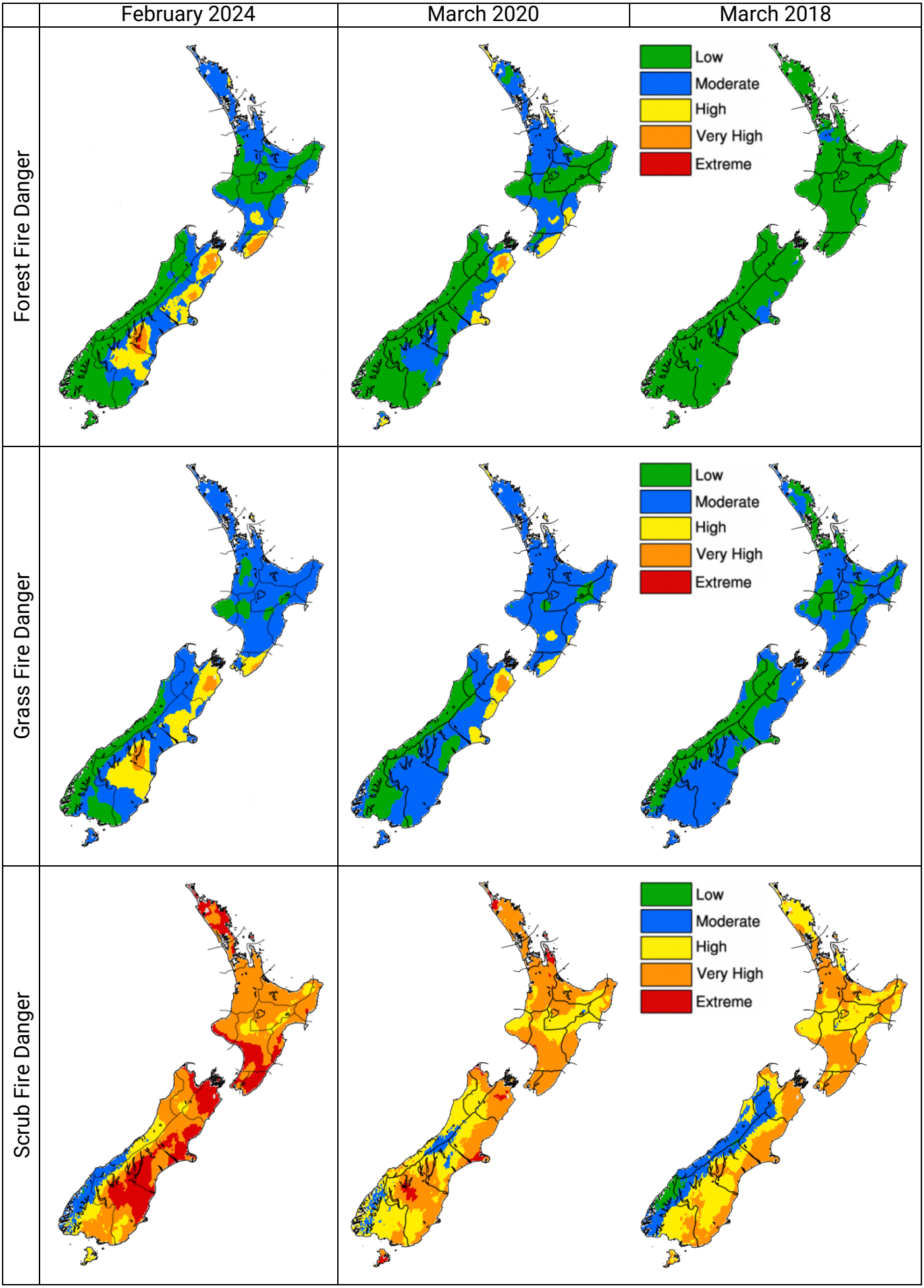


Figure 11: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

Background information on fire weather indices and codes

Fine Fuel Moisture Code: An indicator of the relevant ease of ignition and flammability of fine fuels.

0-74	Difficult
75-84	Moderately easy
85-88	Easy
89-91	Very Easy
92+	Extreme Easy

Initial Spread Index: Combines the effect of wind speed and the FFMC, providing a numerical rating of potential fire spread rate.

0-3	Slow rate of spread
4-7	Moderate fast
8-12	Fast
13-15	Very fast
16+	Extremely fast

Duff Moisture Code: A rating of the average moisture content of loosely compacted organic soil layers (duff/ humus) of moderate depth, and medium-sized woody material.

0-10	Little mop-up needs
11-20	Moderate
21-30	Difficult
31-40	Difficult & extended
41+	Extreme & extensive

Fire Weather Index: Combines the ISI and BUI to indicate the potential head fire intensity of a spreading fire (on level terrain).

0-5	Low fire intensity
6-12	Moderate
13-20	High
21-29	Very high
30+	Extreme

Drought Code: A rating of the average moisture content of deep, compact, organic soil layers, and a useful indicator of seasonal drought effects on forest fuels and amount of smouldering in deep duff layers and large logs.

0-100	Little mop-up needs
101-175	Moderate
176-250	Difficult
251-300	Difficult & extended
301+	Extreme & extensive

Daily Severity Rating: A numerical rating of the daily fire weather severity at a particular station, based on the FWI. It indicates the increasing amount of work and difficulty of controlling a fire as fire intensity increases. The DSR can be averaged over any period to provide monthly or seasonal severity ratings.

Buildup Index: Combines the DMC and DC, and represents the total amount of fuel available for combustion.

0-15	Easy control
16-30	Not difficult
31-45	Difficult
46-59	Very difficult
60+	Extremely difficult

Monthly Severity Rating: is the average of the DSR values over the month. DSR and MSR captures the effects of both wind and fuel dryness on potential fire intensity, and therefore control difficulty and the amount of work required to suppress a fire. It allows for comparison of the severity of fire weather from one year to another.

0-1	Low fire behaviour potential
1-3	Moderate fire potential
3-7	High to very high fire potential
7+	Extreme fire behaviour potential

This document was prepared by NIWA in collaboration with Fire and Emergency NZ