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

Issue: November 2023

Current fire danger situation

Most of October's fire indices were low to moderate across New Zealand, although some higher values were observed in Canterbury and Otago. In addition, scrub fire danger was high to very high across much of the country. See Figures 8-11 for more detail.

El Niño continued during October and will likely intensify over the next three months. It has around a 100% chance of persisting during this time. There's an 80% chance of El Niño continuing through autumn, maintaining an important influence on Aotearoa New Zealand's climate.

Current fuel and soil moisture status

As of 14 November (Figure 4, left), soil moisture levels are near normal to above normal across the upper and eastern North Island and much of the South Island. However, soil moisture is below normal in western Waikato, Wellington, Marlborough Sounds, and parts of Southland.

Current fire dangers across the country are low to moderate as a result of coming out of winter, and the effects of recent rain events which have resulted in wetter than normal spring conditions, even with El Niño.

A change to drier conditions, in eastern and northern areas of both islands from November is seeing fire dangers begin to climb in many areas. This is most obvious in increasing values of the Duff Moisture Code (DMC) (Figure 1), which indicates the potential for greater involvement of medium and shallow subsurface fuels if fires were to occur. Values of the Fine Fuel Moisture Code (FFMC), which represent the dryness of fine fuels, have also been increasing over recent months. These indicate an increased potential for fires to ignite in fine fuels such as scrub and dead grass. In conjunction with periods of increased wind, these elevated FFMC values contribute to high Initial Spread index (ISI) values, indicating potential for any ignitions that do occur in these fine fuels to spread rapidly.

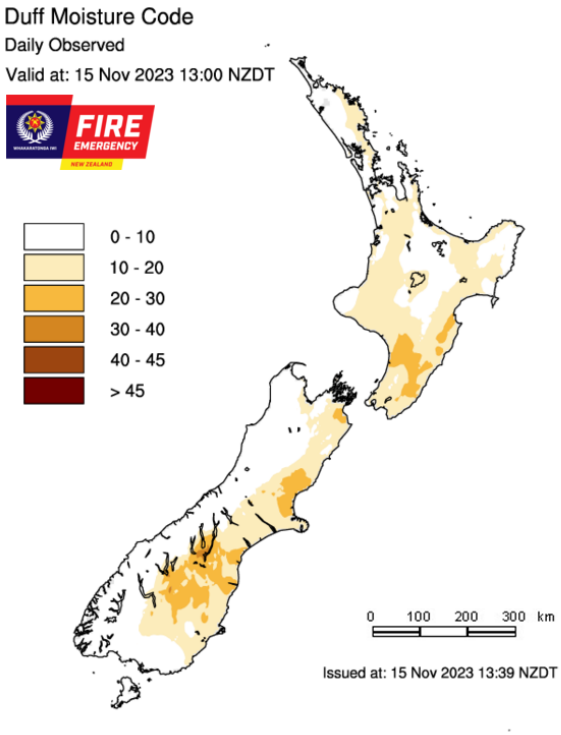


Figure 1: Map of Duff Moisture Code (DMC) values (an indicator of dryness in shallow organic soil layers and medium-sized woody material) as at 15th November.

Forecast climate and weather

The remainder of November may not follow the typical El Niño pattern, as the North Island may tend wetter than normal while the western South Island tends drier than normal. Air flows may also become easterly at times during late November.

For December, El Niño-like patterns become favoured again as high pressure sets up near or over the North Island with low pressure south of the country. This would result in above normal rainfall for the western and lower South Island, but below normal rainfall in the upper and eastern North Island and possibly the east of the South Island. This will also result in near average to above average temperatures and gusty to strong westerly winds at times across much of the country.

December-February will likely exhibit more west-northwest winds than usual. These winds may be strong at times. Drier than normal conditions are favoured in the north and east of the North Island in particular, with wetter conditions in the western and lower South Island. Temperatures overall look to be near average to above average, with the warmest temperatures in the east.

For more information, see pages 4 and 5.

The El Niño climate pattern

While El Niño has about a 100% chance to continue over the next three months, occasional periods that go against the grain of a typical El Niño may occur. For example, late November is favoured to have wetter than normal conditions in the North Island and drier than normal conditions in the western South Island.

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 the 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

A continuation of the more frequent warm, dry W/NW wind conditions, which contribute to easier ignition and fire spread. These can align to produce days with high temperatures and low humidity that escalate fire dangers significantly, especially in eastern areas.

The onset of drier conditions in many areas, especially eastern parts of both islands. This will result in increasing fire dangers, curing-off of grassland areas, and greater involvement of medium and potentially heavier fuels.

Winds stronger than normal could result in large wind-driven fires, especially in light flashy cured grass and scrub fuels. Because these are made up of almost entirely fine fuels, these fuel types can dry out very quickly and become available to burn at high intensities after just a day or two without rain or in windy conditions.

The wet and warmer than normal winter and spring weather has contributed to very good growing conditions. This is resulting in high grass fuel loads that, once they cure, will produce higher than normal fire intensities.

People rushing to burn before fire restrictions come into place may burn in weather conditions that are not suitable (especially windy conditions). People should be reminded to check the conditions before they light, and if a permit is required.

Some of these fires may burn for many weeks if they have soil or silt with them, so could have the potential to reignite as we progress through the coming months. People should therefore ensure their fires are fully extinguished, especially ahead of any forecast wind events.

There will be a continuing of the “see-sawing” of fire dangers heading into December as we get periods of drying interspersed with rain events. This is where fire dangers increase steeply with drying periods, decrease with rain and then increase quickly after. An example is shown in Figure 2 from the Oamaru North weather station and there are similar examples from around the motu.

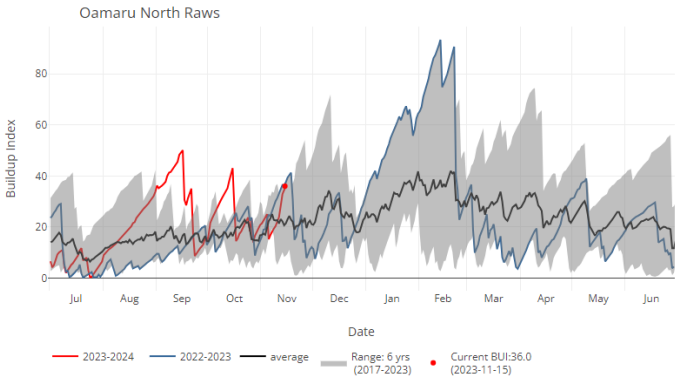


Figure 2: Oamaru North graph of the Buildup Index (BUI) showing the “see-sawing” as periods of drying are interspersed with rain events.

Even in the absence of a strong El Niño influence, a “normal fire season” will have much greater fire potential than the last few fire seasons. The occurrence of the predicted days when dry conditions align with strong winds, high temperatures and low humidity could mean that some areas see many more days of Very High and Extreme fire danger than average for this stage of the fire season. Be vigilant, as indices may change rapidly.

Watch for increasing fire potential as we head into summer. This continues to be the time to complete preparations for the fire season, especially in the north and eastern parts of both islands where the fire potential will more than likely be above normal.

Fire season preparations should include:

- Monitoring risk conditions through our weather station network and grass curing assessments.
- Watching for areas of increasing or already elevated grass curing. During windy conditions, these cured grasses can produce intense fast-moving fires like the Pukaki and Ohau fires of 2020.
- Districts to finalise roster arrangements, including IMT availability for the holiday period and over times of elevated fire danger.
- Te Uru Rakau are reporting that Dothistroma (needle blight) and Red Needle cast are appearing in several North Island plantations because of the wet conditions. The trees typically survive these infections but produce a lot of needle drop which increases the fine fuel loading on the forest floor. Because of the reduced chlorophyll produced, this also makes the live foliage more flammable. There is no information about any inflections in South Island plantations at this stage.
- Planning for spike days when fire danger is especially elevated due to alignment of hot, dry, windy conditions. This could include actions such as awareness campaigns, cancellation of permits or standby arrangements.

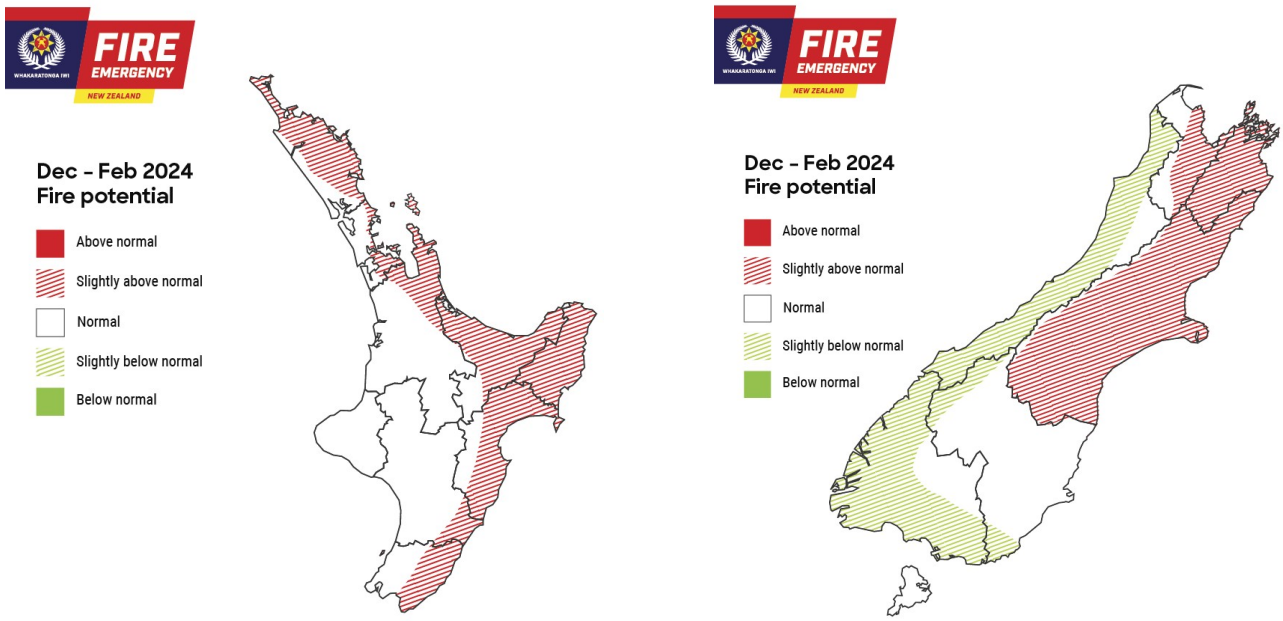


Figure 3: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

Current climate

In October, temperatures were near average (±0.50°C of average) in western Waikato, the lower half of the North Island, Tasman, Nelson, Marlborough, central and interior Canterbury, much of the West Coast, interior Otago, and Southland, and above average (0.51°C to 1.20°C above average) or well above average (>1.20°C above average) in much of Northland, Auckland, northern Waikato, the Coromandel, Bay of Plenty, Gisborne, parts of northern and interior Canterbury, coastal South Canterbury, and eastern Otago. So far in November, temperatures have been near average across a majority of the country, with only small pockets of above average and below average temperatures (Figure 4, right).

October rainfall was above normal (120-149% of normal) or well above normal (>149% of normal) in much of Northland, coastal Gisborne, and interior South Canterbury. Below normal (50-79% of normal) or well below normal (<50% of normal) rainfall was observed in southern Auckland, much of Waikato, Bay of Plenty, Hawke's Bay, Taranaki, Manawatū-Whanganui, Wellington, Tasman, Nelson, Marlborough, coastal Canterbury, the upper West Coast, much of Otago, and Southland. So far in November, rainfall has been below normal or well below normal across much of the country. However, areas of near normal to above normal rainfall have been observed in Northland, Bay of Plenty, Gisborne, Hawke's Bay, Nelson, and the eastern South Island (Figure 4, middle).

As of 14 November, soil moisture levels are near normal to above normal across the upper and eastern North Island and much of the South Island. However, soil moisture is below normal in western Waikato, Wellington, Marlborough Sounds, and parts of 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 31 October) was +1.60˚C (climatology: 1991-2020), within the range of a strong El Niño (classified when the NINO3.4 Index is greater than +1.5˚C). The October 2023 NINO3.4 Index is exceeded by 2015, 1997, and 1982, with data back to 1981. The October NINO1.2 Index value (eastern equatorial Pacific) of +2.38˚C is exceeded only by 1997. From an oceanic perspective, this El Niño continues to rank with the most significant events in recent decades.

The Southern Oscillation Index (SOI) was near the El Niño threshold during August-October (-0.9), but neutral (-0.4) during October (climatology: 1991 – 2020).

Of the models monitored by NIWA, there's around a 100% chance of El Niño continuing through January 2024 and an 80% chance that the event persists through autumn 2024.

In the subsurface equatorial Pacific Ocean, SST anomalies of +3˚C to +6˚C were occurring in the upper 100 metres in the east as of late October. A new area of anomalies greater than +3˚C developed in the west-central equatorial Pacific during the month, in response to a downwelling oceanic Kelvin Wave. This will transfer ocean heat eastward on the time horizon of the next 1-2 months. This lends credence to the models that suggest a peak El Niño strength in December 2023 or January 2024.

Trade wind strength was below normal or well below normal in the Pacific during October, particularly just north of the equator. In parts of the region, this qualified as a Westerly Wind Burst (WWB). This WWB will likely be responsible for the eastward propagation of warm sea water along the equator through the end of the year.

In the Indian Ocean, a strongly positive Indian Ocean Dipole (IOD) event is occurring. In its positive phase, the IOD corresponds to cooler than average seas in the eastern tropical Indian Ocean. The positive IOD event will likely be associated with a strong area of sinking motion over the wider Australasia region into early 2024, seeing high pressure systems commonly migrate from Australia toward northern New Zealand. This pattern is expected to have a strong influence on regional moisture availability and suppress the chance for atmospheric rivers and ex-tropical cyclones in New Zealand. This positive IOD event has strong similarities with the late 2019 event and may reach peak intensity during November.

The low frequency forcing associated with El Niño and the IOD is expected to be a dominant driver of climatic variability in the season ahead. For New Zealand, this will likely lend itself to weather patterns that are aligned with El Niño expectations for extended periods of time, including frequent westerly wind flows and drier than normal conditions in the north and east, especially in the North Island.

A remnant area of warmer than average seas near the International Date Line in the equatorial Pacific will occasionally impose weather patterns that are different to what would normally occur during a typical El Niño, such as what happened with the remnants of Tropical Cyclone Lola in late October. Such periods of variability have low predictability on a seasonal scale and weather-related impacts are tied to the prevailing pressure pattern occurring near New Zealand and the Tasman Sea around the time of occurrence.

Overall, these climate drivers will favour high pressure near and north of the North Island and low pressure to the south of the South Island. The associated pressure gradient (difference in air pressure) is expected to drive stronger than normal and frequent westerly quarter winds and occasionally intense lows and fronts into the western and lower South Island. More frequent high pressure to the north of the country will also reduce, but not eliminate, the chance for strong atmospheric rivers and ex-tropical cyclones.

Seasonal wind strength is predicted to be above normal across the country. This means there will be a higher than normal risk for damaging winds. These winds will also bring warm-to-hot and dry air from Australia at times, culminating in spells of well above average temperatures, particularly in eastern areas of both islands.

New Zealand's coastal water temperatures were generally near average or slightly above average for the time of year during October. Localised marine heatwaves were occurring along the northern and eastern coastal fringes of both islands. In the months ahead, the expectation for stronger winds, in association with a fully developed El Niño, means that the risk for the development of widespread marine heatwave conditions in New Zealand's coastal waters is low; however, during periods of unusually warm conditions, localised-to-regional marine heatwaves may continue or develop, particularly near the north and east of both islands.

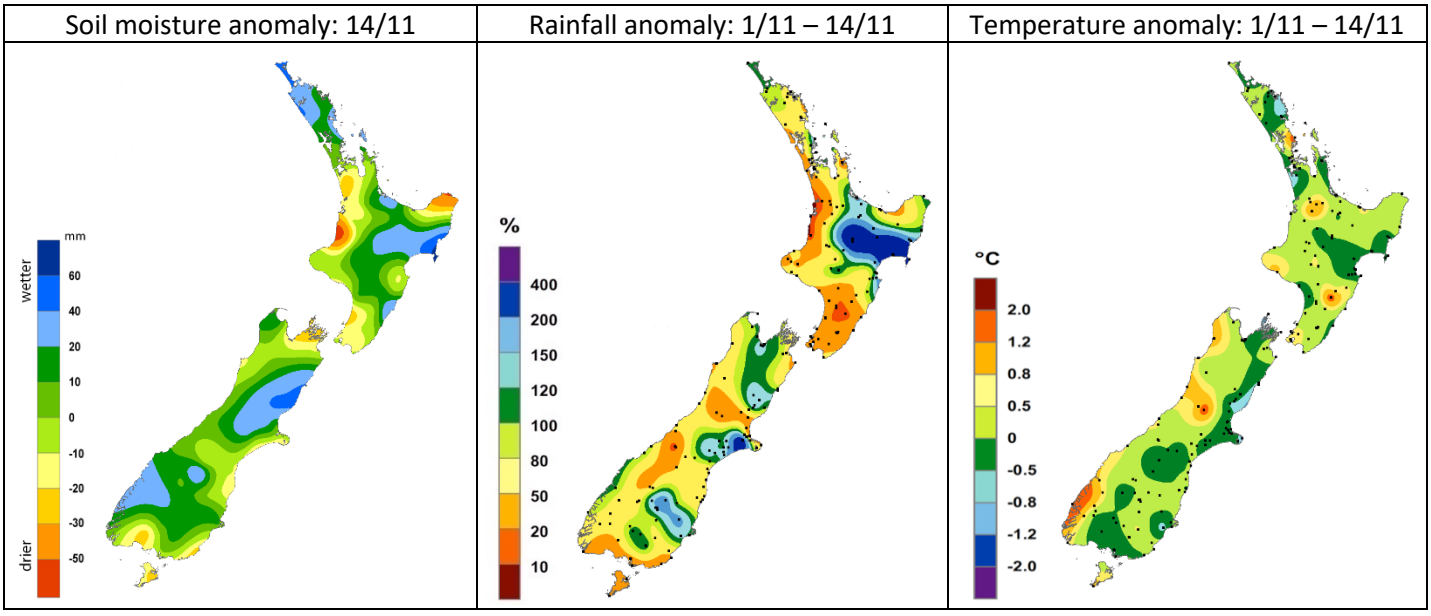


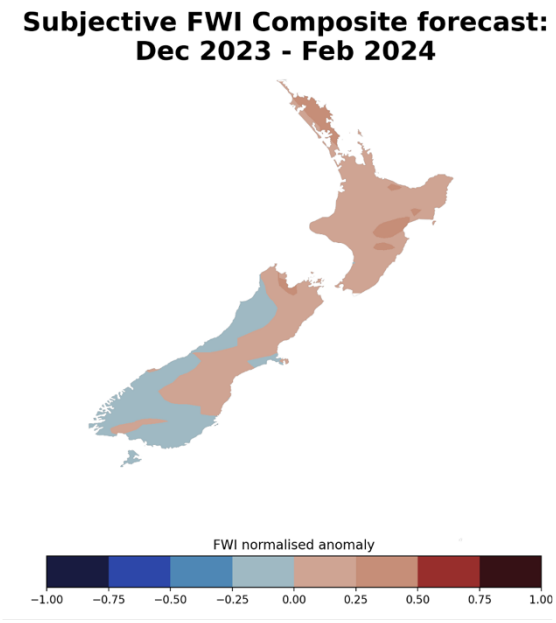
Figure 4: Maps showing the current soil moisture anomaly, as well as rainfall and temperature differences from normal since the start of the month.

Fire season analogues

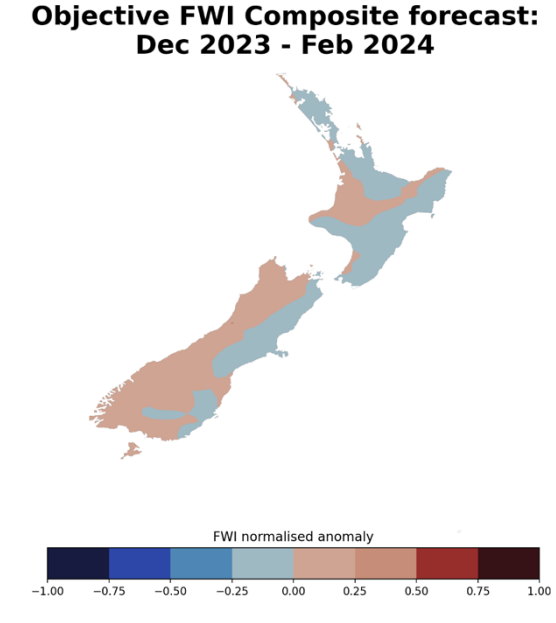
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

This season's analogue years featured historical years that had El Niño patterns in the ocean and/or atmosphere (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 strongly favours the expert-selected years for December-February.

The North Island is expected to have higher fire danger than normal during the season, with enhanced chances in parts of Northland and the east coast. Meanwhile, eastern and northern parts of the South Island are expected to have higher fire danger risks than normal, while western and southern areas see a decreased risk. This agrees with the expected westerlies commonplace with an El Niño pattern.



Forecaster-selected analogue season - Dec to Feb
2019-2020
1997-1998
2018-2019
2015-2016
2009-2010
1982-1983
2006-2007
2004-2005



Machine-selected analogue season - Dec to Feb
1996-1997
2007-2008
2013-2014
2014-2015
1980-1981
2006-2007
2001-2002
2020-2021

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: December 2023

December's air flows are generally expected to be more westerly than normal, which is typical during El Niño. The signal is for a drier than normal month for much of the North Island, especially in the north and east. In the South Island there is a drier lean in Marlborough and Canterbury, but other regions lean wetter. Wind speeds are expected to be above normal across the country. Near average to above average temperatures and lower than normal relative humidity are favoured in many regions, especially in the east of both islands (Figure 6).

Climate outlook: December 2023 – February 2024

El Niño will continue during the season, and this will favour a west-northwest air flow anomaly. Temperatures continue to look near average to above average overall, although occasional hot days will be likely (Figure 7). Rainfall is favoured to be below normal in parts of the North Island, but wetter conditions are indicated for the western and lower South Island. Slightly below normal relative humidity is expected in eastern regions. Wind speeds are expected to be higher than normal for most of the country.

The tropical cyclone season for the Southern Hemisphere runs from November through April. In this El Niño pattern, the tropical cyclone risk for New Zealand is forecast to be slightly below average.

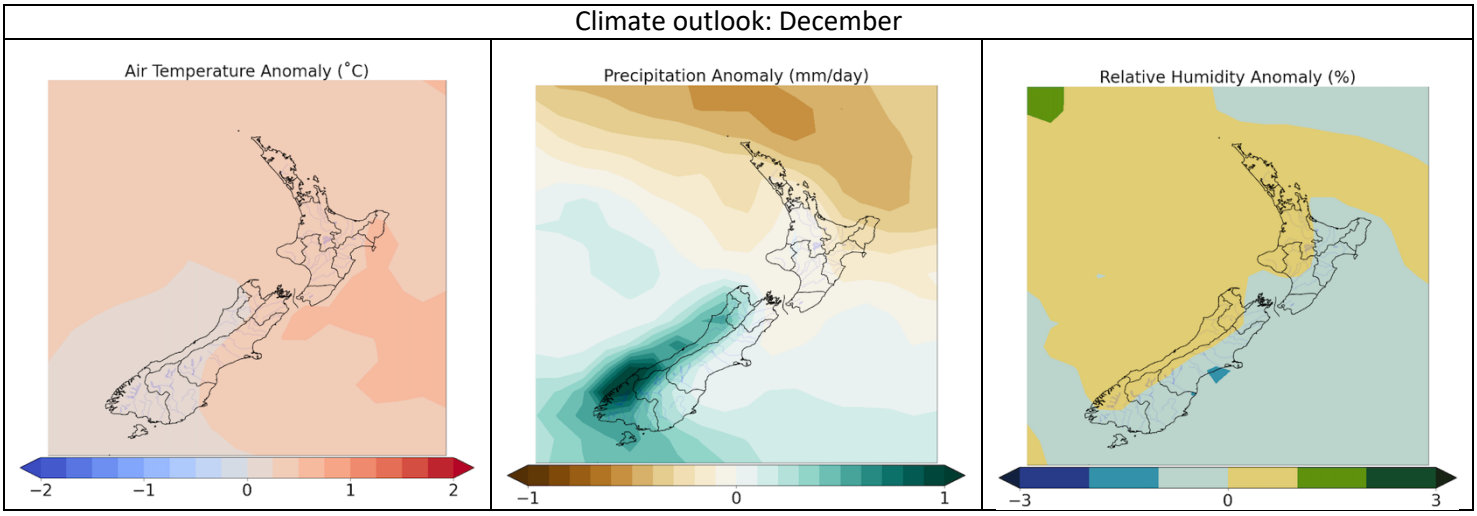


Figure 6: Climate outlook for December showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

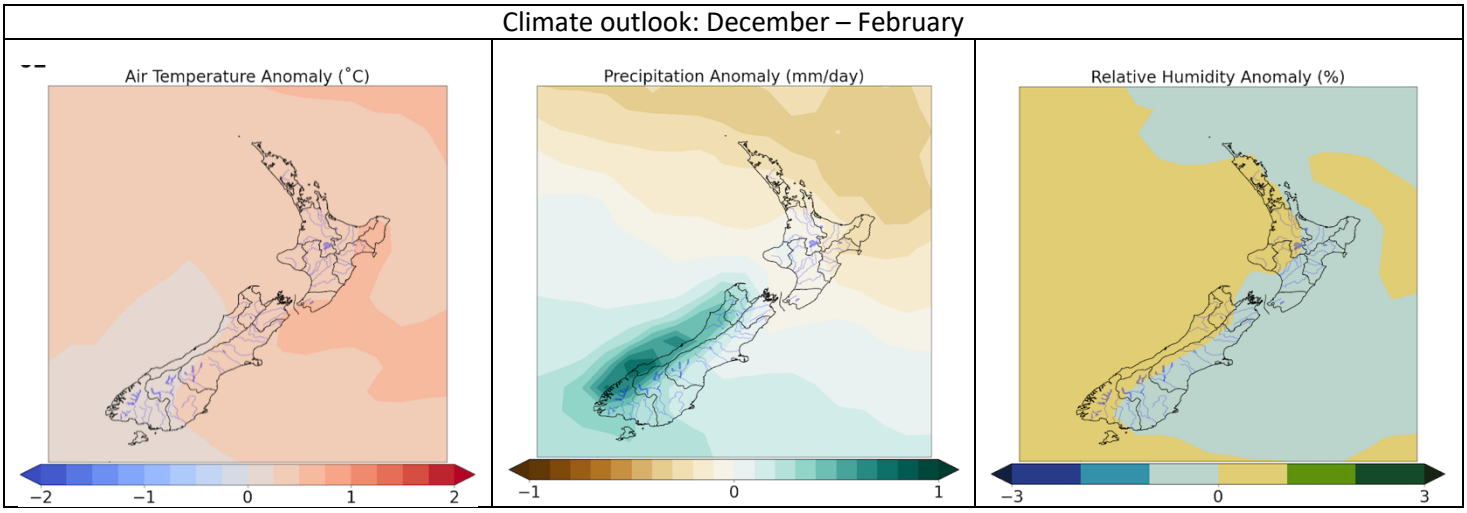


Figure 7: Climate outlook for December-February showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

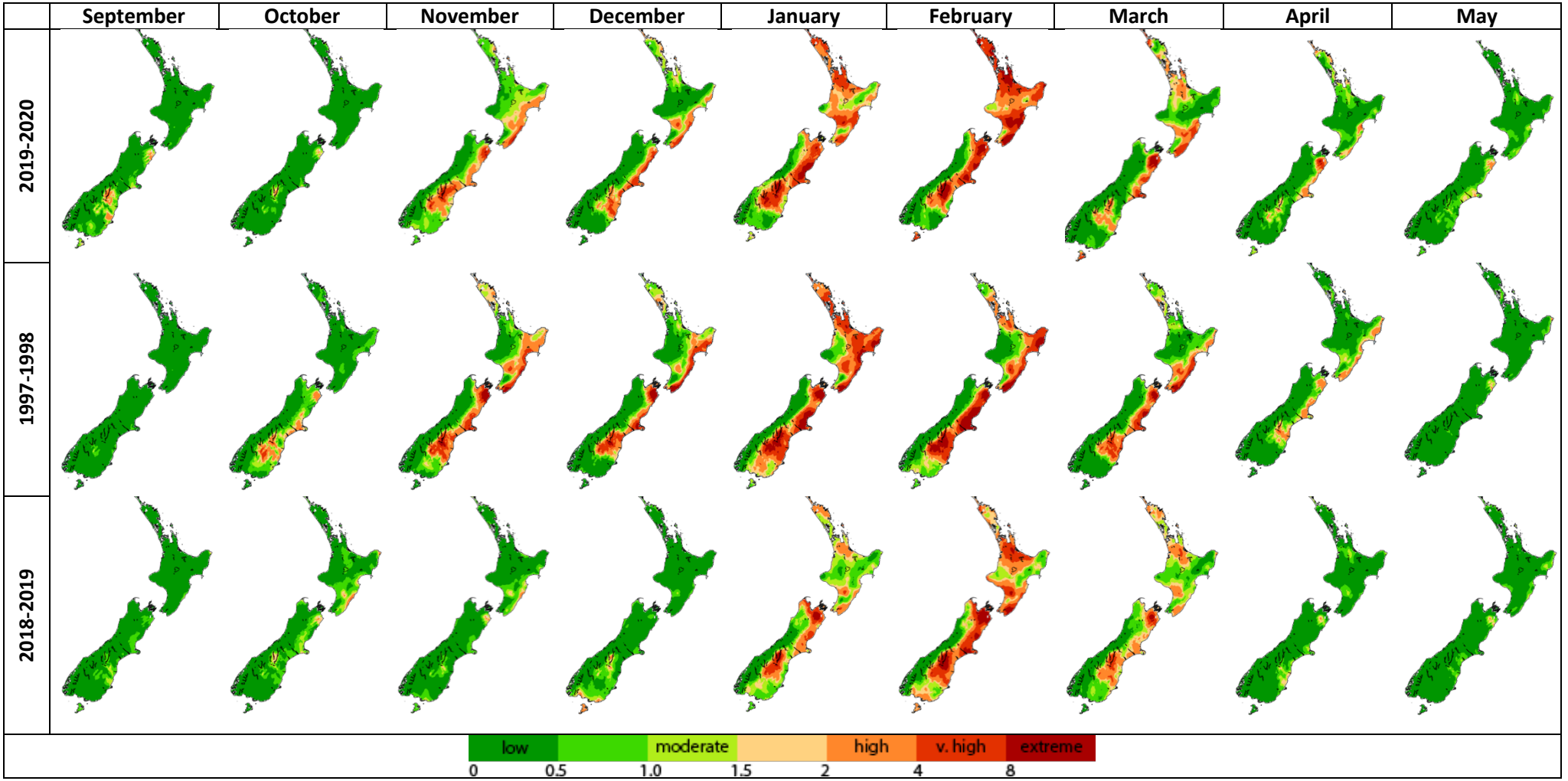


Figure 8: Monthly average severity rating for the comparative years of 2019/2020, 1997/1998, and 2018/2019. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

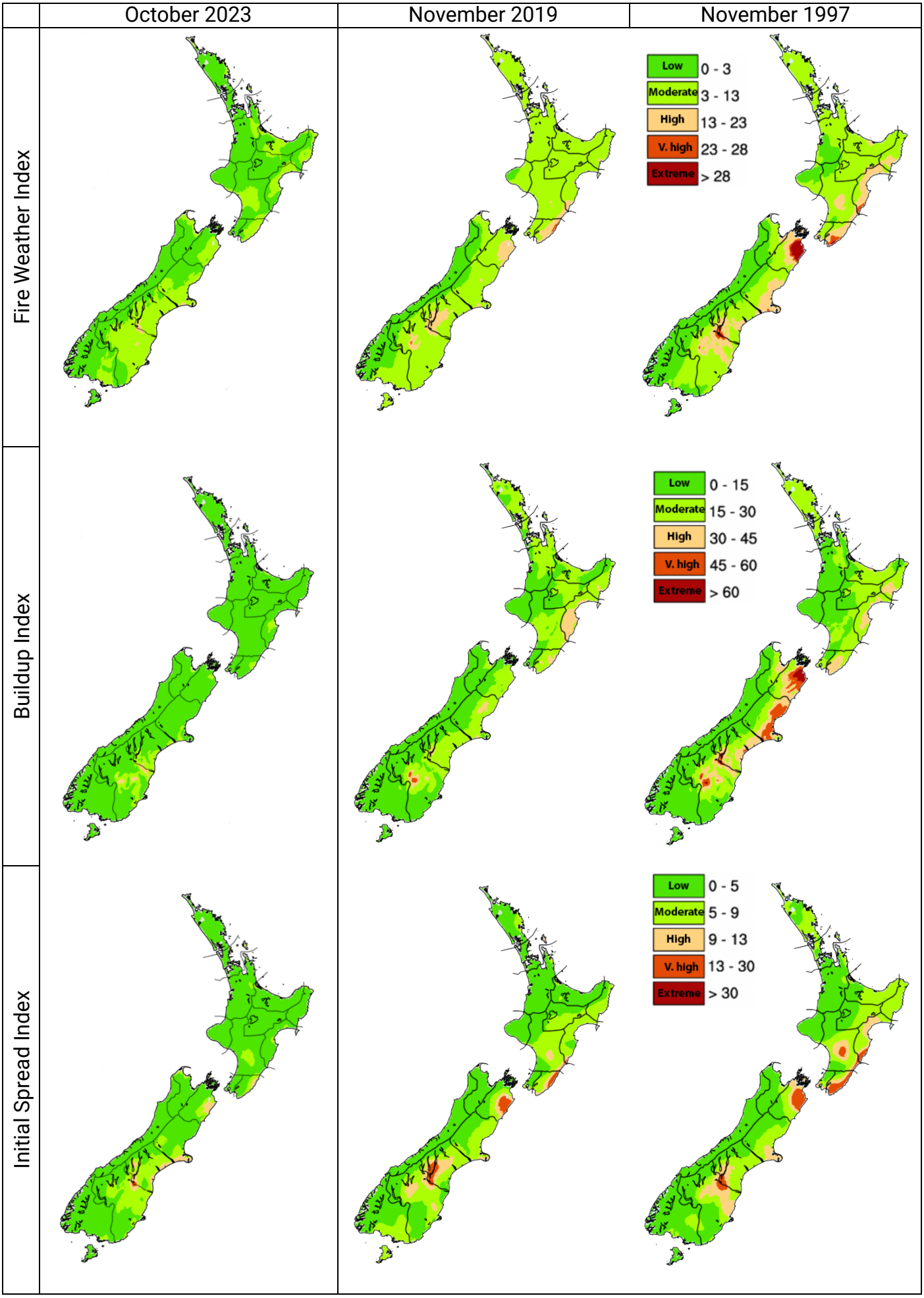


Figure 9: The most recent observed month (left column) and analogue months for November (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

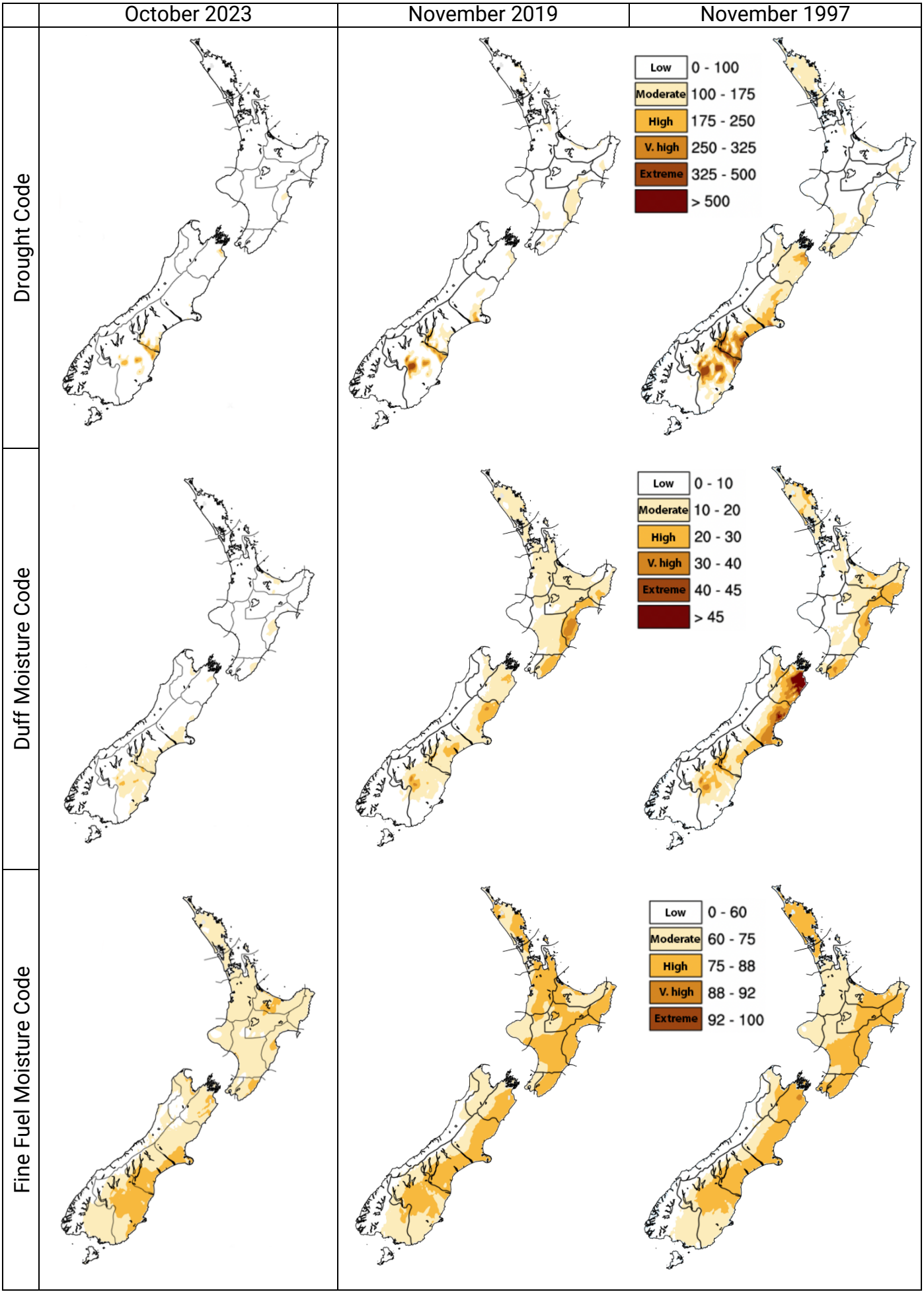


Figure 10: The most recent observed month (left column) and analogue months for November (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

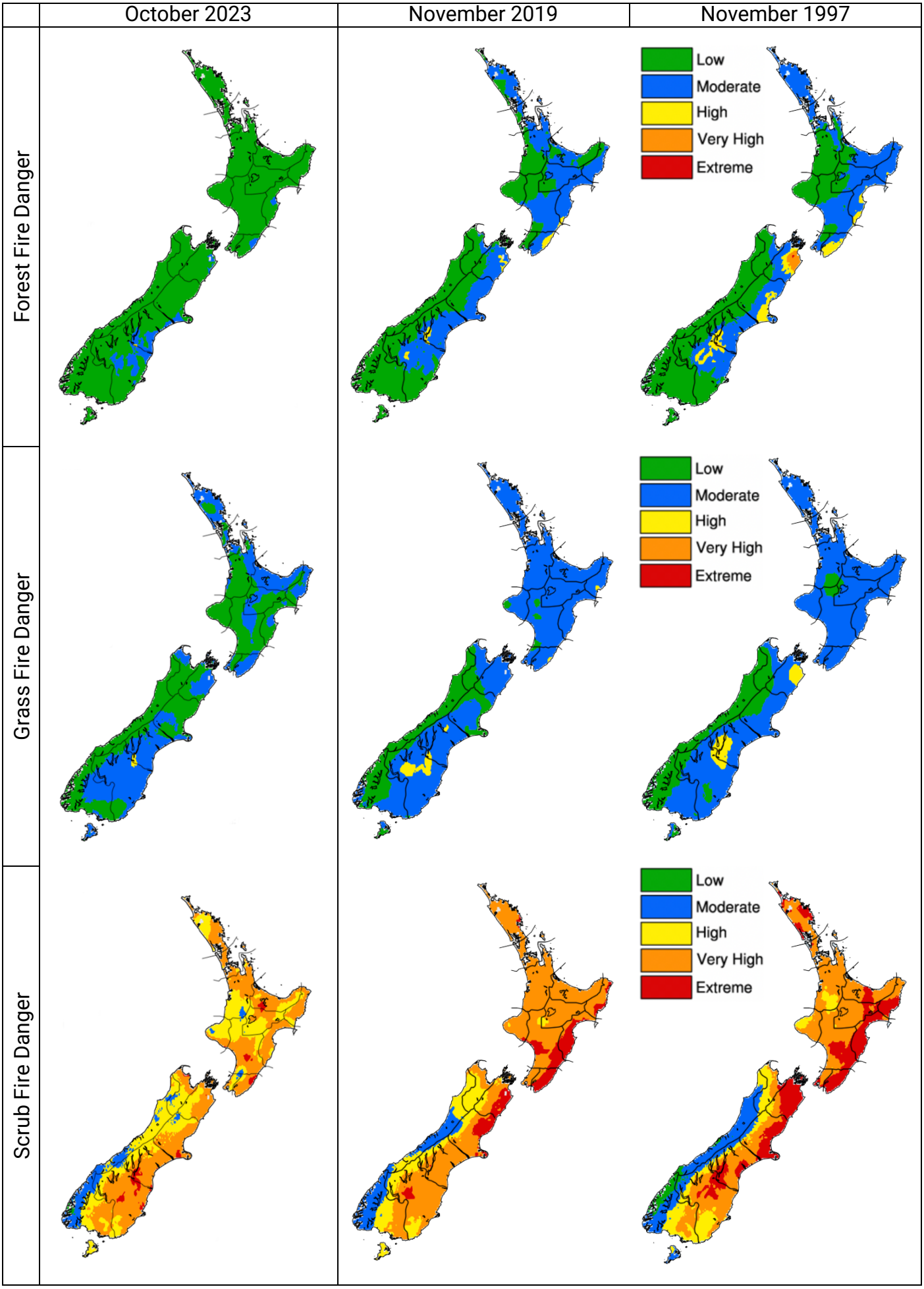


Figure 11: The most recent observed month (left column) and analogue months for November (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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