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

Issue: October 2023

Current fire danger situation

September's various fire indices were generally low to moderate, although some higher values were observed in South 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 was officially declared by NIWA at the end of September when a majority of NIWA's criteria for classifying an El Niño event were satisfied. In particular, the Southern Oscillation Index (SOI) was firmly in El Niño territory, suggesting the atmosphere has become coupled to the ocean.

Current fuel and soil moisture status

As of 13 October (Figure 4, left), soil moisture levels are near normal across a majority of the country, with some drier than normal soils in the top of the South Island and wetter than normal soils in the east of both islands.

Current fire dangers across the country are low to moderate as a result of coming out of winter, the carry-over effects of the below normal fire dangers last season which resulted from the wetter than normal summer and autumn in most parts of the country and recent rain events.

However, a change to drier conditions, in eastern and northern areas of both islands from November will see fire dangers begin to climb. 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 weeks. 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.

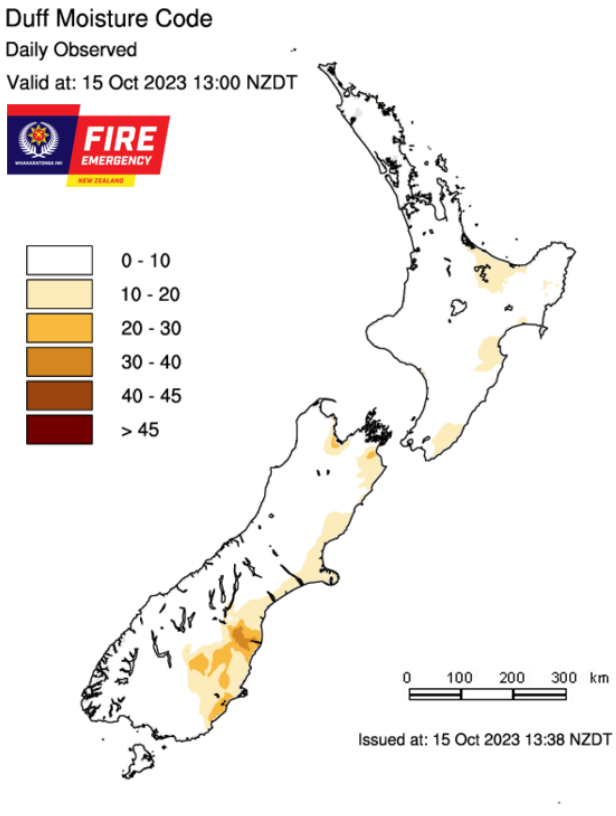


Figure 1: Map of Duff Moisture Code (DMC) values (an indicator of dryness in shallow organic soil layers and medium-sized woody material) as at 15th October.

Forecast climate and weather

The remainder of October looks to be variable, with a mix of dry periods and occasional areas of low pressure mostly arriving from the west.

For November as a whole, El Niño-like conditions may become more entrenched 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 west of the South Island, but below normal rainfall in the North Island and the east of the South Island. This will also result in variable temperatures and gusty to strong westerly winds at times, especially in the South Island.

November-January will likely exhibit more westerly winds than usual, as is typically the case during an El Niño. These winds may be strong at times. Drier than normal conditions are favoured in eastern and northern areas of both islands, with wetter conditions in the western and lower South Island. Temperatures overall look to be near average to above average.

For more information, see pages 4 and 5.

The El Niño climate pattern

The formation of a fully-fledged El Niño event requires the coupling of both the atmosphere and ocean, and these parameters were reached at the end of September, leading NIWA to declare an official El Niño.

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. Previous El Niño seasons (and their strength) include 2015/16 (strong), 2009/10 (strong), 2002/03 (moderate) and 1997/98 (strong).

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

More frequent warm, drier W/NW wind conditions which contribute to easier ignition and fire spread. These may 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 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 early spring weather has contributed to very good growing conditions. This will result in high grass fuel loads that, once they begin to 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).

More and larger burns this year as people clean up storm damage. Some of these fires may burn for many weeks if they have soil or silt with them these will have the potential to reignite as we progress through the coming months.

Even a “normal fire season” will have much greater fire potential than last fire season. However, 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 early part of the fire season. Be vigilant, as indices may change rapidly.

There will be a continuing of the “see-sawing” of fire dangers heading into November 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.

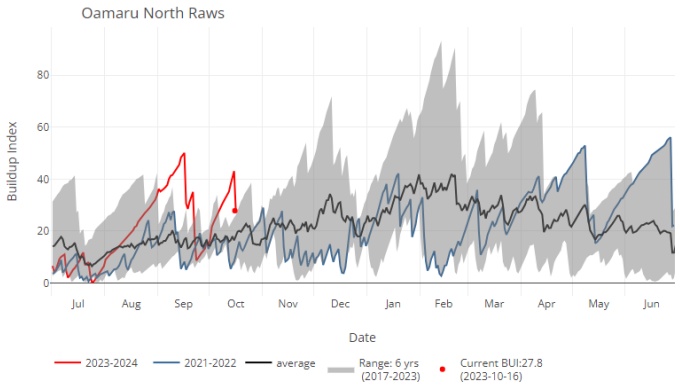


Figure 2: Oamaru North graph of the build up index showing the “see-sawing” as periods of drying are interspersed with rain events.

Watch for increasing fire potential as we head into summer. This continues to be the time to prepare 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.
- Watch 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.
- Carrying out Fire Crew and Brigade readiness checks.
- Ensuring contract and FENZ resources are available for response especially as we head into the holiday season.
- Raising awareness of defensible spaces around assets.
- 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.
- Have a plan with industries for additional risk management should the conditions escalate, such as management of spark hazardous activities and standby arrangements.
- Identify people that have the expertise to assist with more localised forecasts for your patch

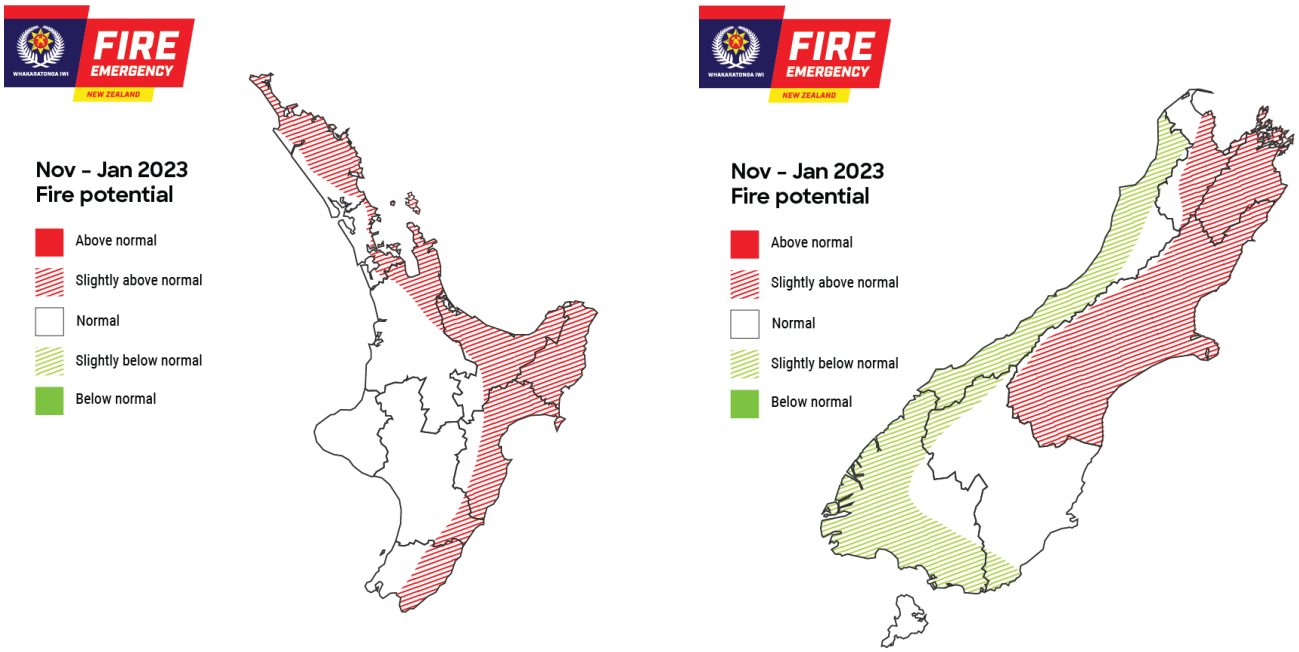


Figure 3: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

Current climate

In September, temperatures were above average (0.51°C to 1.20°C above average) or well above average (>1.20°C above average) in every region of the country. The nationwide average temperature was 1.3°C above the 1991-2020 September average, making it the country's warmest September on record. So far in October, temperatures have been near average or below average across the entire North Island along with the top and west of the South Island. Above average temperatures have been observed across much of Canterbury, Otago, and Southland (Figure 4, right).

September rainfall was above normal (120-149% of normal) or well above normal (>149% of normal) in parts of Southland, Otago, Canterbury, coastal Wairarapa, Gisborne, Bay of Plenty, Waikato, and Auckland. Rainfall was below normal (50-79% of normal) in parts of the Hutt Valley, Kāpiti Coast, Manawatū-Whanganui, southern Hawke's Bay, and Banks Peninsula. So far in October, rainfall has been below normal or well below normal across a majority of the country. However, pockets of near normal to above normal rainfall have been observed in Northland and the east coast of the North Island (Figure 4, middle).

As of 13 October, soil moisture levels are near normal across a majority of the country, with some drier than normal soils in the top of the South Island and wetter than normal soils in the east of both islands (Figure 4, left).

Climate drivers

The NINO3.4 Index anomaly (which covers the west-central equatorial Pacific) over over the last month (through 27 September) was +1.58˚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 September 2023 NINO3.4 Index is exceeded only by 2015 and 1997, with data back to 1981. The September NINO1.2 Index (eastern equatorial Pacific) of +2.86˚C is exceeded only by 1997. From an oceanic perspective, this strengthening El Niño ranks close to the most significant events in recent decades.

The Southern Oscillation Index (SOI) was well within the El Niño range during September (-1.5) (climatology: 1991 – 2020). The three-month SOI value was -1.0.

El Niño conditions are now occurring, as a majority of NIWA's criteria for classifying an El Niño event have been satisfied. In particular, the Southern Oscillation Index was firmly in El Niño territory over the last three months, suggesting that the atmosphere is now coupled with the ocean.

Of the models monitored by NIWA, there's around a 100% chance of El Niño continuing through December and over a 95% chance that the event persists through summer. There's a 75% chance for the continuation of El Niño conditions through autumn 2024.

In the subsurface equatorial Pacific Ocean, anomalies of +3˚C to +6˚C were occurring in the upper 100 metres in the east as of late September. The distribution of the anomalously warm water remained consistent with the development of an east-based canonical El Niño event. The abnormally warm waters are predicted to continue to surface and expand westward over the course of the next three to four months, with the event peaking as a very strong El Niño (classified

when the NINO3.4 Index is greater than 2.0˚C) in December 2023-January 2024.

During September, trade wind strength was below normal in the west-central Pacific just east of the International Date Line and near normal or above normal farther east.

In the Indian Ocean, a positive Indian Ocean Dipole (IOD) event has developed. In its positive phase, the IOD corresponds to cooler than average seas in the eastern tropical Indian Ocean, and warmer than average seas in the west. Its development is forecast to be associated with a strong cell of suppressed convection over the wider Australasia region during October-December, which will see 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 tropical rainmakers.

This burgeoning positive IOD event has strong similarities with the 2019 event and the indices that monitor the IOD are of nearly identical strength at the end of September 2023 as they were at the end of September 2019.

In the second half of October, the MJO could briefly pass from the Maritime Continent into the western Pacific (phases 4-6). During October-December, these phases tend to favour more easterly winds for New Zealand with wetter conditions in the east of both islands, which could occur for short periods during the season.

This type of convective forcing has happened periodically in recent months and appears linked to a remnant area of warmer than average ocean water near the International Date Line along the equator – atypical for a classical, east-based El Niño event.

This remnant warmth in the western Pacific will likely continue to influence some level of variability in New Zealand's air pressure and wind flow patterns in the months to come, with brief windows of weather that are not traditionally associated with the typical circulation patterns of El Niño.

Overall, the combined effects of the El Niño and IOD will favour high pressure near and north of the North Island and low pressure near and south of the South Island over the October-December period. 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 atmospheric rivers.

Seasonal wind strength is predicted to be above normal across the country. The winds will be strong-to-damaging at times, bring warm, dry air from Australia, and culminate in spells of well above average temperatures in eastern areas of both islands. Warm periods will likely be followed up by sharply colder southerlies, contributing to a season that will have even more variability than a typical October-December.

New Zealand's coastal water temperatures became more unusually warm in all regions except the east of the South Island during September. At the end of the month, localised marine heatwaves were affecting coastal waters around the North Island and northern South Island. The expectation for stronger winds, in association with 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 develop, particularly near the north and east of both islands.

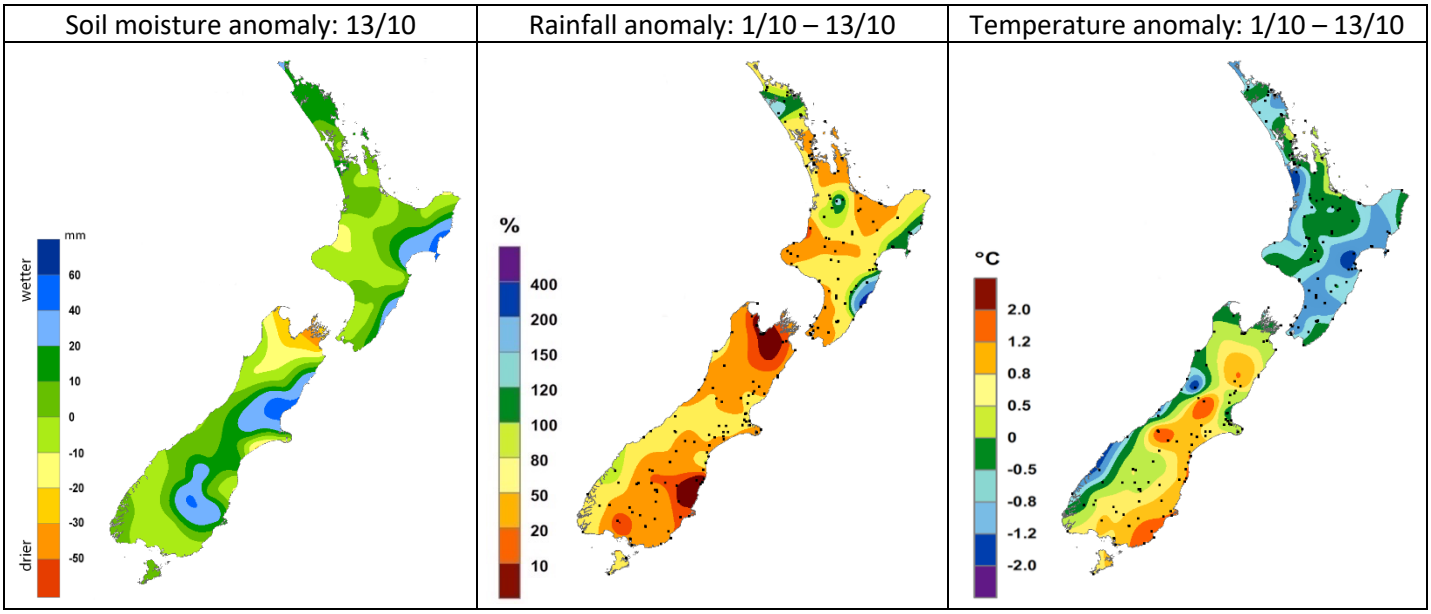


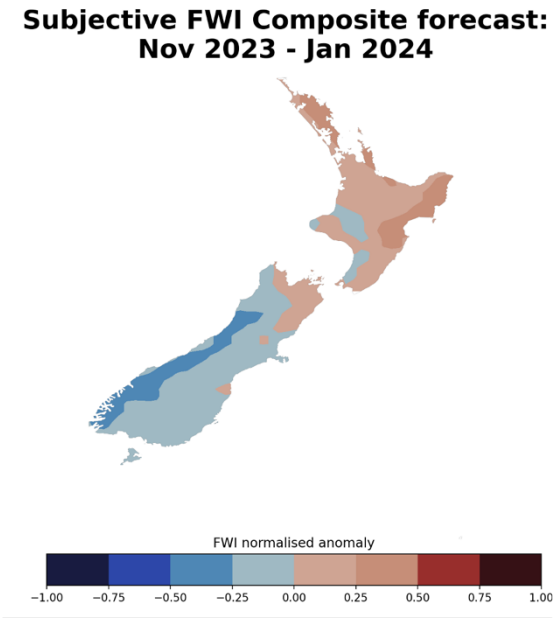
Figure 4: Maps showing the current soil moisture anomaly, as well as rainfall and temperature differences from normal since the start of the month.

Fire season analogues

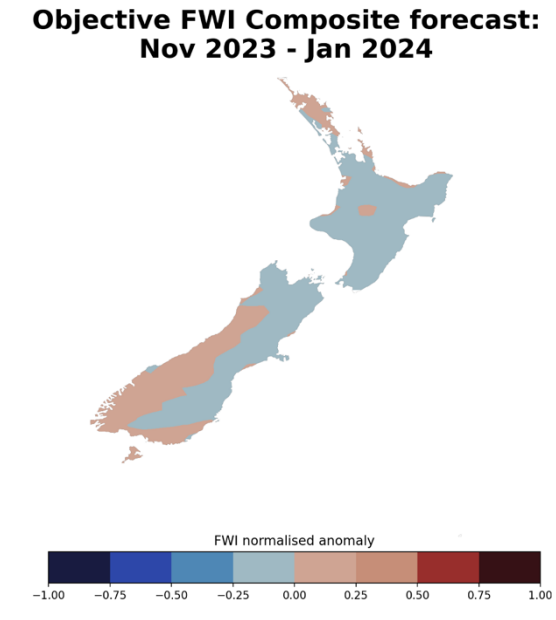
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

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 November-January.

Most areas of the North Island are expected to have higher average fire danger than normal during the season, although some western areas could see a slightly decreased risk. Meanwhile, eastern and northern areas of the South Island are expected to have higher fire danger 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 - Nov to Jan
2019-2020
1997-1998
2006-2007
2004-2005
1994-1995
1992-1993
1991-1992
1982-1983



Machine-selected analogue season - Nov to Jan
2007-2008
2011-2012
2001-2002
2014-2015
2009-2010
2002-2003
1996-1997
2013-2014

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: November 2023

November's air flows are generally expected to be more westerly than normal, which is commonplace during El Niño. The signal is for a drier than normal month for the North Island, with the potential for substantial rainfall deficits, especially in the north. In the South Island, there is a drier lean in the east and north. Wind speeds are expected to be above normal for nearly the entire country. Near average to above average temperatures and lower than normal relative humidity are favoured in many regions (Figure 6).

Climate outlook: November 2023 – January 2024

El Niño will continue during the season, and this will continue to favour a westerly wind 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, especially in the North Island and northeastern 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.

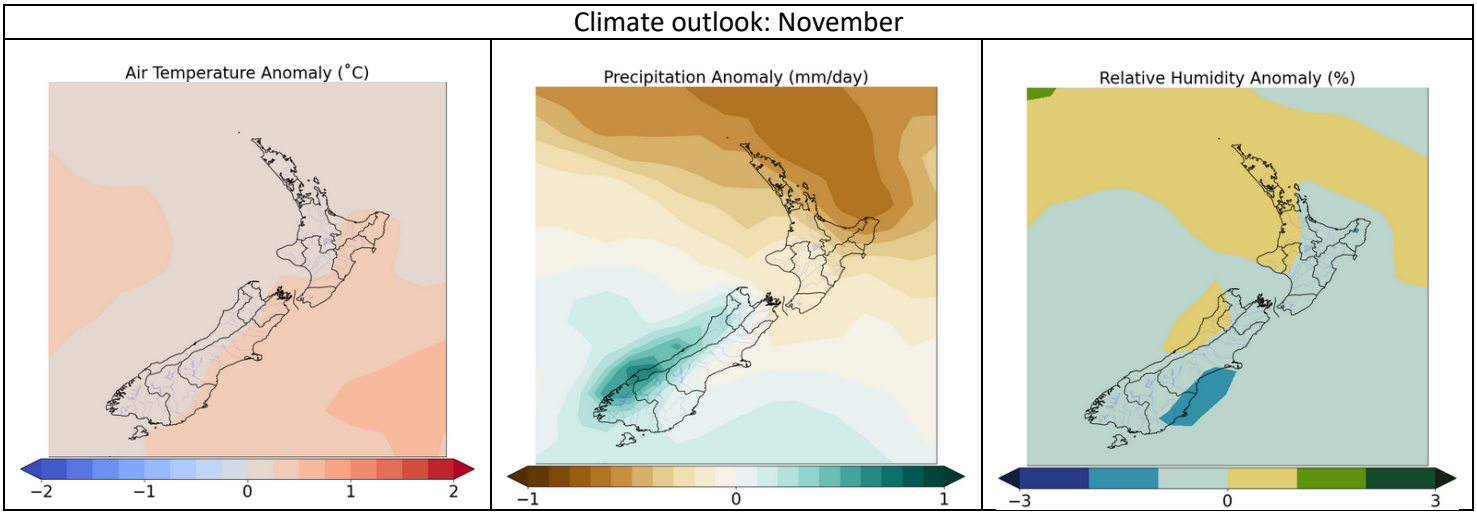


Figure 6: Climate outlook for November showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

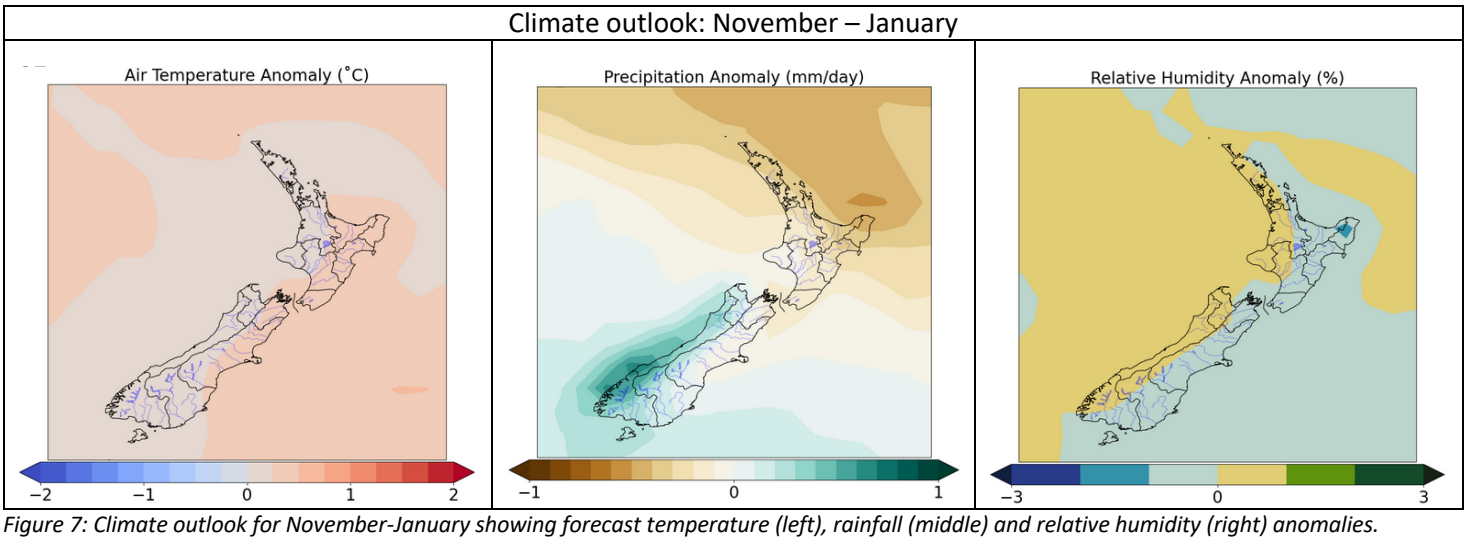


Figure 7: Climate outlook for November-January showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

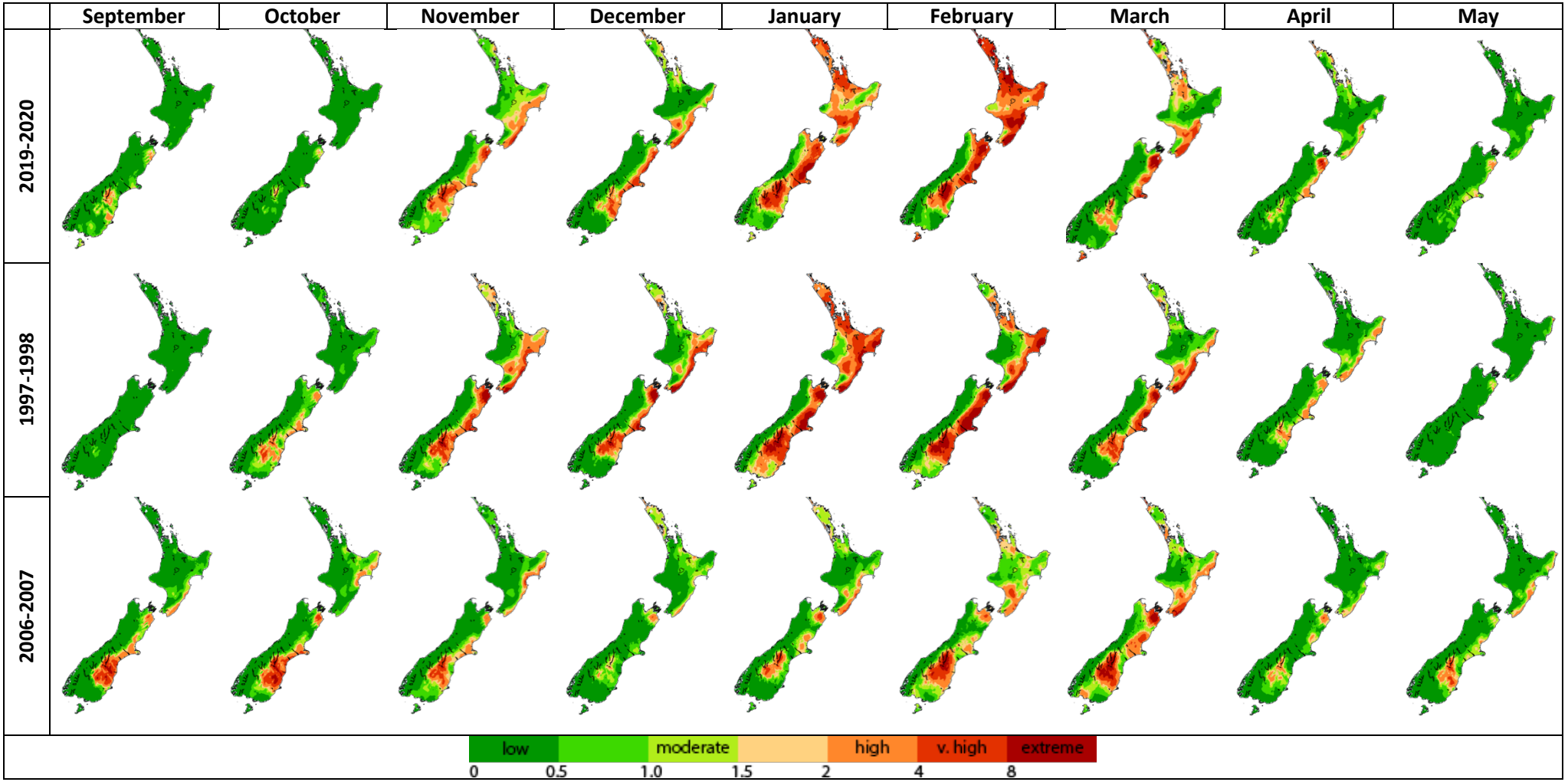


Figure 8: Monthly average severity rating for the comparative years of 2019/2020, 1997/1998, and 2006/2007. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

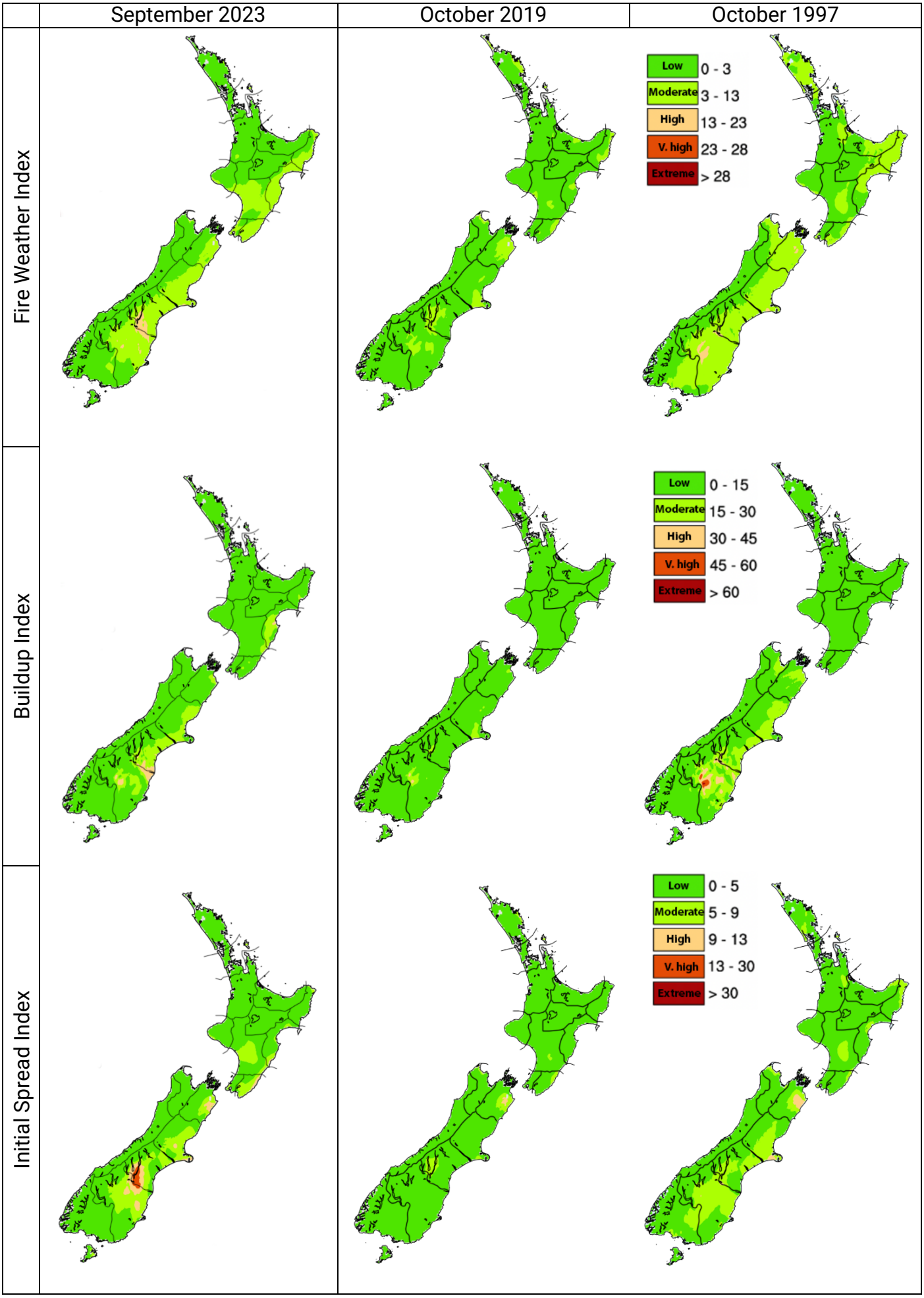


Figure 9: The most recent observed month (left column) and analogue months for October (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

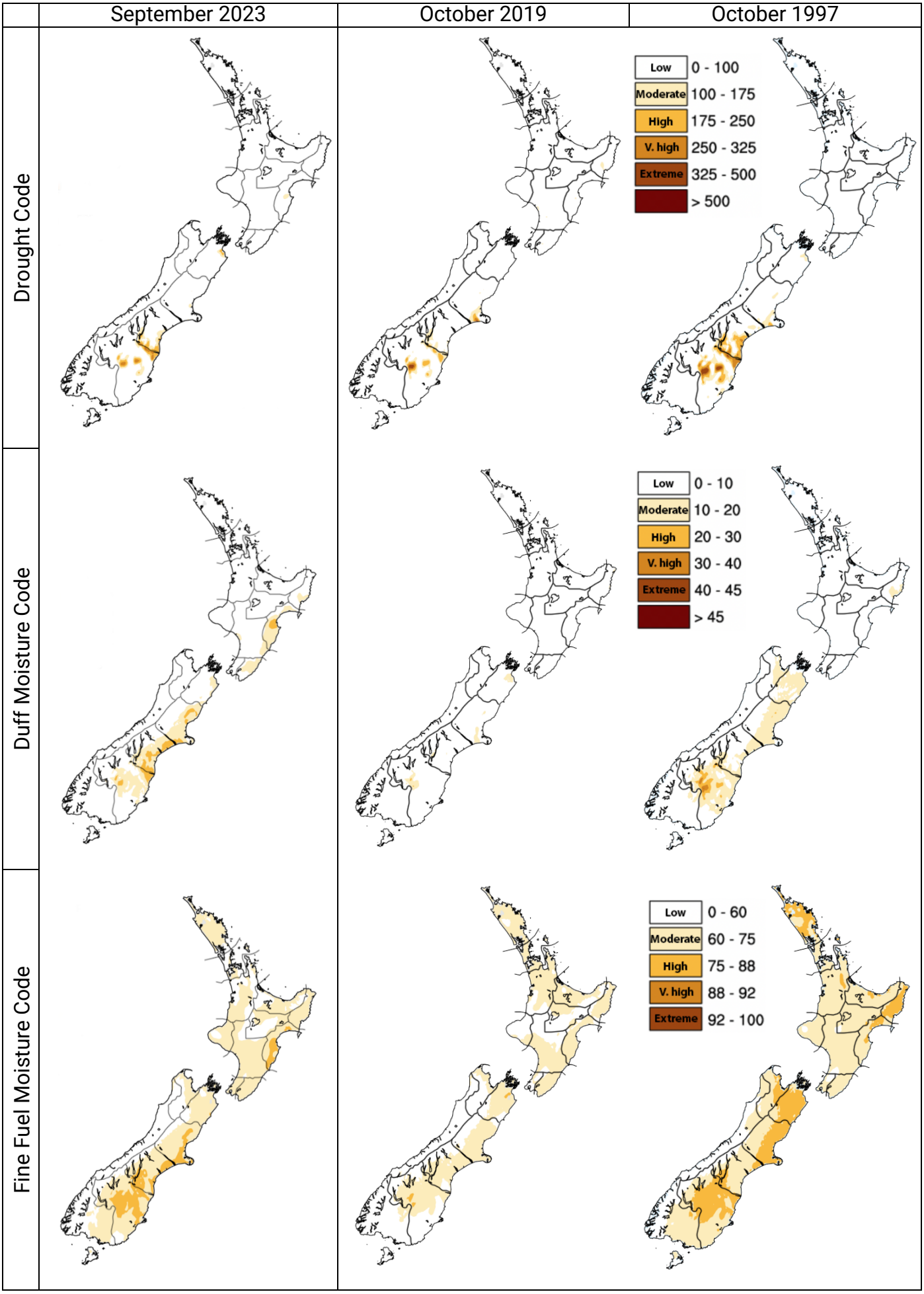


Figure 10: The most recent observed month (left column) and analogue months for October (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

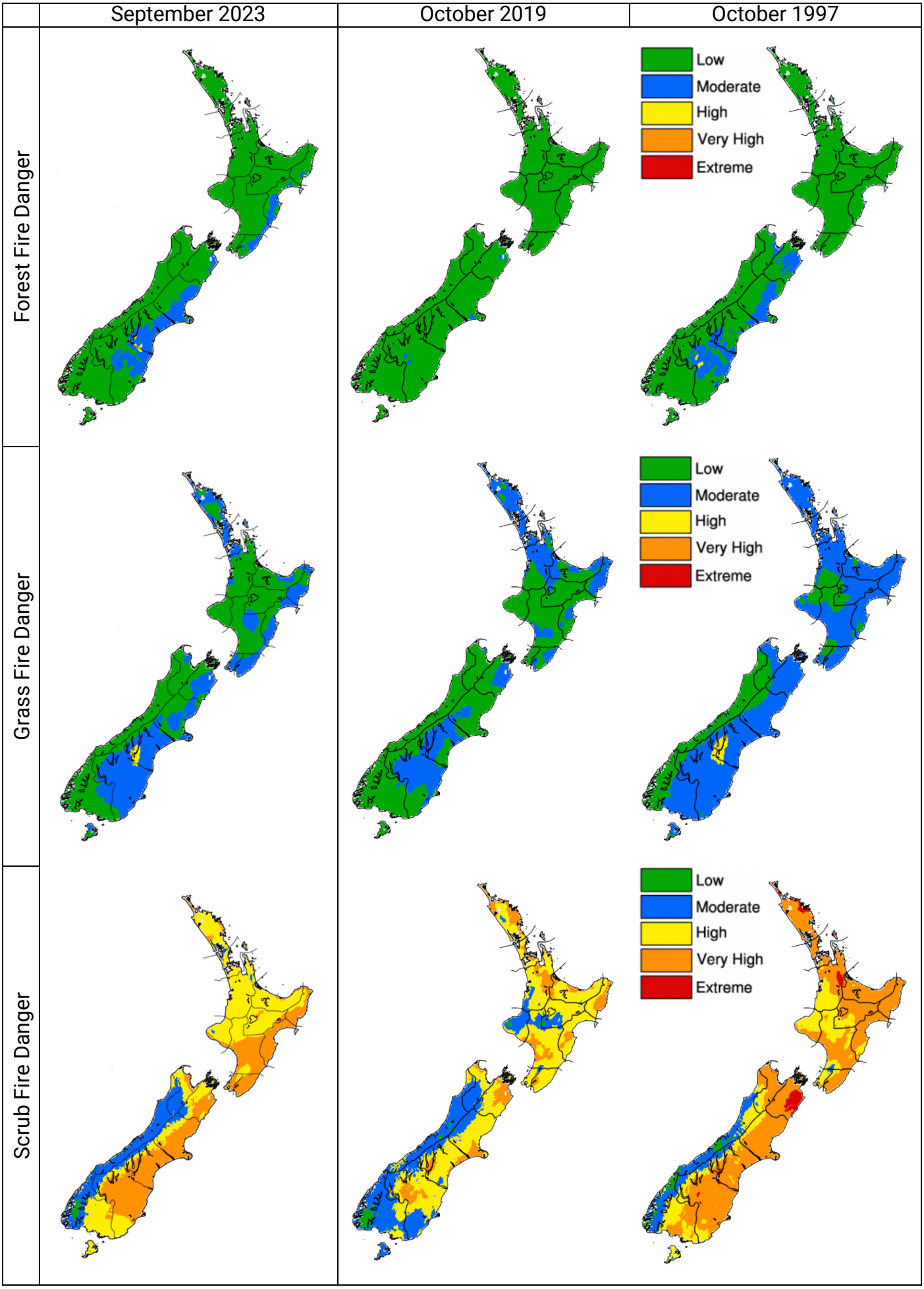


Figure 11: The most recent observed month (left column) and analogue months for October (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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