South Island Monthly Fire Danger Outlook (2023/2024 season)
Issue: August 2023

Current fire danger situation

July's various indices mostly show low to moderate values across the South Island, although Fine Fuel Moisture Code and Scrub Fire Danger have been reaching moderate to high values in parts of southern Canterbury and Otago. See Figures 8-10 for more detail.

However, a likely change to the El Niño climate pattern has been signalled in the next month or two. This could bring a significant shift from the below normal fire dangers seen over much of the South Island in recent years to more normal or even above normal fire dangers in some areas, including potentially an earlier start to this year's fire season.

Current fuel and soil moisture status

As of 16 August (Figure 3, left), soil moisture levels are generally near normal to even slightly above normal in much of the South Island, although soil moisture levels are slightly below normal in Marlborough Sounds. The New Zealand Drought Index is currently showing that dry conditions are present in Marlborough Sounds.

Current fire dangers across the South Island (Figures 8-10) are low as a result of just coming out of winter, and the carry-over effects of the below normal fire dangers last season which resulted from the wetter than normal summer and autumn in northeastern parts of the island. The exceptions are in the Waitaki Valley, where recent below average rainfall caused elevated Drought Code (DC) values, although this is dissipating; and in Central Otago, where levels of many of the fire danger codes and indices have already started climbing, although this is normal for this area where elevated levels are common most fire seasons.

The current low Buildup Index (BUI) values and contributing DC and Duff Moisture Code (DMC) values mean burning of moderate, heavy or subsurface fuels would be unlikely at present across most of the South Island. However, Fine Fuel Moisture Code (FFMC) values, which represent the dryness of fine fuels, have been increasing over recent weeks (Figure 1). This indicates an increasing potential for fires to ignite in fine fuels such as scrub and dead grass. When also associated with periods of increased wind, these elevated FFMC values can contribute to high Initial Spread index (ISI) values indicating potential for any ignitions that do occur in these fine fuels to spread and grow more rapidly.

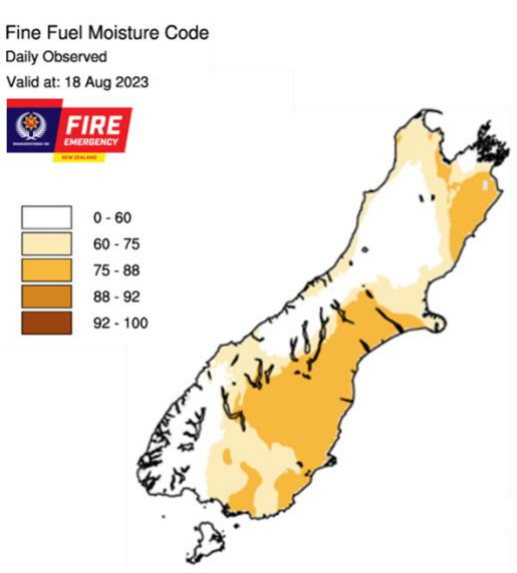


Figure 1: Map of Fine Fuel Moisture Code (FFMC) (an indicator of the dryness of fine dead fuels and ease of ignition) for the South Island as at 18th August.

Forecast climate and weather

Late August is expected to generally feature drier than normal conditions as high pressure becomes favoured. For September as a whole, more westerly winds than normal are expected as an El Niño pattern becomes dominant. Drier than normal conditions are likely in eastern regions, while the West Coast may be wetter than normal.

September-November will likely continue to exhibit more westerly winds than usual, as an official El Niño is expected to emerge. South Island rainfall totals again look to be above normal in the west but below normal in the east. In addition, warmer than average temperatures would be favoured in the east due to westerlies downsloping off the Alps.

For more information, see pages 3 and 4.

The El Niño climate pattern

The formation of a fully-fledged El Niño event requires the coupling of both the atmosphere and ocean, and currently only the oceanic indicators (such as sea surface temperatures) have reached the threshold required for El Niño. However, while currently lagging behind, predictions from all global climate models are that the atmospheric indicators (trade winds, pressure patterns) will reach required levels in the next few months.

But no two El Niño events are the same, and each event can produce different effects on weather conditions and therefore resulting fire dangers across New Zealand depending on its timing, strength and duration. In general though, 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), 2019/10 (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 events however did bring very dry conditions to eastern areas.

What to watch for

Winds stronger than normal resulting in wind driven fires, especially in light flashy scrub and dry grass fuels. Because these are almost entirely made up of fine fuels, they can dry out very quickly and become available to burn after just a day or two without rain or in windy conditions.

A move to more frequent warm, drier wind conditions (W/NW) in eastern areas, which contribute to easier ignition and fire spread.

The wet and warmer than normal winter conditions are contributing 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).

Watch for increasing fire potential through the spring months. This is the time of year to prepare for the fire season, especially in the northeastern parts of the South Island where the spring fire potential will more than likely be above normal. Fire Season preparation should include:

- Monitoring risk conditions through our weather station network and grass curing assessments.
- Watch for frost curing, especially in high country areas. During windy conditions, these cured grasses can produce intense fast-moving fires in late winter or early spring, like the Pukaki and Ohau fires of 2020.
- Have a plan with industries for additional risk management should the conditions escalate, such as management of spark hazardous activities and standby arrangements.
- Carrying out Fire Crew and Brigade readiness checks.
- Ensure contract and FENZ resources are available for response.
- Raising awareness of defensible spaces around assets.
- Considering fire breaks in high-risk areas.
- Plan for spike days when fire danger is especially elevated. This could include actions such as awareness campaigns, cancellation of permits or standby arrangements.

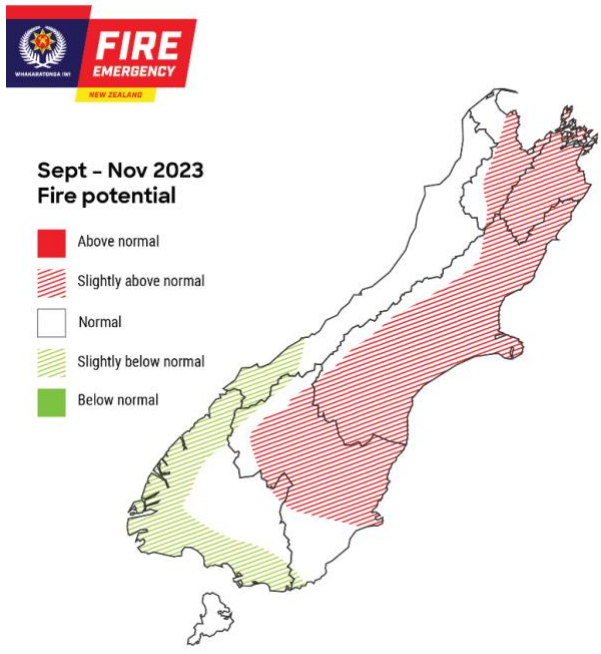


Figure 2: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

Current climate

July temperatures were well above (>1.20°C above average) or above average (0.51-1.20°C above average) for most of the South Island. Pockets of near average temperatures (±0.50°C of average) were observed in isolated parts of North Canterbury. So far in August, temperatures have been near average to below average across nearly the entire South Island (Figure 3, right).

July rainfall was above normal (120-149% of normal) or well above normal (>149% of normal) in eastern and southern parts of the South Island. Rainfall was below normal rainfall (50-79% of normal) or well below normal (<50% of normal) for inland, western, and northern parts of the South Island. So far in August, rainfall has generally been above normal in the lower South Island, but below normal elsewhere (Figure 3, middle).

Soil moisture levels are generally near normal to even slightly above normal in much of the South Island, although soil moisture levels are slightly below normal in Marlborough Sounds. The New Zealand Drought Index is currently showing that dry conditions are present in Marlborough Sound (Figure 3, left).

Climate drivers

The NINO3.4 Index sea surface temperature anomaly (in the central equatorial Pacific) during July was +1.07˚C (climatology: 1991-2020). At the same point during the developmental phase of strong past El Niño events, it was +1.30˚C in 2015, +1.27˚C in 1997, and +0.33˚C in 1982.

The July monthly Southern Oscillation Index (SOI) was within the neutral range (-0.5) in July (climatology: 1991-2020).

Trade wind strength was above normal in the east-central equatorial Pacific during July. A strong trend toward reduced trade winds is forecast in early August. A second reduction in trades is likely in the middle part of August. This is expected to lead to warmer seas in the central equatorial Pacific.

In the subsurface central equatorial Pacific, significant anomalies of +5˚C to +7˚C were occurring around 50 m depth in the eastern part of the basin as of late July. The most unusually warm waters were consolidating in the eastern Pacific Ocean, consistent with the development of a classic east-west propagation of ocean temperature anomalies (canonical) El Niño event.

Based on this information, NIWA continues in El Niño Alert. An official El Niño event, according to NIWA's criteria, is expected to develop in the next three months (over 90% chance) with an 85% chance of the event continuing through summer 2023-2024.

The potential emergence of a positive Indian Ocean Dipole (IOD) event in late winter or early spring is also being monitored. A positive IOD is characterised by cooler than average seas north-west of Australia and warmer than average seas north of Madagascar in the western Indian Ocean. Such a pattern could reinforce El Niño's effect on the atmosphere. A strongly positive Indian Ocean Dipole helped kickstart a drier than normal summer for northern New Zealand in 2019-2020.

New Zealand's coastal water temperatures became less unusually warm in the north and west of both islands and more unusually warm in the east. Marine heatwave conditions continued in coastal waters near the South Island and lower North Island. The unusually warm seas will likely have an influence on regional air temperatures, particularly near the coast.

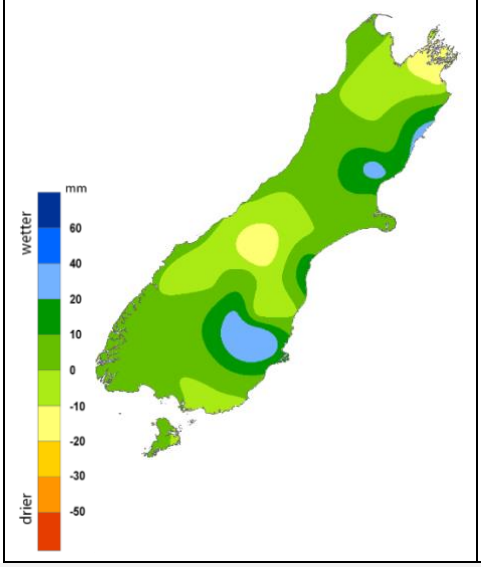
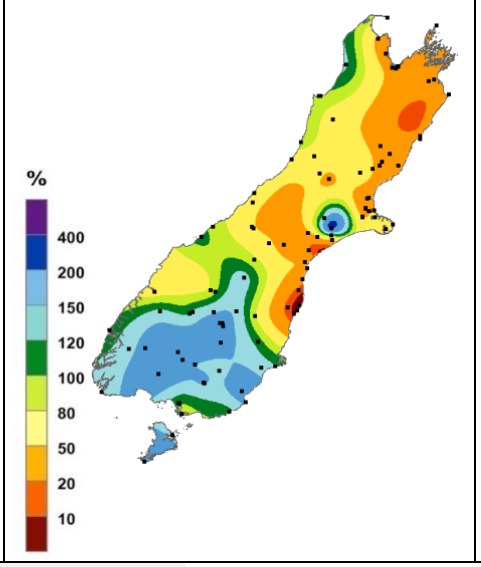
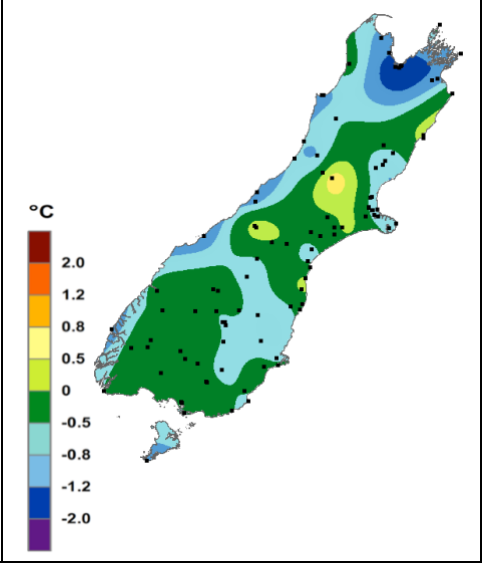
Soil moisture anomaly: 16/8	Rainfall anomaly: 1/8 – 16/8	Temperature anomaly: 1/8 – 16/8
		

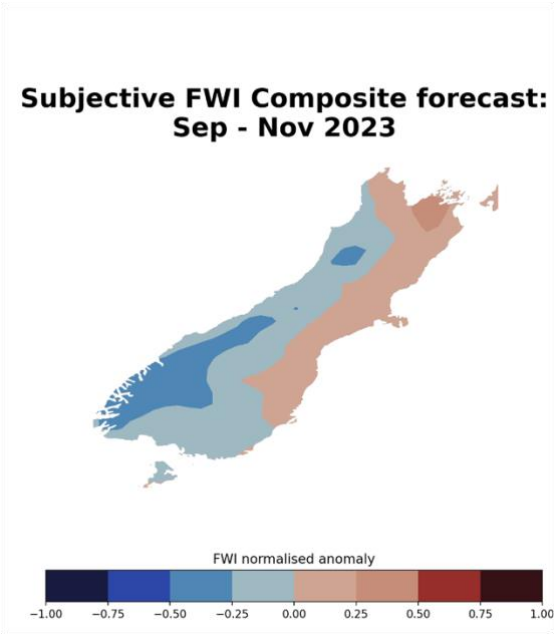
Figure 3: Maps showing the current soil moisture anomaly, as well as rainfall and temperature differences from normal since the start of the month.

Fire season analogues

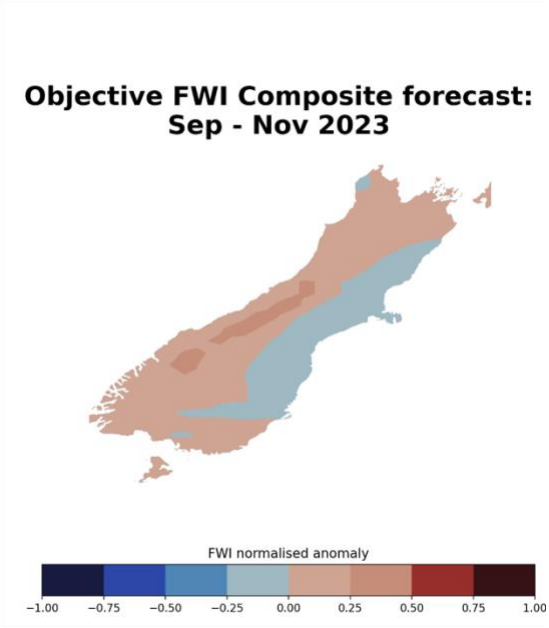
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

This season's analogue years featured historical years that had El Niño patterns in the ocean and/or atmosphere (Figure 4). 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 September-November. Northern and eastern areas of the South Island are expected to have higher fire danger than normal during the season, although western and southern areas could see a decreased risk (Figure 7). This agrees with the expected westerlies commonplace with an El Niño pattern.



Forecaster-selected analogue season - Sep to Nov
2019
2015
2002
1997
2018
2006
2004
1982



Machine-selected analogue season - Sep to Nov
2019
2005
2013
2003
2016
2017
2000
2007

Figure 4: 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: September 2023

September's air flows are generally expected to be more westerly than normal as an El Niño-like pattern continues. Rainfall is forecast to be reduced in the north and east, but perhaps wetter than normal in the west and south. Wind speeds are expected to be above normal during September. Above average temperatures appear likely, especially in eastern regions. Relative humidity may be lower than normal for much of the South Island (Figure 5).

Climate outlook: September – November 2023

An official El Niño will likely be in place by the end of September, and this will continue to favour a westerly wind anomaly through the season. Temperatures overall look to be warmer than average, especially in eastern regions (Figure 6). Rainfall is favoured to be above normal in the west and south, but drier conditions are favoured in eastern regions. Slightly below normal relative humidity is expected in most regions. Wind speeds are favoured to be above normal or well above normal for most of the South Island.

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

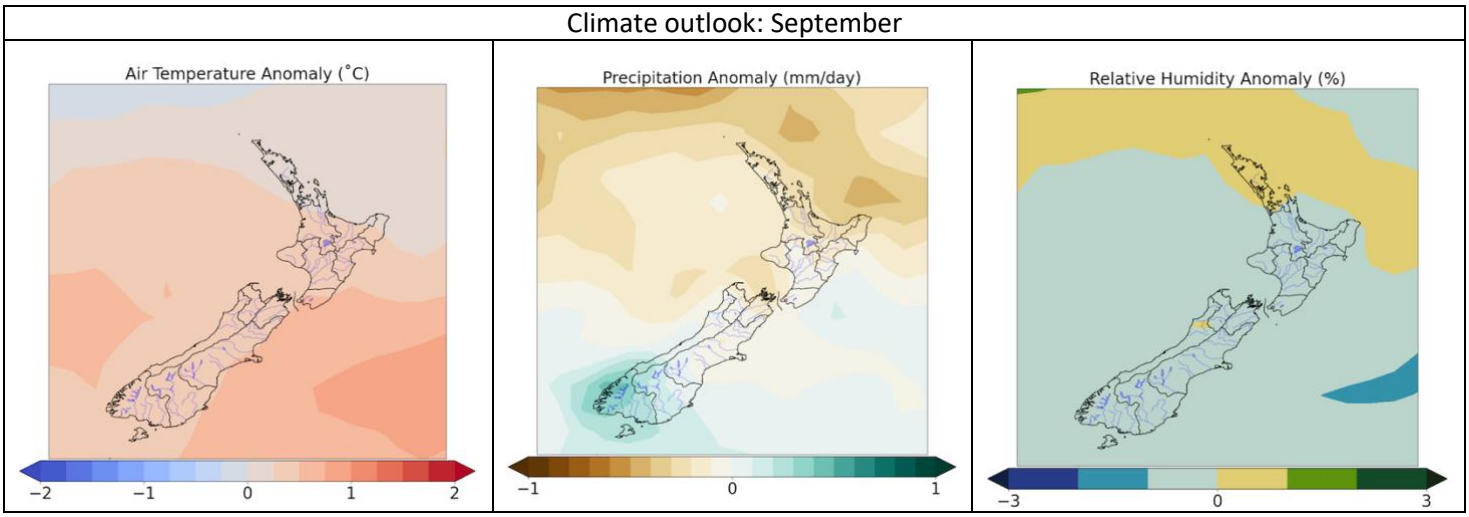


Figure 5: Climate outlook for September showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

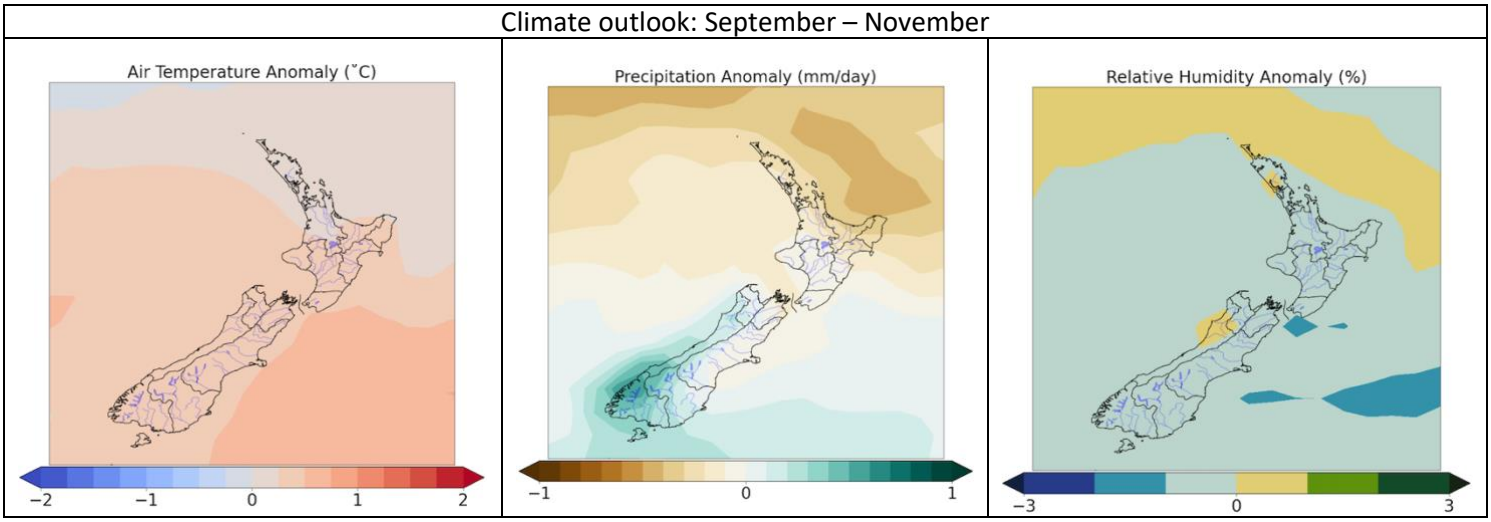


Figure 6: Climate outlook for Sep-Nov showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

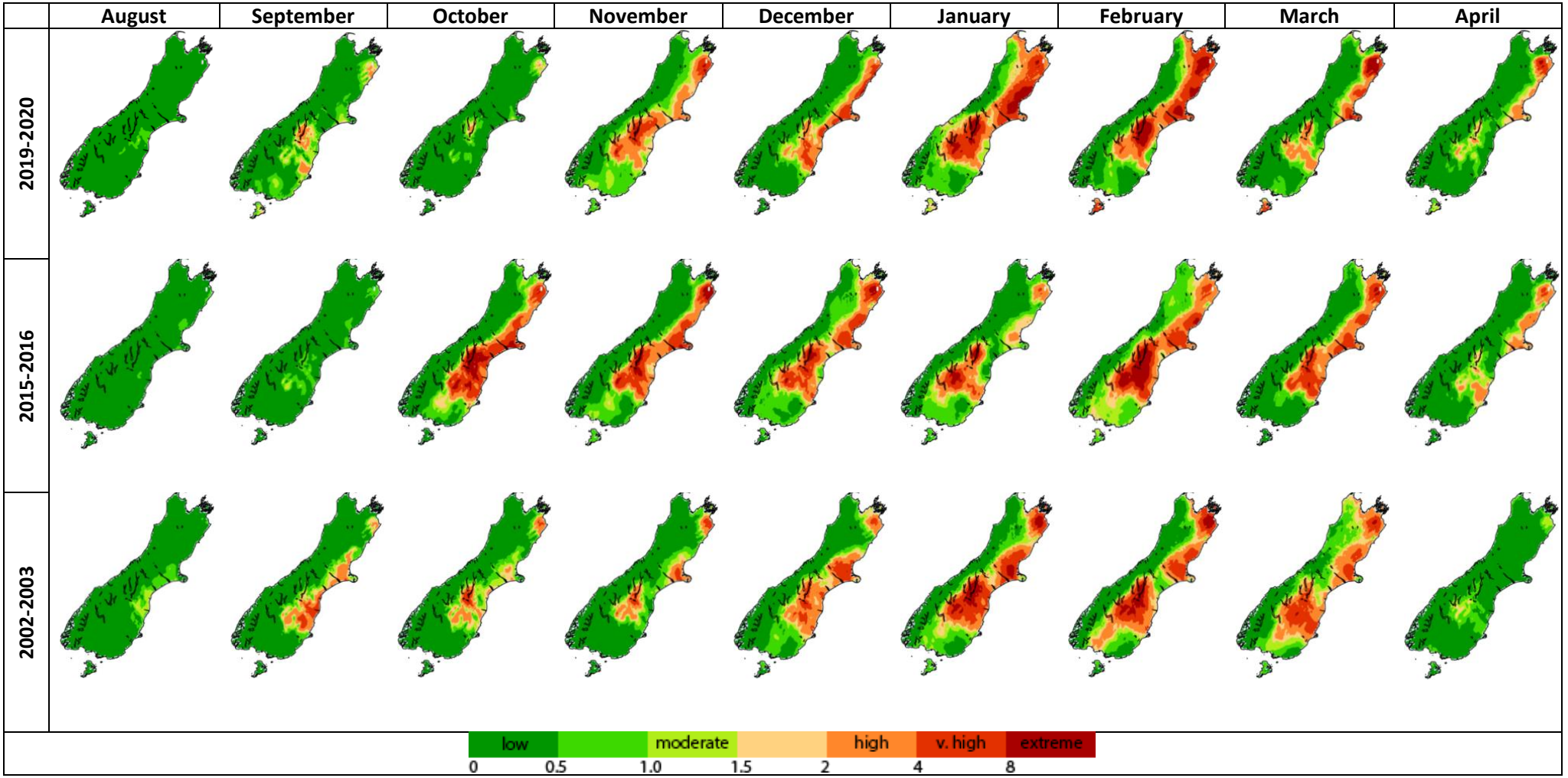


Figure 7: Monthly average severity rating for the comparative years of 2019/2020 (neutral), 2015/2016 (strong El Niño), and 2002/2003 (moderate El Niño). These are analogue years for the current season and give us an insight into what the upcoming season may be like.

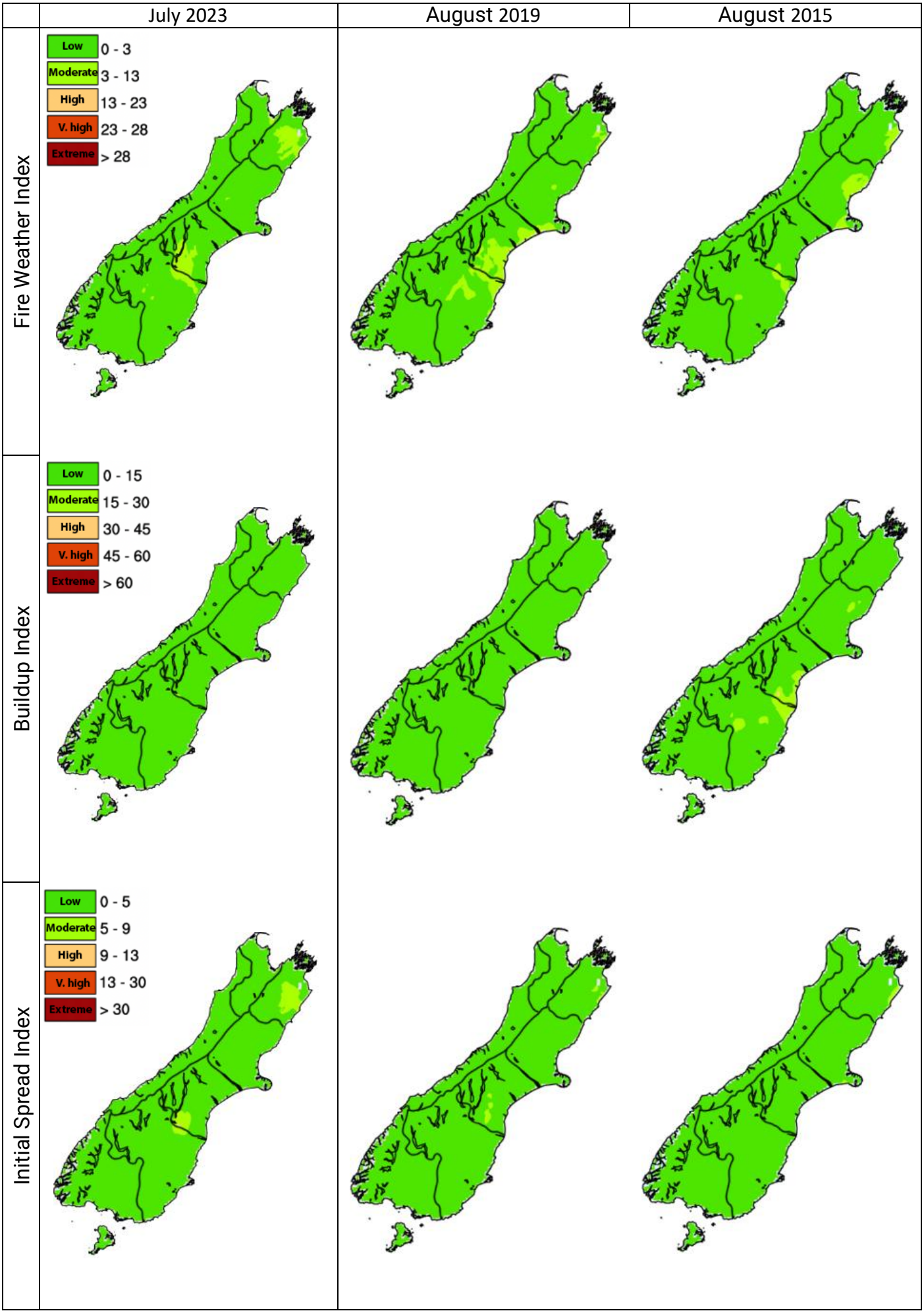


Figure 8: The most recent observed month (left column) and analogue months for August (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

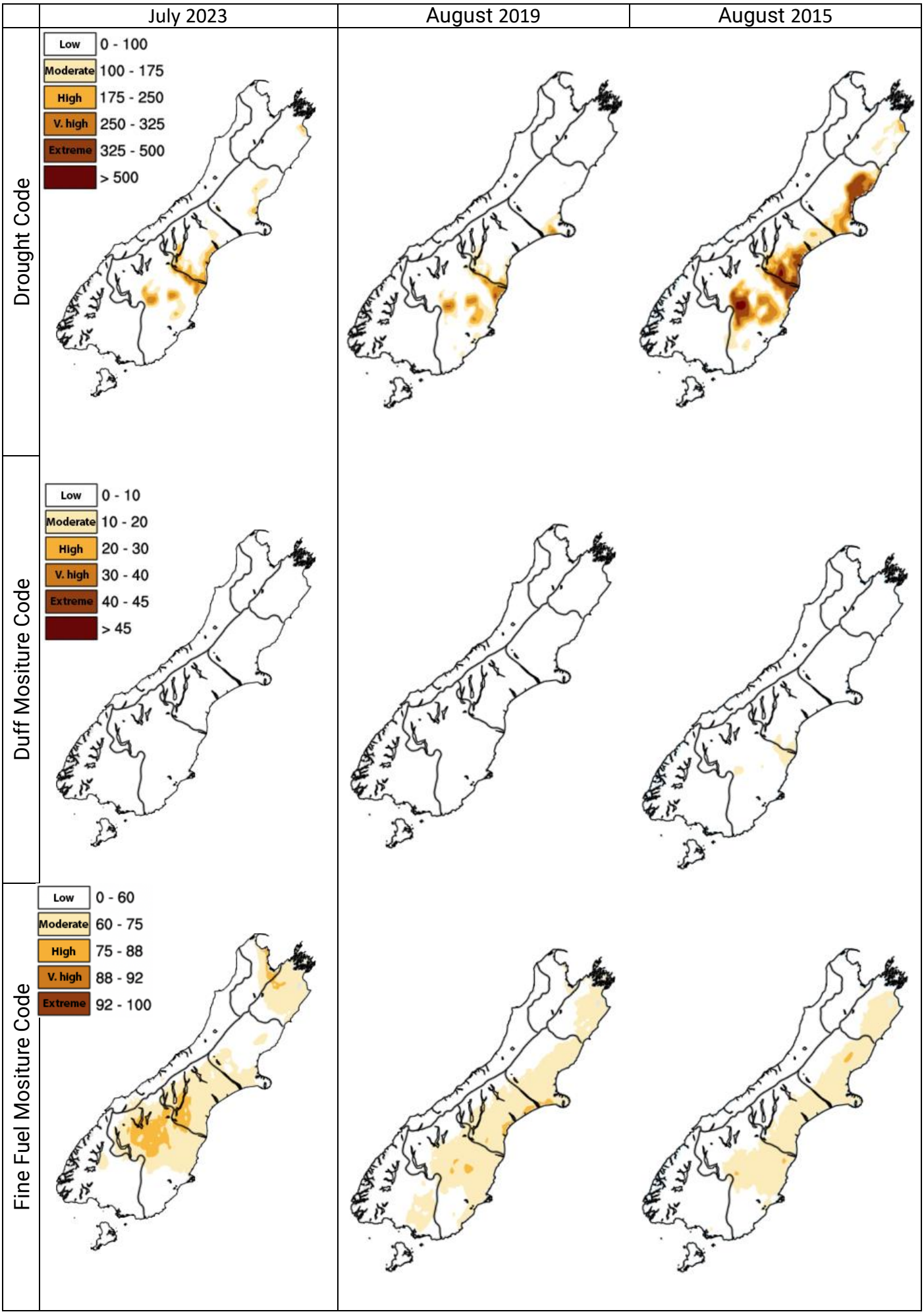


Figure 9: The most recent observed month (left column) and analogue months for August (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

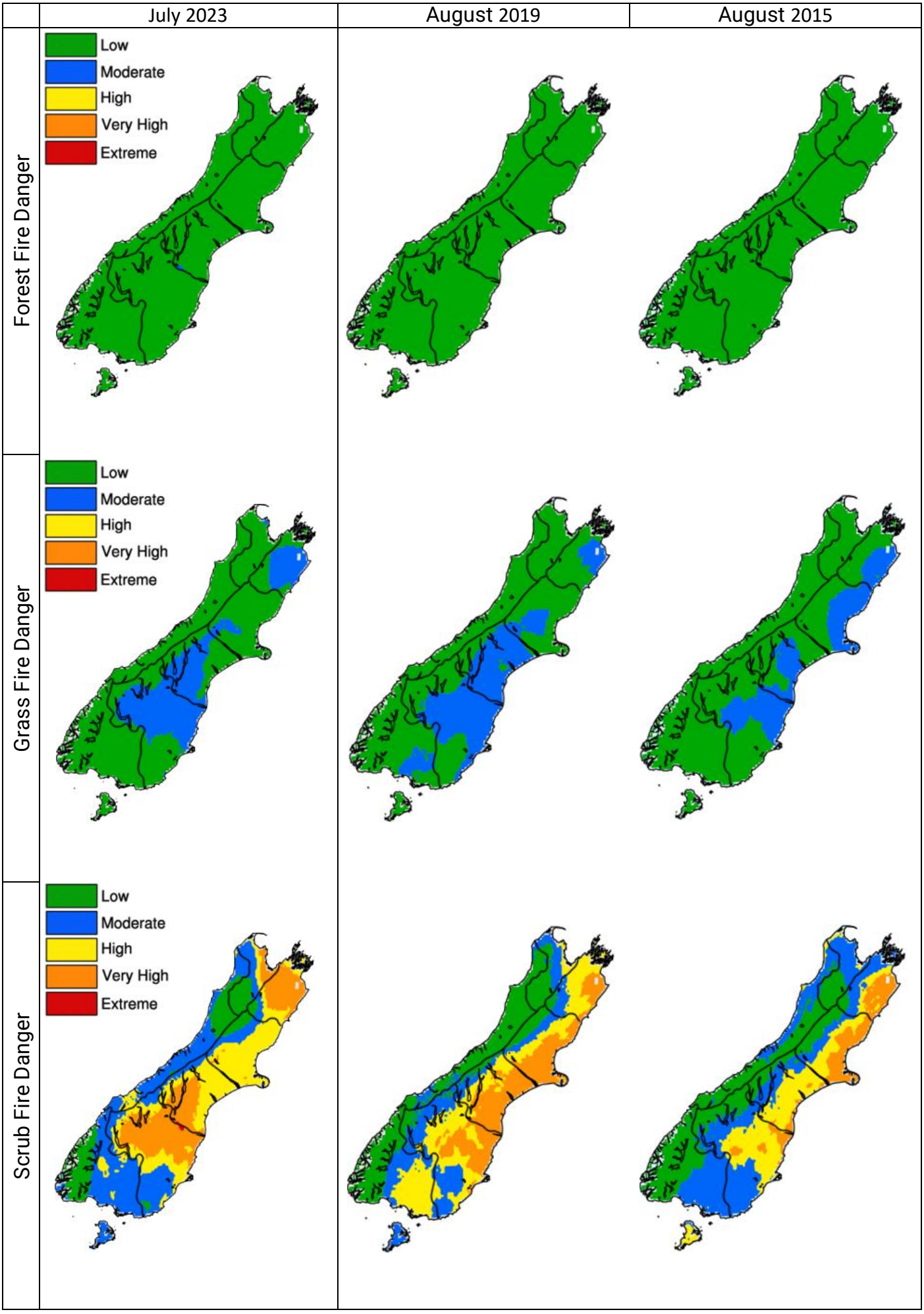


Figure 10: The most recent observed month (left column) and analogue months for August (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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