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

Issue: January 2024

Current fire danger situation

Most of December's fire indices were low to moderate across New Zealand, although higher values were observed in places such as Wairarapa, Marlborough, southern Canterbury, and interior Otago. In addition, scrub fire danger was high to extreme across much of the country. See Figures 8-11 for more detail.

El Niño continued during December and has around a 100% chance of persisting through March and an 85% chance of persisting through autumn. Although it will have an important influence on New Zealand's climate, unusual ocean heat in the western equatorial Pacific and on a global scale has contributed to circulation patterns that are not typically associated with a traditional El Niño.

Current fuel and soil moisture status

As of 16 January (see Figure 4, left), soil moisture levels are near normal to above normal across the upper and central North Island and western South Island. However, soil moisture is below normal in the lower North Island and eastern South Island.

Current fire dangers across the country also show a country of two halves. Fire dangers in the North Island remain low to moderate due to the effects of regular rain events, with the exception of the Wairarapa region where fire dangers are more elevated. Large areas of the South Island show much higher fire dangers, especially around inland South Canterbury and Otago, North Canterbury and Marlborough.

Fire dangers in many areas have tended to "see-saw, with brief upward trends in codes and indices during periods of dry weather but decreases again with the regular rainfalls. However, a change to hotter, drier conditions in December and early January has seen fire dangers increase dramatically in some areas, especially in the southern North Island and inland and eastern areas of the South Island, in some cases to above normal levels for this time of year.

This is shown in elevated values of the FWI System's moisture codes (DMC and DC) and Buildup Index (BUI) in these areas (Figure 1), which indicate the potential for greater involvement of medium and larger woody fuels and deep organic layers if fires occur. In contrast, values of across the North Island are lower, and below normal in most areas, indicating little involvement of deeper or larger fuels.

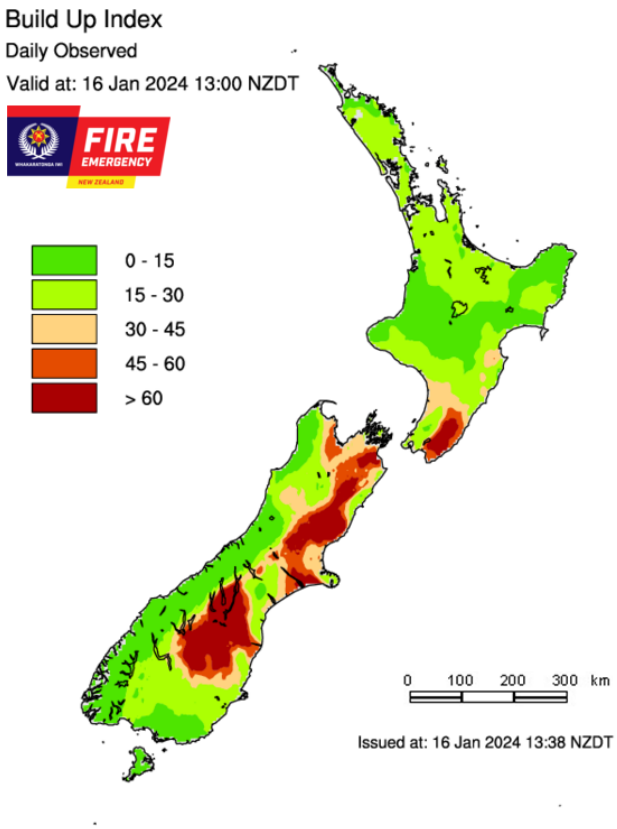


Figure 1: Map of Buildup Index (BUI) values (indicator the total amount of fuel available for combustion) as at 16th January.

Forecast climate and weather

The remainder of January is expected to feature unsettled conditions with some areas of the country seeing substantial rainfall amounts. This includes the North Island as well as the top of the South Island.

For February, a mixed flow pattern is generally favoured. With an active Madden-Julian Oscillation (MJO) in place, this could result in above normal rainfall for much of the North Island and the upper South Island. However, drier than normal conditions may continue to be favoured in the lower South Island. Above average temperatures and stronger than normal winds are forecast across the country in February.

February-April will likely exhibit more northwest winds than usual. These winds may be strong at times, especially in the South Island. Wetter than normal conditions may continue for many areas in late summer before a drying trend becomes more likely during autumn. Temperatures overall look to be above average, along with above average relative humidity in northern and western regions.

For more information, see pages 4 and 5.

The El Niño climate pattern

While El Niño has around a 100% chance of continuing over the next three months, periods that go against the grain of a typical El Niño will likely occur, especially over the next few weeks. The effect of a non-traditional El Niño will encourage increased variability in circulation patterns and air flows as compared to historical El Niño summers.

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. However, through at least mid-February, much of the country could see wetter than normal conditions.

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 high degree of uncertainty around weather conditions and resulting fire dangers in many areas of the country over the next few months, due to the non-typical El Niño. This will particularly be the case for the North Island and northern South Island.

In the short term, likely a continuation of the "see-sawing" of fire dangers in many areas through January and February, as we get periods of drying interspersed with rain events.

Generally wetter than normal conditions continuing across the North Island and along the west of the South Island, but including the possibility of occasional spill-over rain over the Alps into inland areas with strong westerly wind events.

But the onset of drier than normal conditions for large areas of the South Island, especially eastern and inland areas from North Canterbury south. This will result in increasing fire dangers, curing-off of grassland areas, and greater involvement of medium and potentially heavier fuels.

Already or increasingly becoming elevated fire dangers in some areas, especially in the southern North Island and eastern and inland South Island, where fire dangers could reach above normal or even well above-normal levels. This includes areas such as Central Otago and inland South Canterbury (Fig. 2) in particular.

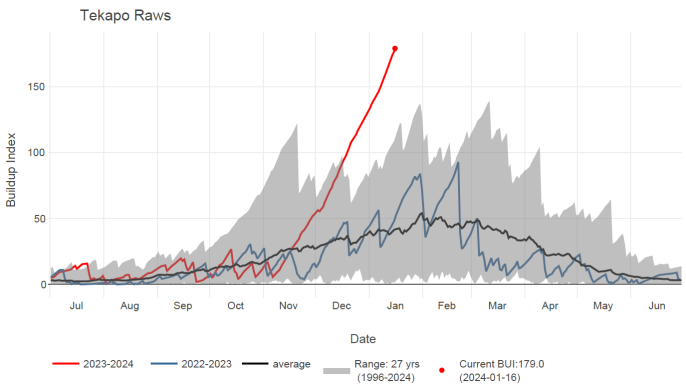


Figure 2: Trend in the Buildup Index (BUI) for Tekapo Raws, showing the already elevated values as of 16 January which will reach well above normal (and record) levels if dry conditions continue.

The likelihood of El Niño conditions continuing through summer and into autumn could mean an extended fire season. In some areas, the worst fire danger conditions may not occur until late February, March or even April.

The occurrence of more frequent warm, dry W/NW wind conditions, which are expected to continue over the next few months. These often align to produce days with high temperatures and low humidity that escalate fire dangers significantly, especially in eastern areas, contributing to easier ignition and rapid fire spread.

Winds stronger than normal could result in large wind-driven fires, especially in light flashy cured grass and scrub fuels. As they are made up of mainly fine fuels, these fuel types 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 spring weather have contributed to very good growing conditions. This has resulted in high grass fuel loads that are now cured or curing off, which will result in fires spreading more rapidly and with higher than normal fire intensities.

Restricted or prohibited fire seasons are now in place over much of the country. However, people rushing to burn before increased fire restrictions come into place may look to 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 via the 'Check its Alright' website.

Where spike fire weather conditions are forecast, consideration should also be given to imposing temporary restrictions or prohibitions (e.g. using Section 52) on spark-hazardous or other high fire-risk activities.

Delays in crop growth due to weather conditions have pushed back harvesting by a few weeks, meaning crop burning is likely to therefore be later this year.

Some forest owners are continuing to observe increased outbreaks of red needle cast disease due to the higher humidity conditions, which is resulting in greater amounts of dead needles. This could increase plantation forest fire risk in some areas, especially in the North Island.

Even in the absence of a strong El Niño influence, a "normal fire season" in many areas will have much greater fire potential than the last few fire seasons. Be vigilant, as indices may change rapidly.

Watch for increasing fire potential as we head through summer. Ongoing fire season preparations should include:

- Regular monitoring of fire 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.
- Planning for spike days when fire danger is especially elevated due to alignment of hot, dry, windy conditions. This could include actions such as public awareness campaigns, cancellation of permits, crew and IMT standby arrangements, and elevated initial attack response levels.

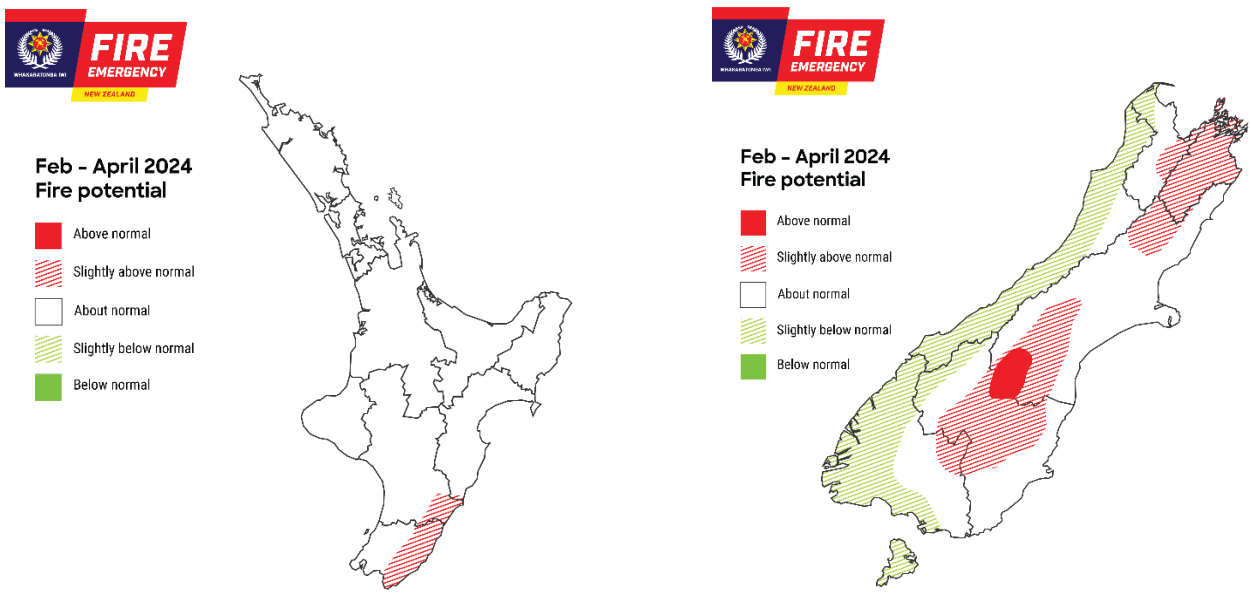


Figure 3: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

Current climate

In December, temperatures were above average (0.51°C to 1.20°C above average) or well above average (>1.20°C above average) across nearly all of New Zealand. However, near average temperatures (±0.50°C of average) were observed in small portions of coastal Wellington, Marlborough Sounds, and Southland. So far in January, temperatures have been above average to well above average across a majority of both islands (Figure 4, right).

December rainfall was above normal (120-149% of normal) or well above normal (>149% of normal) in western Northland, much of Auckland, western and interior Waikato, Gisborne, and much of the immediate West Coast. Below normal (50-79% of normal) or well below normal (<50% of normal) rainfall was observed in eastern Northland, parts of the Coromandel and Bay of Plenty, southern Hawke's Bay, Manawatū-Whanganui, Wairarapa, Nelson, Marlborough, northern and interior Canterbury, and interior Otago. So far in January, rainfall has been below normal or well below normal across much of the country (Figure 4, middle).

As of 16 January, soil moisture levels are near normal to above normal across the upper and central North Island and western South Island. However, soil moisture is below normal in the lower North Island and eastern South Island (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 December 2023) was +2.01˚C, within the range of a very strong El Niño (classified when the NINO3.4 Index is greater than +2.0˚C). In terms of 30-day anomalies ending 31 December, the NINO3.4 Index is exceeded only by 2015, 1982, and 1997, with records dating back to 1981.

The Southern Oscillation Index (SOI) was in the neutral range during December (-0.4) and on the El Niño side of neutral from October-December (-0.6) (climatology: 1991 – 2020).

Of the models monitored by NIWA, there's around a 100% chance of El Niño continuing through March and around an 85% chance for the continuation of El Niño conditions through autumn. ENSO neutral conditions are favoured during winter (around a 55% chance).

In the subsurface equatorial Pacific Ocean, anomalies of +3 to +6˚C were occurring in the upper 100 m in the central and east as of late December. Anomalies of +2˚C persisted in the vicinity of the International Dateline, as did the warmest SSTs. Because most of the equatorial Pacific Ocean is unusually warm, the El Niño is best described as a "full basin" event. The climatic impacts from a "full basin" event have been and will continue to be different from a classical, east-based event.

Trade wind strength was below or well below normal in the central and west-central equatorial Pacific during December, allowing the oceanic El Niño to reach near its peak intensity. Trade winds are forecast to strengthen during January, likely seeing the El Niño event weaken slightly from an oceanic perspective by February.

In the Indian Ocean, a positive Indian Ocean Dipole (IOD) continued during December, but will likely ease through January.

During December, convective forcing focused in the west-central tropical Pacific. Notably, activity was reduced over the eastern tropical Pacific, contrary to what is expected of a strong oceanic El Niño. Forcing was greatly reduced over the eastern tropical Indian Ocean and western Australia, in association with the strongly positive IOD.

In the Pacific Ocean, the MJO has reached the Maritime Continent and West Pacific. This may contribute to a risk for heavy rainfall and flooding from the third week of January, particularly in the North Island and northern South Island. Significant heat and humidity is also expected to build across the country in mid-to-late January, lasting the longest in the North Island.

Following the MJO activity in the western Pacific during late January, guidance supports movement into the eastern Pacific, the Americas, and Africa during February. Convective forcing near the International Date Line, which has been a major source of climatic variability over the last year, is expected to wane in February-March. This may mean that New Zealand becomes less exposed to northerly low pressure systems later in the three month period and that westerly winds become more common.

Seasonal wind strength is predicted to be above normal across the country, but especially in the South Island. These winds will 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 above average near the northern and eastern coasts of both islands in early January. Marine heatwave conditions were widespread in the western and central Tasman Sea and Coral Sea. These marine heatwaves may contribute to excessive heat and humidity in New Zealand from late January, particularly in the North Island. This may cause marine heatwaves to develop or intensify.

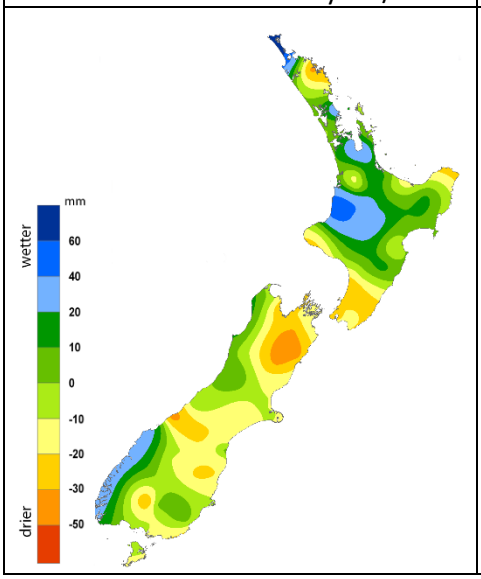
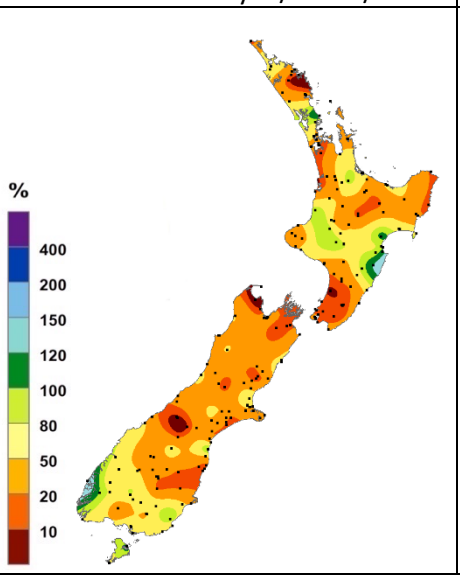
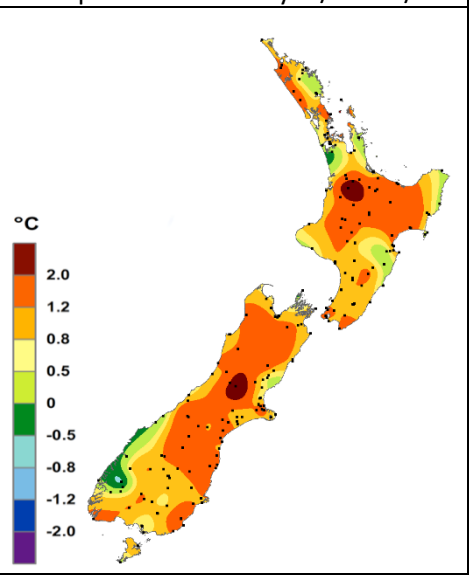
Soil moisture anomaly: 16/1	Rainfall anomaly: 1/1 – 16/1	Temperature anomaly: 1/1 – 16/1
		

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

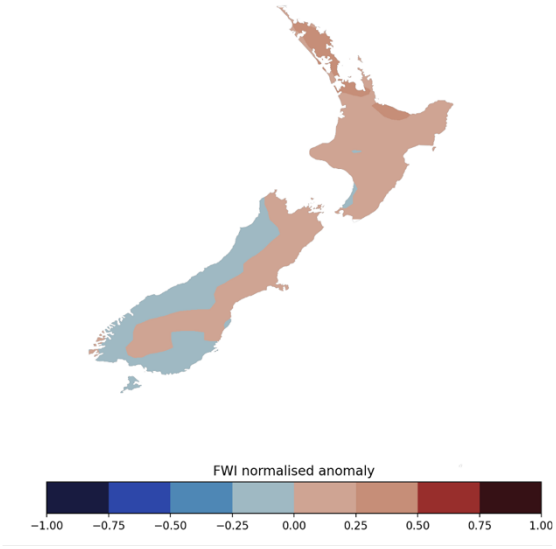
Images from the Whitireia Fire In Wellington January 2024

Fire season analogues

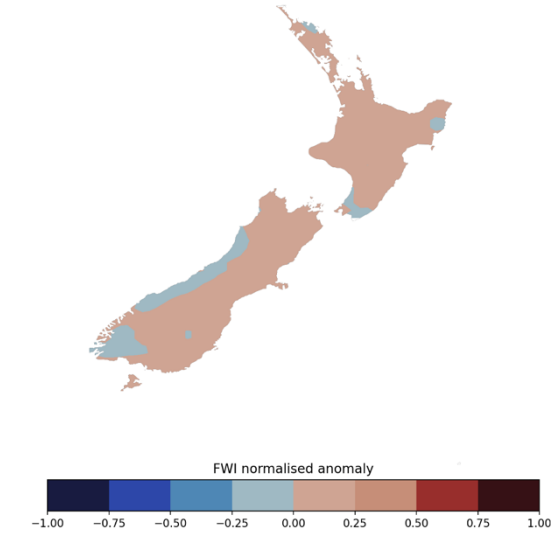
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

This season's analogue years featured historical years that had 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 favours a mix of the two analogue sets, especially during autumn.

The expectation for near normal to above normal rainfall across large swaths of the country in the coming weeks should lessen the fire weather threat at least temporarily. However, drier conditions may become more likely during autumn, with the fire weather threat increasing in the North Island in particular.



Forecaster-selected analogue season - Feb to Apr
2010
2002
1998
1994
2020
2019
2017
1993



Machine-selected analogue season - Feb to Apr
2007
1989
2014
2000
2019
2004
2001
2006

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: February 2024

February's air flows are expected to be mixed overall. This will bring a chance for near normal or above normal rainfall for much of the country, although drier conditions are favoured in the lower South 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 with periods of high humidity are favoured in many regions (Figure 6).

Climate outlook: February – April 2024

A non-traditional El Niño will continue during the season, and this will favour a northwest air flow anomaly. Temperatures continue to look above average overall (Figure 7). Rainfall is generally favoured to be above normal early in the season, but a drier trend will be possible heading into autumn. Slightly below normal relative humidity is expected in the eastern South Island, although it may above normal elsewhere. Wind speeds are expected to be higher than normal for most of the country.

The tropical cyclone season for the Southwest Pacific runs through April. In this El Niño pattern, the tropical cyclone risk for New Zealand is forecast to be slightly below average through the rest of the season.

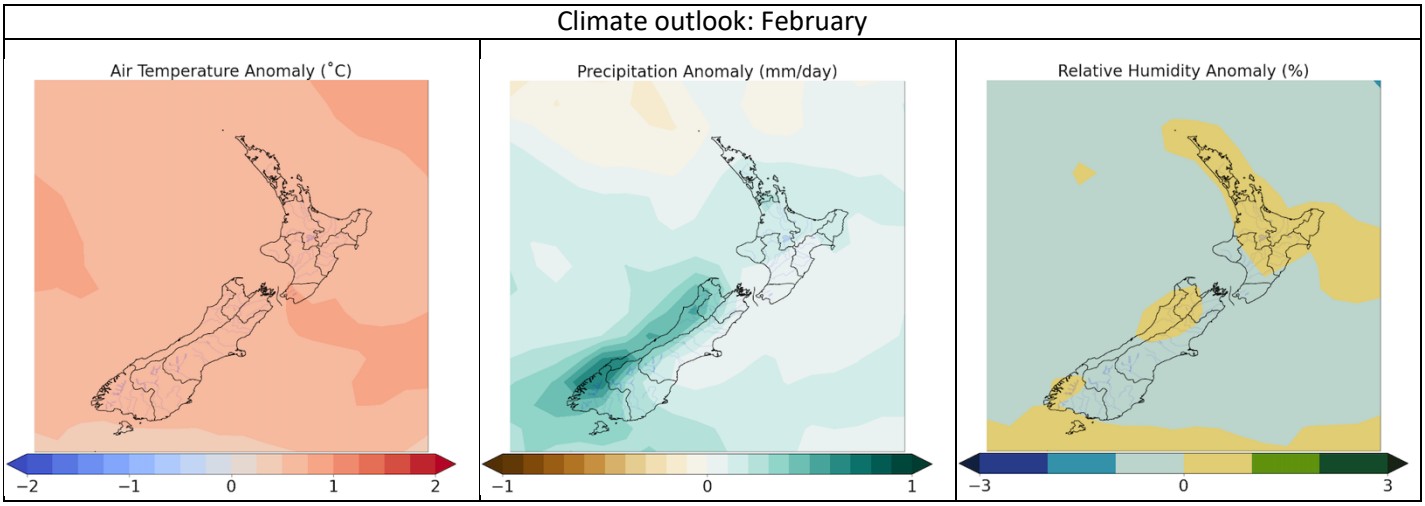


Figure 6: Climate outlook for February showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

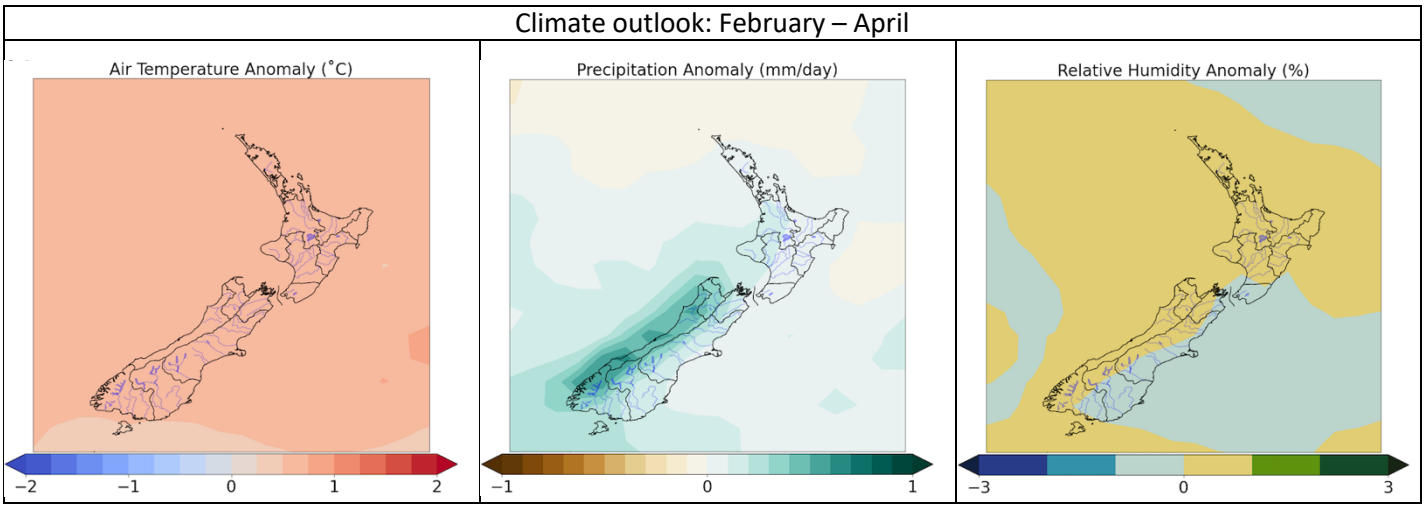


Figure 7: Climate outlook for February-April showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

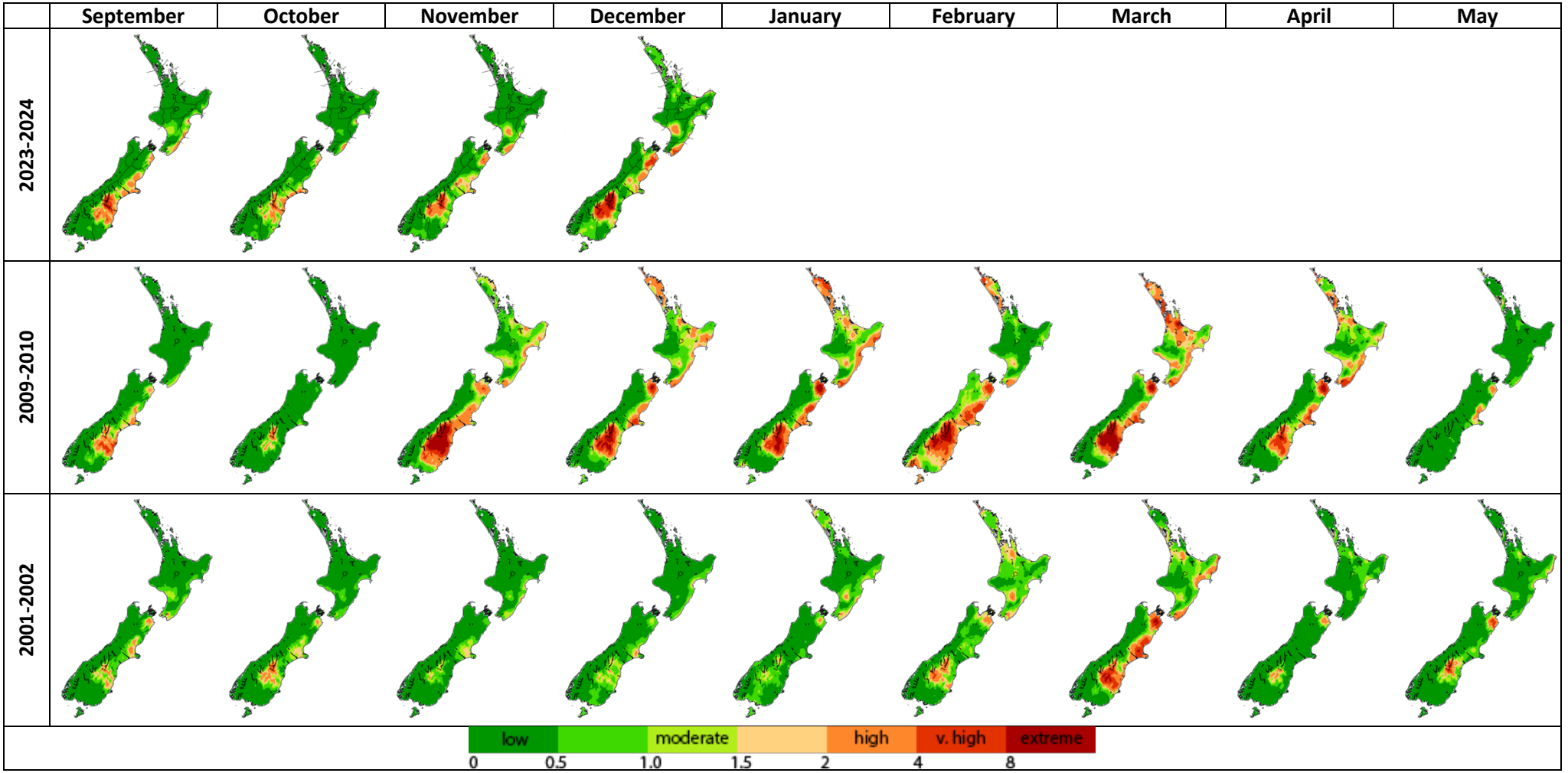


Figure 8: Monthly average severity rating for the current year 2023/2024 and the comparative years of 2009/2010 and 2001/2002. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

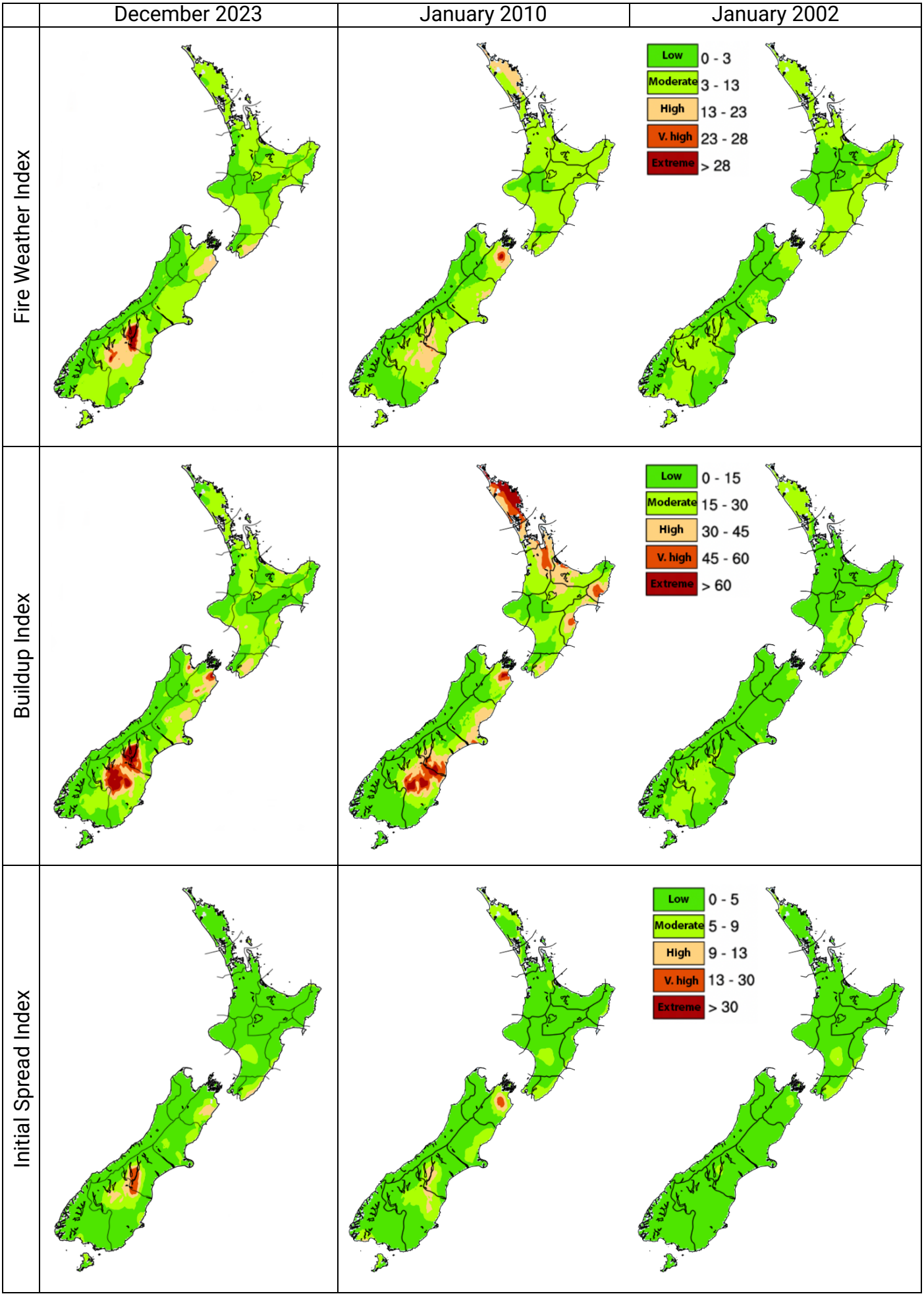


Figure 9: The most recent observed month (left column) and analogue months for January (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

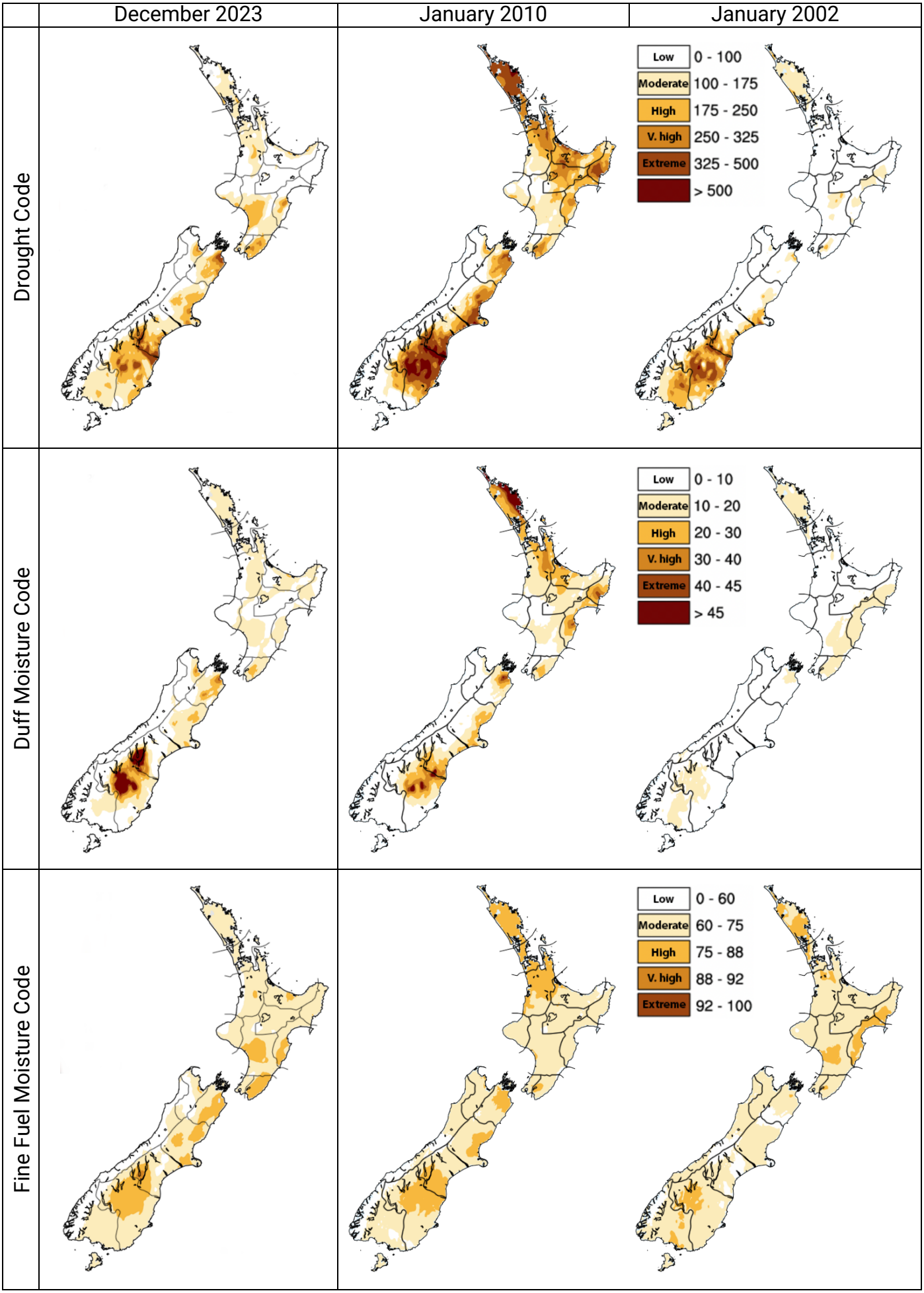


Figure 10: The most recent observed month (left column) and analogue months for January (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

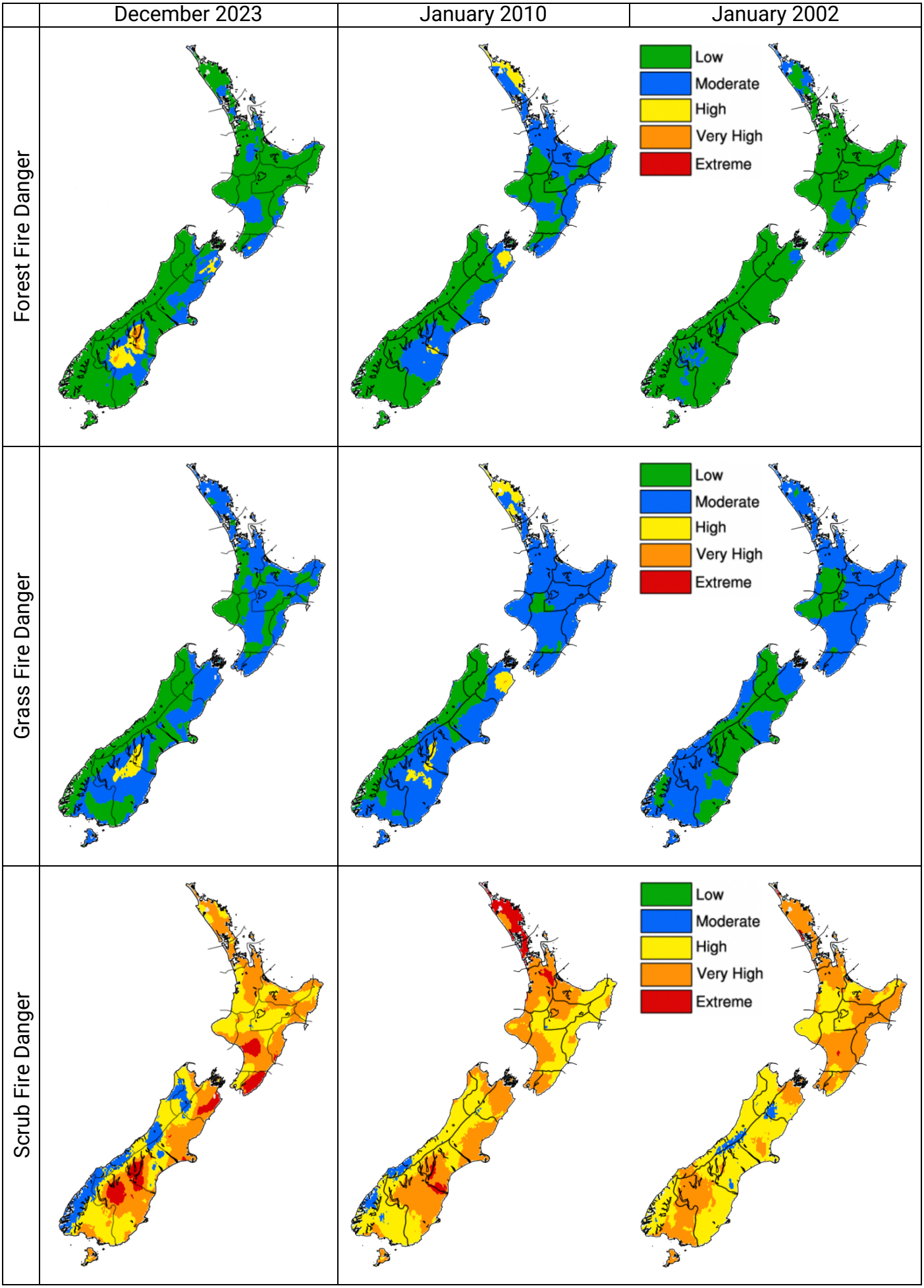


Figure 11: The most recent observed month (left column) and analogue months for January (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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