Aotearoa New Zealand National Monthly Fire Danger Outlook (2024/2025 season)

Issue: January 2025

Current fire danger situation

Eastern parts of both islands generally saw fire indices move into moderate and high ranges by the end of December, with western areas still remaining at lower levels. However, the west of both islands have generally been quite dry in January, causing fire indices to significantly increase there, while the east of the North Island has seen many indices decline due to significant rainfall at the very end of December.

A weak La Niña may officially form in the coming weeks, but even so it would likely be short-lived and "traditional" La Niña-like patterns may not be consistently observed.

Current fuel and soil moisture status

As of 21 January (see Figure 5, left), soil moisture levels were below normal or well below normal across the west of both islands. Near normal soil moisture was generally observed in the north and east of both islands, with pockets of above normal soil moisture in the Far North, Gisborne, and Banks Peninsula.

The elevated values of the Duff Moisture Code (DMC), and Buildup Index (BUI) present at the end of December (Fig. 1, left), which were indicating increased amounts of medium and total fuels available to burn, have declined in many areas following the recent rainfalls, but higher than normal values for this time of year still remain in some areas such as Waikato, the central western North Island and Central Otago (Fig. 1, right). Values of the Drought Code (DC) however have remained high (see Fig. 3), indicating that any fires will involve deeper organic layers and large woody fuels and require extended mop-up.

Dry and sunny weather over the past month has also seen rapid drying of fine fuels in northern and western parts of the North Island, with Northland, Auckland and Waikato and parts of Bay of Plenty areas seeing the greatest increases. Curing of grasses in many areas, along with periods of strong winds, has caused elevated Initial Spread Index (ISI) values, especially in northern parts of the North Island. However, values have decreased significantly following the recent heavy rain north of Auckland, although these will increase again with periods of warm, dry weather.

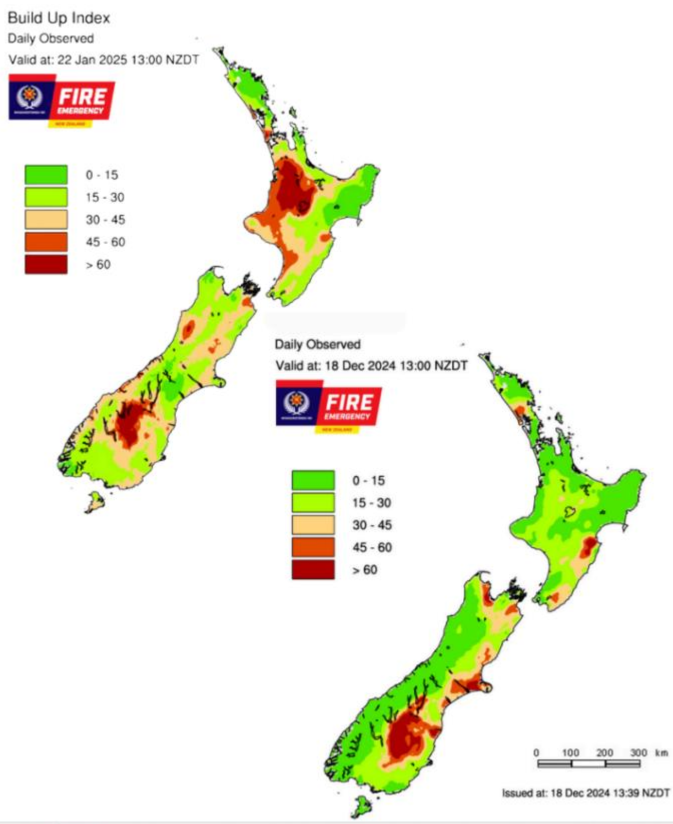


Figure 1: Maps of the BUI indicating total fuel availability from previous outlook (18 Dec., bottom right,) and now (22 Jan., top left) following the recent rain.

Periods of warmer weather between rain events have also brought rapid drying of fine fuels, as represented by increasingly more elevated values of the Fine Fuel Moisture Code (FFMC) (Fig. 2). The FFMC is a key indicator of ease of ignition and a significant factor influencing fire spread rates, along with wind. Dry and sunny weather over the past month has seen drying of fine fuels, curing of grasses in the North and South Island, along with periods of winds, elevating the Initial Spread Index (ISI) values.

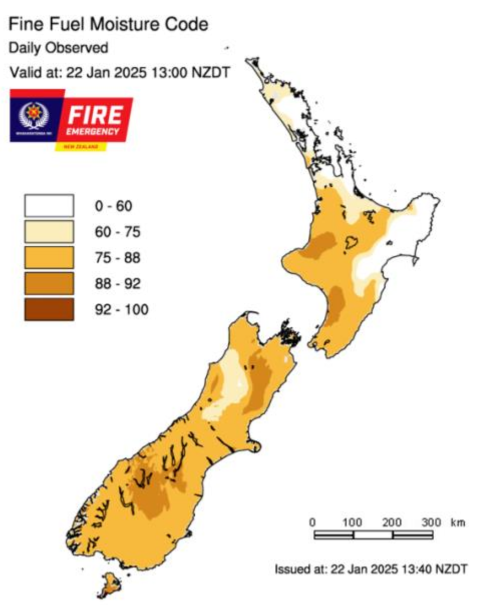


Figure 2: Map of the Fine Fuel Moisture Code (FFMC) as at 22nd January, with elevated values across the country indicating dryness of fine fuels and relative ease of ignition.

Forecast climate and weather

Variable conditions are expected for the rest of January, with rainmaking fronts and low pressure interspersed with high pressure. Notably, after a very dry month so far, the West Coast is expected to receive more significant rainfall through the end of January.

February may begin on a dry note with high pressure favored at the start of the month. A pulse of the Madden-Julian Oscillation (MJO) moving into the western Pacific may channel tropical moisture toward New Zealand around the second week of the month, increasing the possibility of rainfall, especially for the North Island. However, there remains a possibility that this event may either miss New Zealand or have only minor impacts, resulting in drier than normal conditions. Late February may favour high pressure and a drier lean overall. An east-northeast wind anomaly is most likely, reflecting the influence of a weak La Niña.

The February to April period is expected to see a continued prevalence of northeasterly and easterly winds with the influence of a weak La Niña. Wetter than normal conditions are favored for the upper North Island and eastern areas of both islands, while the lower South Island could experience drier than normal conditions. Temperatures are forecast to be near average to above average, accompanied by lighter than average winds.

For more information, see page 9.

The La Niña climate pattern

A weak La Niña may officially form in the coming weeks, but even so it would likely be short-lived and “traditional” La Niña-like patterns may not be consistently observed.

No two La Niña 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, La Niña events are historically associated with higher-than-normal pressures east of New Zealand, resulting in more northeasterly winds than normal. This leads to wetter than normal conditions being favoured for northern and eastern areas, while drier than normal conditions tend to prevail in the south and west.

The El Niño-Southern Oscillation (ENSO), which includes El Niño and La Niña phases, is often highlighted in seasonal forecasts, as it the most important source of intraseasonal variability. While ENSO provides predictability over longer timescales, it doesn’t fully explain all climate variability. Increasing global Sea Surface Temperatures (SSTs) due to climate change in recent years have also altered traditional impacts of ENSO phases and its associated weather patterns. It is therefore essential to continue monitoring the fire season through the Fire Weather System, with an understanding that even under normal or near-normal conditions, there will be periods of elevated fire danger.

What to watch for

Complacency

The perception by many is that the current conditions are not favourable for fires to escape, especially if there has been some "greening up" following rain. This can lead to complacency amongst the public, landowners, and firefighters. This is especially true of areas that are not used to high seasonal drying. Once weather conditions improve, we can expect the indices to return to more elevated levels. Warm temperatures, strong winds and availability of fine flashy fuels still provide conditions suitable for fires to start, spread rapidly and burn with moderate to high intensities, which can result in burning of large areas.

Left – Photo from the Te Toke Rd Fire near Taupo, Bay of Plenty, which burned in broom and grass across 19 ha *(photo supplied by Roger Nelson, FENZ. Right – photo from the Tropicana Fire, near Whangarei (Dennis Cooper, FENZ).*

Responsiveness of light flashy, medium, and heavy fuels

Recent fires in Tāmaki Makaurau Auckland and Northland show light flashy fuels that are exposed to sunlight and wind are very responsive to fire. These fuels will again become readily available to burn quickly following rain due to their elevated nature. This is observable with the changing FFMC.

Due to their larger size moisture content of medium and heavy fuels increases relatively slowly. Consequently, when rain is of short duration or of small amounts medium and heavy fuels can remain deceptively dry.

Some hedges, especially the conifer species, can be readily available to burn as, like scrub fuels, they are also elevated with fine needles and can hold dead fuel throughout their structure. Sheltered medium and heavier fuels protected within the hedge can also dry out so that if they burn, they burn with high intensity. Managing burn piles near hedges requires extra vigilance.

Wind driven fires

The current seasonal forecast indicates winds over summer will have more of a northeasterly influence. Up until now, we have seen a season characterized by windy northwest or southeasterly conditions. We can continue to expect periods of strong winds, usually associated with passing weather systems, which can lead to wind-driven fires with rapidly growing perimeter size.

Humidity

Relative humidity (RH) is a key factor in the potential for fires starting and growing. RH is itself a good indicator of the dryness of fine dead fuels, so the lower the humidity, the drier these fine fuels, and the easier fires can ignite and spread.

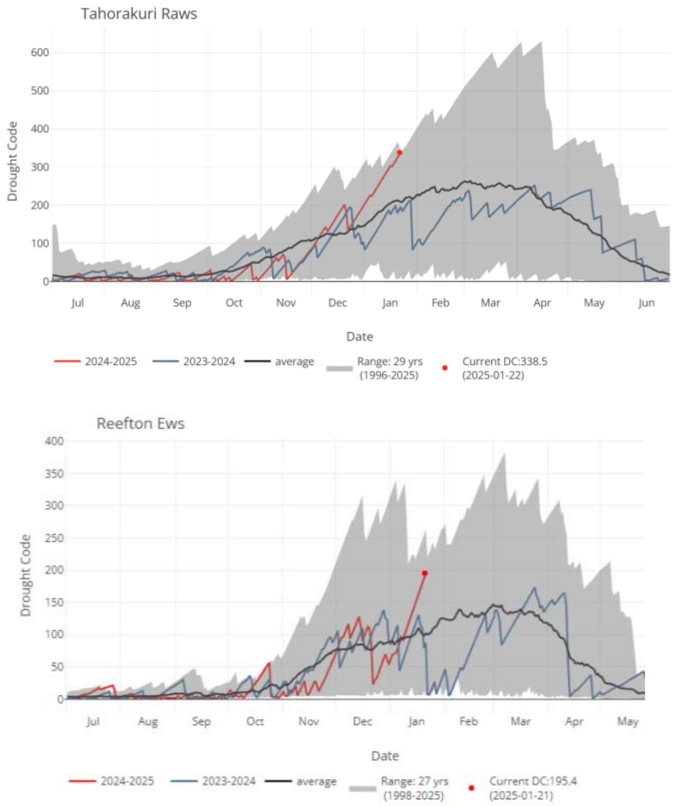
The flow of air over mountain ranges can result in warmer and drier air on the lee side of the terrain, known as the foehn effect. Under westerly winds, this is more common in eastern areas such as Canterbury and Hawkes Bay. However, under La Niña conditions when northeasterly flows are more common, this can mean the opposite occurs, with warm dry conditions and lower RH on the western side. A change from the usual westerly to northeasterly winds therefore can pose a significant risk to communities that are not used to dry conditions; for example, on the western side of both islands, which could see significant drying in all fuel types.

<u>Grass curing</u>

There has been rapid curing of grasses in parts of the country, and seasonal die-off is well underway. Following the recent rainfall, we can expect some greening up of areas as the warmer weather returns. There is therefore currently a bit of a see-saw effect in some areas, where new growth is replacing previously cured grass following the recent rain events. Monitoring the curing as it changes is critical to maintaining good data on which to base fire season decision-making.

Fire normally starts in the fine fuels, but with an increase in the amount of dead fine fuel present, this means that everyday activities can cause fires. Managing grass fuels before they cure in the summer months is the key to reducing fire starts as well as potential fire intensity if they do occur.

Above: Example of deep-seated burning requiring heavy machinery Te Toke Road Fire in the Tahorakuri Forest area north of Taupō.



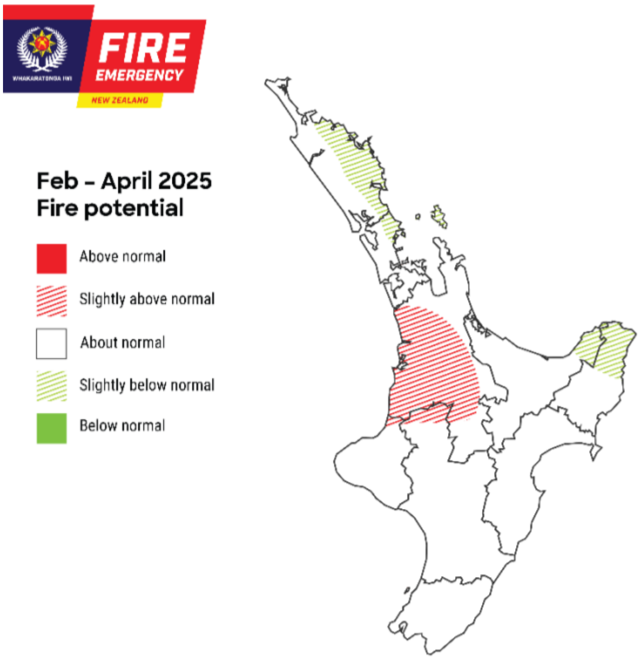
Above: Examples of current trends (red line) in fire dangers using the Drought Code (DC), for Tahorakuri Remote Automatic Weather Station (RAWS) near Taupo (top) and Reefton RAWS on the South Island's West Coast (bottom). Both stations show elevated values, well above normal (black line) and for the same time last year (blue line), highlighting the underlying dry conditions in soil organic layers and large woody fuels. These DC values (along with other codes and indices such as the DMC and BUI) are indicators that fires in these locations will burn deeper than average years and be difficult to put out.

<u>Areas to watch:</u>

The North Island has seen a recent reversal in areas experiencing drier weather. Areas to monitor for fire potential include the currently dry regions on the west coast of the North Island, Waikato, inland Taupo, Taranaki, Whanganui, Rangitikei, Manawatu and Horowhenua, as well as the South Island's West Coast and Central Otago.

Warm, dry, windy conditions in these areas could result in fire dangers quickly elevating from their already above-normal levels. However, if recent changeable weather patterns continue, or if there is an onset of more easterly flows with La Niña bringing increased rainfall and humidity, fire dangers could decline to normal or below normal levels, especially along the eastern coasts of both islands.

In the longer term, the onset of La Niña could potentially bring moister flows to eastern and northern parts of both islands. This may lead to below normal fire potential, particularly for the east and north of the North Island around East Cape, the Coromandel, and Northland, where conditions are predicted to be slightly below normal.



For the South Island, there has been almost complete switch from an early fire season to a return of grass growth. A north Easterly flow is predicted to result in slightly above normal fire potential for inland Otago and the West Coast.

The current forecast is predicted to produce more normal fire dangers in other areas due to the wetter than normal conditions experienced in these areas in recent months. Although areas around Marlborough, Central Otago have missed much of the recent rains and are beginning to dry. Along the east coast of the South Island, fire potential is expected to be around normal to slightly below normal for parts of Canterbury and South Canterbury, with the fire dangers around Christchurch and North Canterbury significantly lower due to wetter conditions than at the start of the season. Depending on the strength of the La Niña event, fire potential might end up below normal, especially along the eastern coastal strip, or possibly even dry out again and increase if La Niña does not eventuate and dry periods continue.

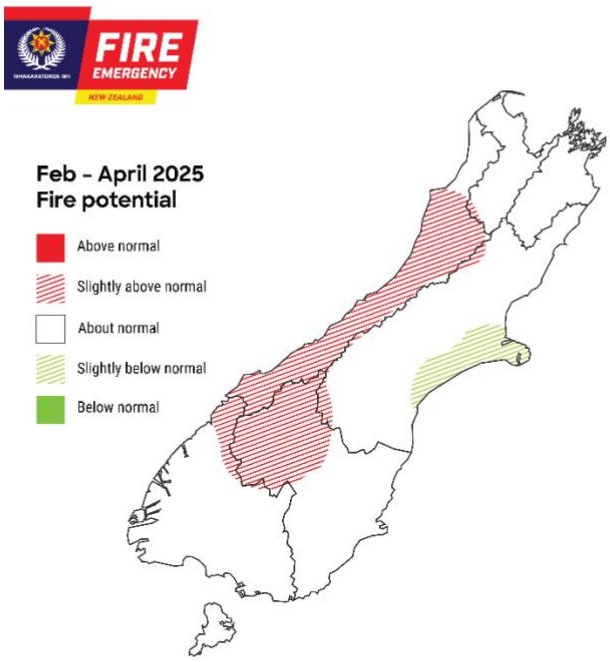


Figure 4. Fire potential over the next three months for the North and South Islands based on assessment of the effects of climate predictions for the Feb-Apr period. Note that this outlook is at odds with the current situation, where fire dangers are at or below normal in many areas, which may offset the impact of the seasonal prediction. Areas identified as above or below normal may change in future outlooks as certainty around seasonal climate derives increases as the fire season develops.

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) throughout the country. However, so far in January temperatures have been below average to well below average across much of the country due to a southerly air flow, although the West Coast has been warmer than average (Figure 5, right).

December rainfall was above normal (120-149% of normal) or well above normal (>149% of normal) in eastern and southern parts of the North Island, inland Marlborough, northern, eastern and central parts of Canterbury, parts of the West Coast, and central and eastern parts of Southland. Below normal (50-79% of normal) or well below normal (<50% of normal) rainfall was observed in northern, central and western parts of the North Island, Nelson, Tasman, southern Canterbury, and North Otago.

So far in January, rainfall has been below normal or well below normal for much of the country, particularly in the west of both islands. Pockets of near normal to above normal rainfall have been observed in the Far North, eastern North Island, Nelson, and central Canterbury (Figure 5, middle).

As of 21 January (see Figure 5, left), soil moisture levels were below normal or well below normal across the west of both islands. Near normal soil moisture was generally observed in the north and east of both islands, with pockets of above normal soil moisture in the Far North, Gisborne, and Banks Peninsula.

Climate drivers

Sea surface temperatures (SSTs) remained in the neutral range in the central equatorial Pacific (Niño 3.4 Index) at the end of December (-0.4˚C). As of late December, the 30-day relative Niño 3.4 Index[1] (RONI) was -0.9˚C, reflective of the central equatorial Pacific being significantly cooler than the average of the global tropics.

The Southern Oscillation Index (SOI) was technically in La Niña range (+1.83) during December. However, large variability characterised the SOI during December, with daily values at the end of the month being slightly negative (i.e. on El Niño side of neutral).

While several oceanic and atmospheric indicators have ventured into La Niña territory at times, the ocean and the atmosphere have failed to *fully and consistently* couple. Thus, conditions still fall short of a full-fledged La Niña event. There still is large uncertainty as to whether official La Niña thresholds will be met over the coming season: guidance from international forecast models that NIWA monitors indicates decreasing chances for La Niña (about 40%) and an increasing probability for ENSO-neutral conditions (about 60%) over the outlook period.

The Indian Ocean Dipole (IOD) index remained negative during most of December but remained in the neutral range, with the average anomaly for the month of December being -0.51°C. The guidance from the Australian BoM is for the IOD to remain neutral throughout the forecast period.

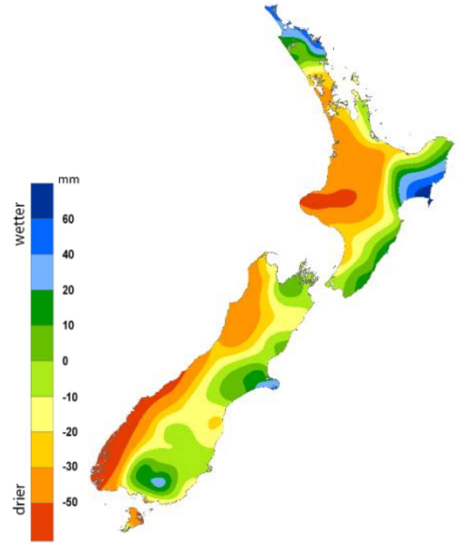
During December, convective forcing associated with the MJO reached the Maritime Continent (phase 5). The forecast is for convective activity associated with the MJO to move through the Maritime Continent through the first two weeks of January, then weaken from mid-month as it passes through the Western Pacific (phases 6 and 7) and toward the western hemisphere (phases 8 and 1) by the end of January.

New Zealand’s coastal water temperatures remained generally above average in December, with anomalies ranging from about +0.9°C to +1.6°C by the end of the month, but marine heatwave conditions (MHW) have receded in both extent and amplitude recently. While MHW conditions remain possible over the coming three months, widespread MWH conditions are less likely than previously believed.

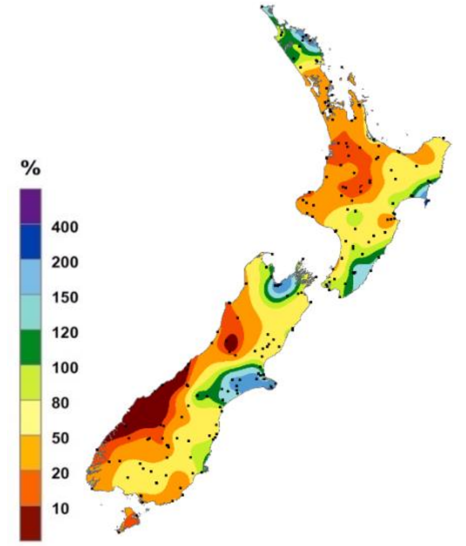
[1] The Relative Oceanic Niño 3.4 Index (RONI) is a modern way of measuring oceanic El Niño and La Niña that is complementary to oceanic traditional indices. While traditional oceanic indices like the Niño 3.4 Index monitor SSTs in one region, the RONI compares the average SST in the central equatorial Pacific with the average SST across the global tropics. Since tropical rainfall patterns respond to relative changes in ocean temperatures, this new relative index can help forecasters better determine if the equatorial Pacific is warmer or cooler than the rest of the global tropics, which has become more challenging to discern as seas warm because of climate change.

Figure 5: Maps showing the current soil moisture anomaly, as well as rainfall and temperature differences from normal since the start of the month.

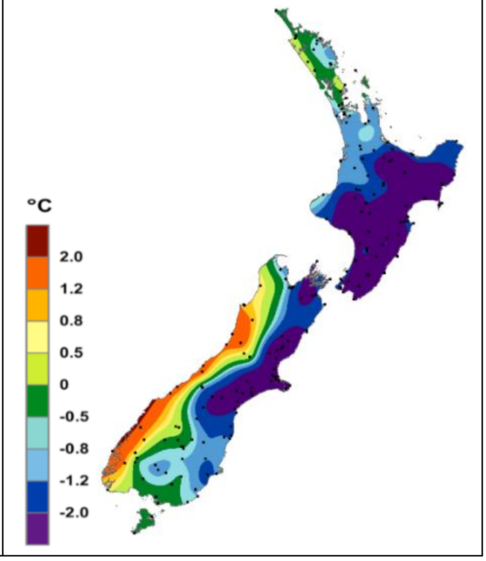
Soil moisture anomaly:
21/1/25



Rainfall anomaly:
1/1/25 – 21/1/25



Temperature anomaly:
1/1/25 – 21/1/25

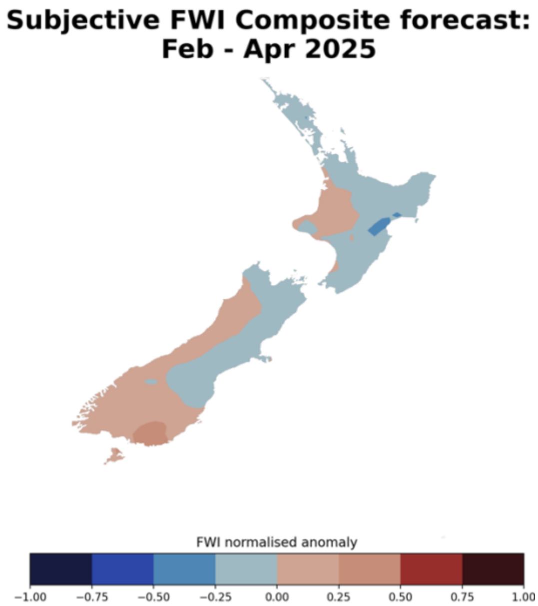


Fire season analogues

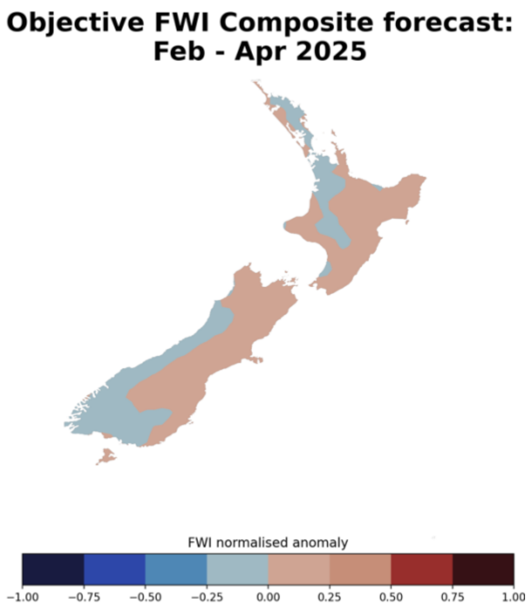
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

This season’s analogue years feature historical years that had La Niña patterns weakening into the autumn season (Figure 6). 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 objective analogues have less similarity than normal to the subjective years owing to weak La Niña conditions this summer.

Northeasterly quarter winds will become more likely in the coming months, and this is likely to cause a drying trend in the west of both islands, potentially increasing the fire weather threats there. However, this pattern may not be consistently observed in the coming months. Conversely, the east of both islands may be exposed to more rainfall, onshore winds, higher humidity, and a decrease in the fire weather potential. The upper North Island may also be more exposed to northerly rainmakers as the three-month period progresses.



Forecaster-selected analogue season - Feb to Apr
2022
2021
2018
2012
2011
2008
1999
1997



Data-driven analogue season - Feb to Apr
2019
2014
2007
2006
2004
2001
2000
1989

Figure 6: 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 2025

February's air flows are expected to tend more northeasterly to easterly at times as high pressure becomes favoured near and east of New Zealand. This will bring an increased chance for drier than normal conditions to the west of both islands, although the West Coast may still see moisture-bearing fronts at times. Meanwhile, the east and north of the North Island may see irregular heavy rainfall events. Wind speeds are expected to be near average or slightly above average, while above average temperatures are favoured (Figure 7).

Climate outlook: February – April 2025

A northeast to east air flow anomaly will be favoured during the season. Temperatures for the next three months are expected to be above average overall (Figure 8). With the potential for weak and short-lived La Niña-like conditions throughout the season, rainfall is generally favoured to be above normal in the upper North Island and east of both islands, with drier than normal conditions possible in the lower South Island. Slightly above normal relative humidity is expected in most northern and eastern regions. Wind speeds are expected to be lower than normal.

The tropical cyclone season for the Southwest Pacific runs through April 2025. NIWA has assessed that the risk for an ex-tropical cyclone to come within 550 km of New Zealand is normal to elevated for this season.

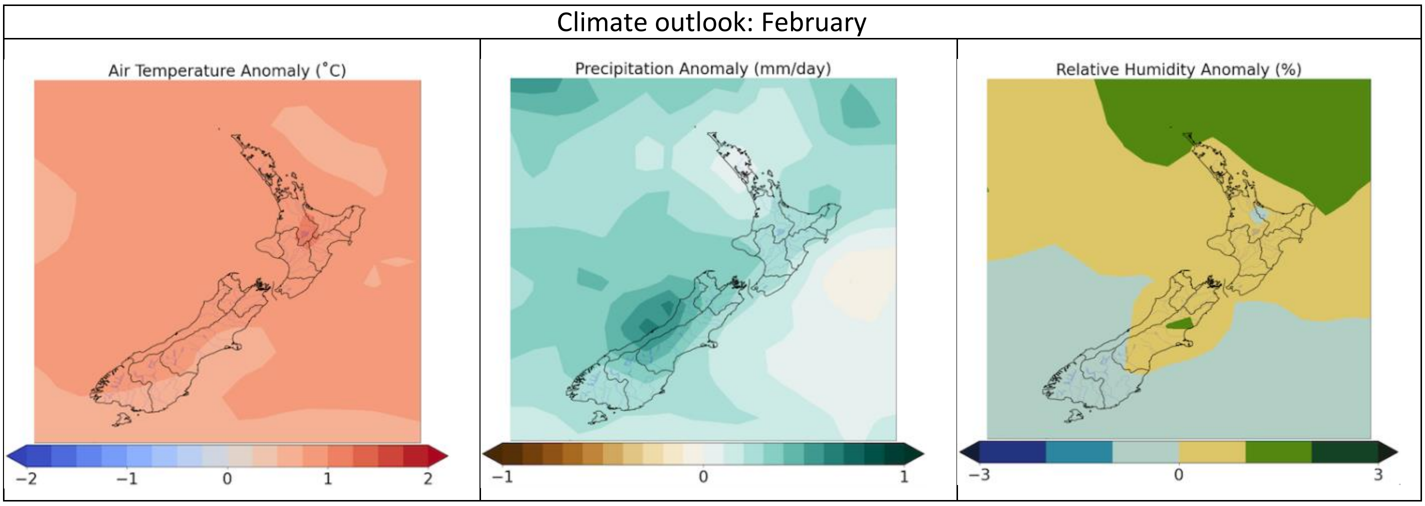


Figure 7: Climate outlook for February showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

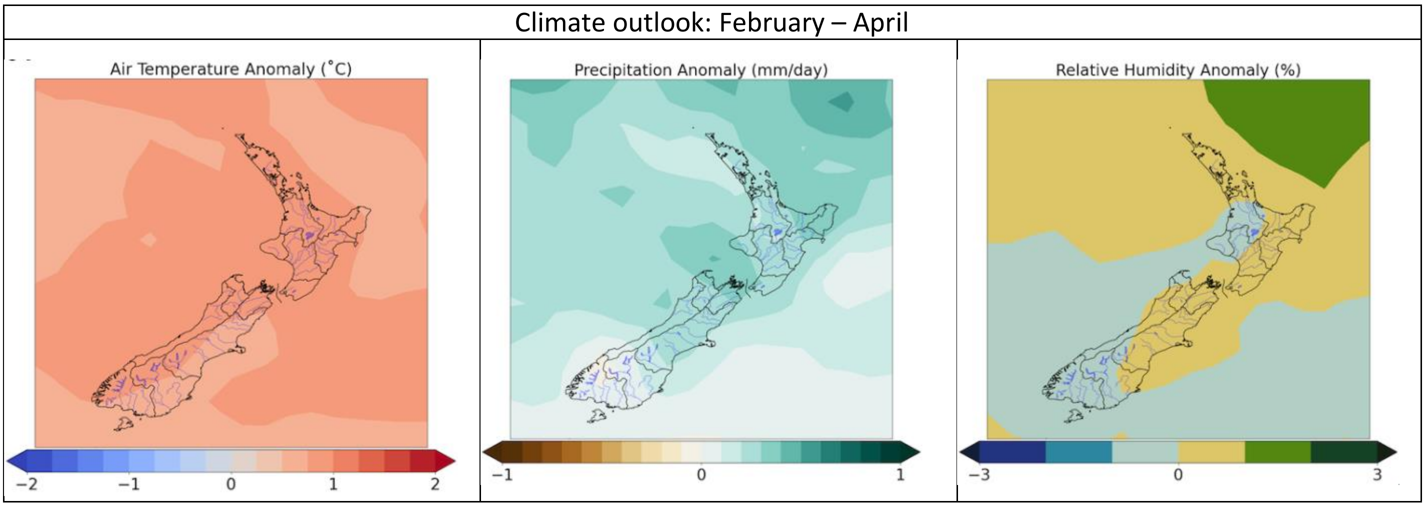


Figure 8: Climate outlook for February-April showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

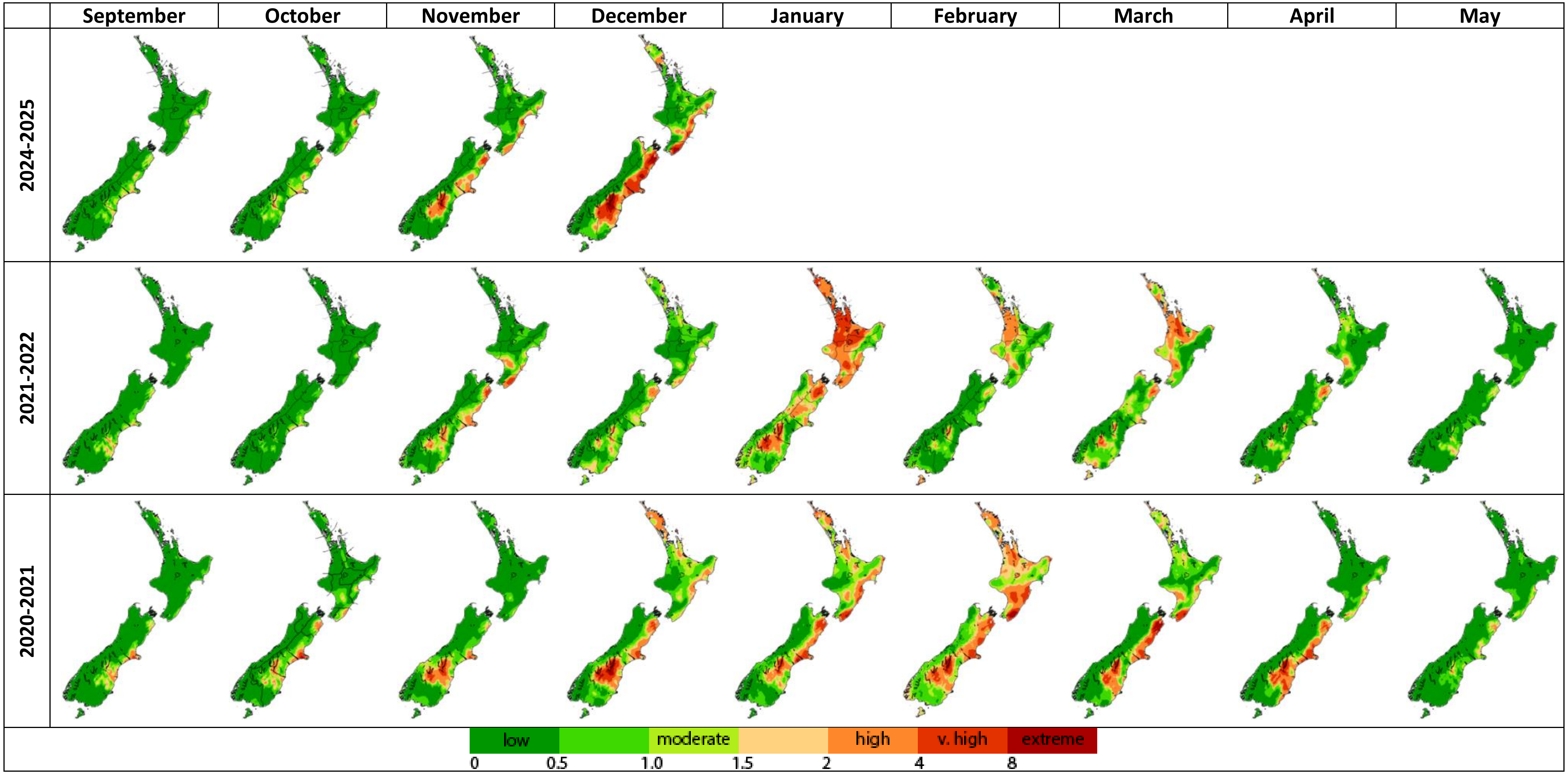


Figure 9: Monthly average severity rating for the current year 2024/2025 and the comparative years of 2021/2022 and 2020/2021. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

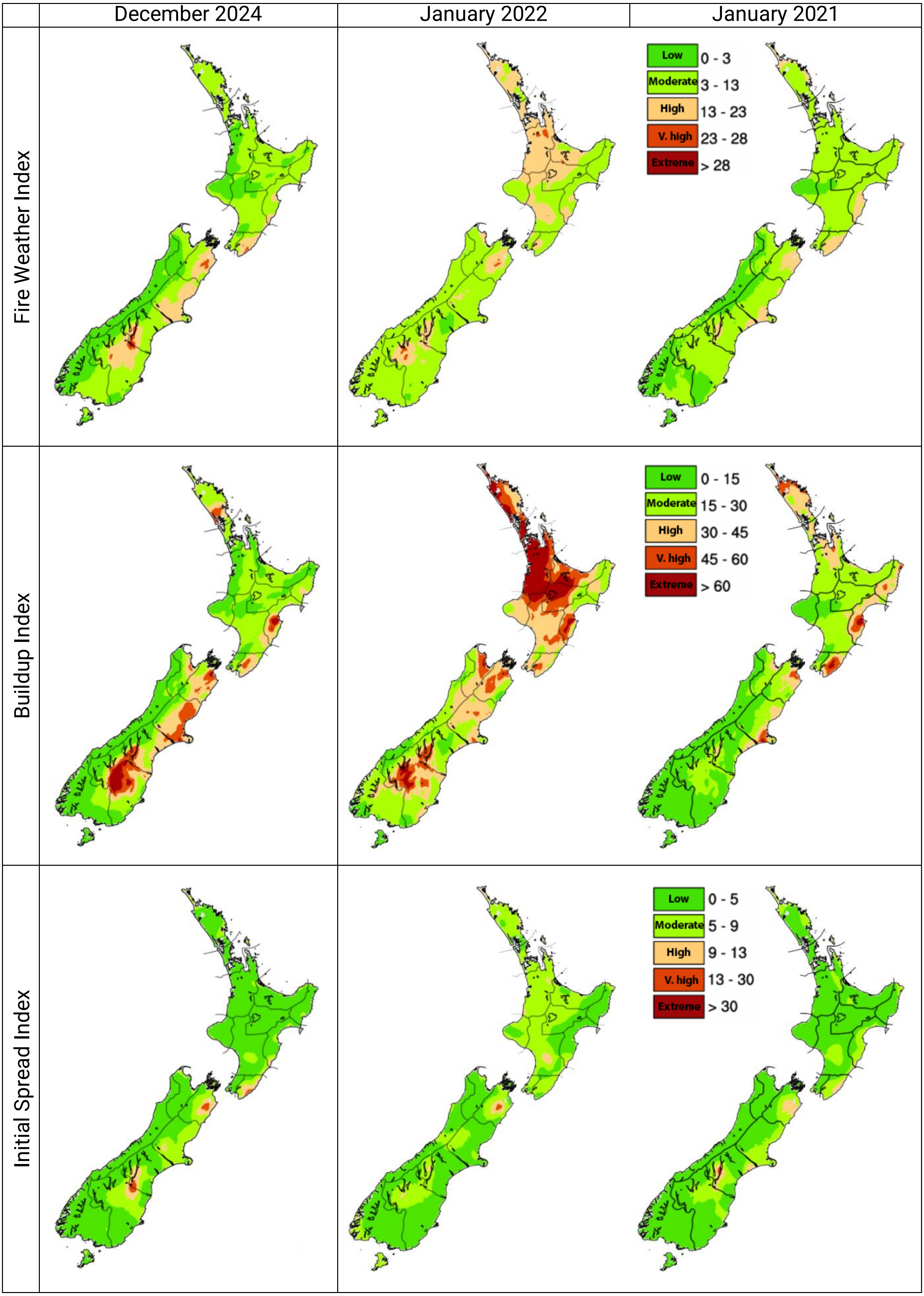


Figure 10: The most recent observed month (left column) and analogue months for January (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

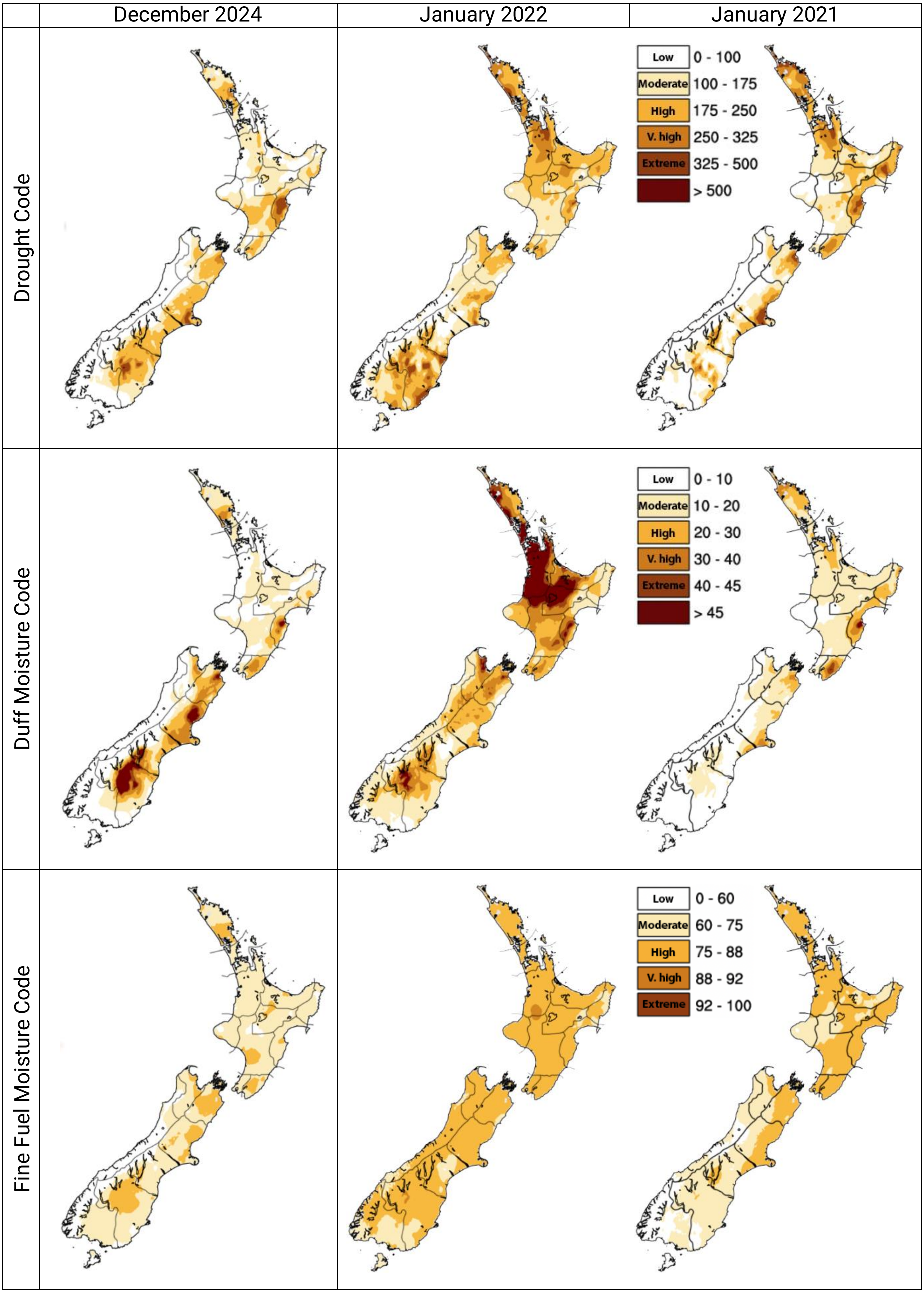


Figure 11: The most recent observed month (left column) and analogue months for January (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

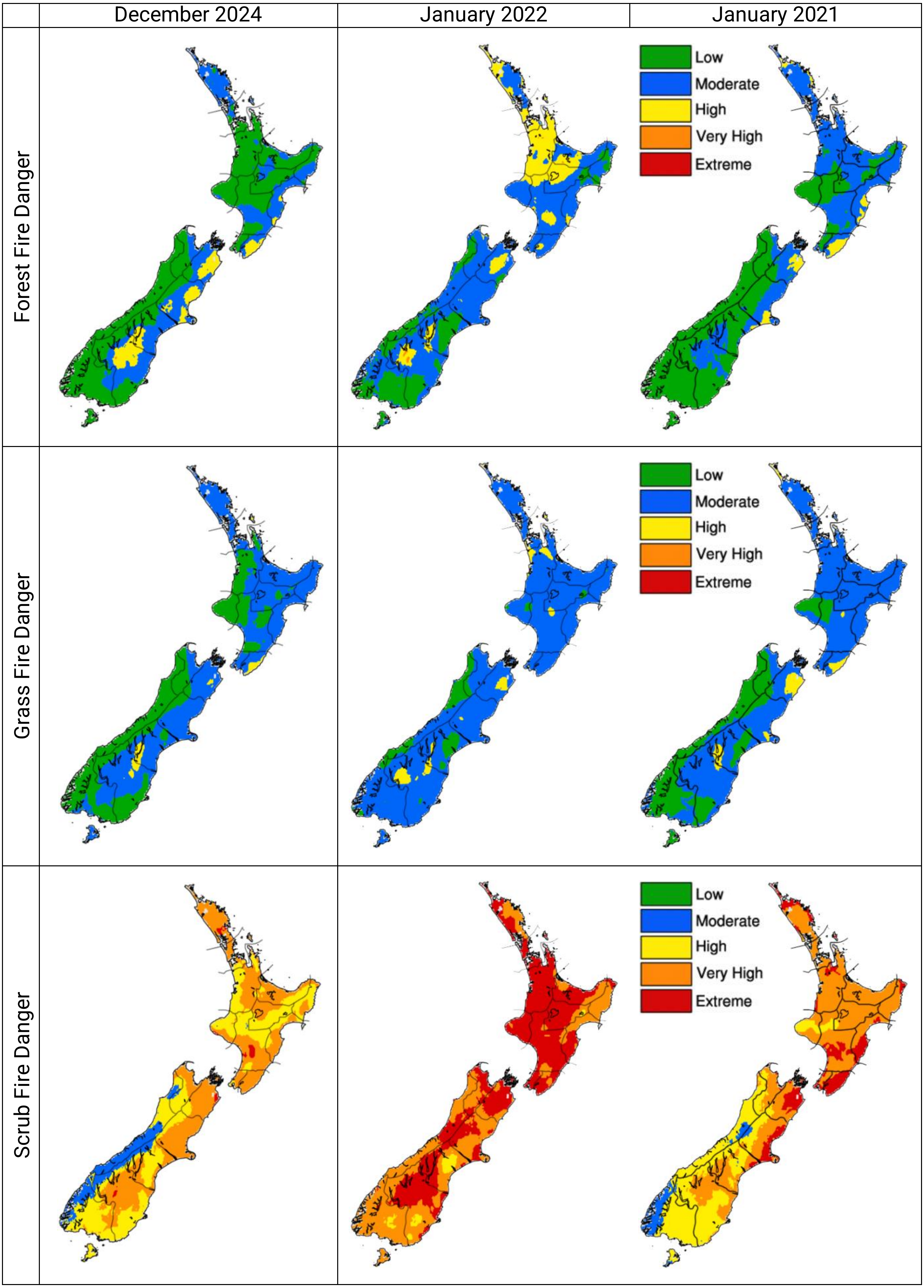


Figure 12: The most recent observed month (left column) and analogue months for January (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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

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

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

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

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

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

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.

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