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

Issue: February 2024

## Current fire danger situation

Fire dangers across much of the country have steadily climbed through January and early February. Most of the North Island currently has Moderate fire dangers, with High fire dangers in Northland, Manawatu, and Gisborne, and Very High-to-Extreme fire dangers in Wairarapa. Most of the eastern and north eastern parts of the South Island have frequently experienced Very High to Extreme fire dangers, especially during periods of strong north westerly winds. West Coast, Southland, and Chatham Islands are the only large areas with consistently lower fire dangers.

El Niño conditions continued through January and have around a 100% chance of persisting through till April. There is around a 65% chance of ENSO neutral conditions being favoured from May to July.

## Current fuel and soil moisture status

As of 18 February (see Figure 4, left), soil moisture levels were below normal across most of the North Island except parts of the Central Plateau, Hawke's Bay, and Gisborne ranges, as well as the upper South Island, eastern Otago, and south Canterbury. Above average soil moisture was seen in the central North Island, as well as the western and southern South Island. Near-normal soil moisture was seen for all other areas.

Fuel moistures have been decreasing steadily over past weeks in the absence of significant rain for most of the country, other than parts of the West Coast of the South Island, Southland, and Chatham Island. For forests, as fuel moisture decreases, more medium and heavy fuel (sticks, logs, and ground fuels) become available to burn, and with greater fuel available, fire intensity increases along with the fire danger. Medium and heavy fuel availability is represented by the BUI as depicted in Figure 1.

The parts of the country that are drying out will also have increased curing (browning of grass). As the curing increases, the moisture content decreases making the grass easier to ignite and likely to burn with higher rates of spread and intensities.

Lower fine fuel moisture content increases the ease of ignition and spread rates. Fine fuel moisture varies greatly over short periods (days or even hours) and is represented in the Fire Weather System by the fine fuel moisture code (FFMC). Frequently we have seen the FFMC elevated, especially during periods with low humidity higher temperatures and without rain. We have recently seen examples of these conditions in eastern parts of the South Island because of northwesterly foehn winds, and in the North Island from high pressure weather systems.

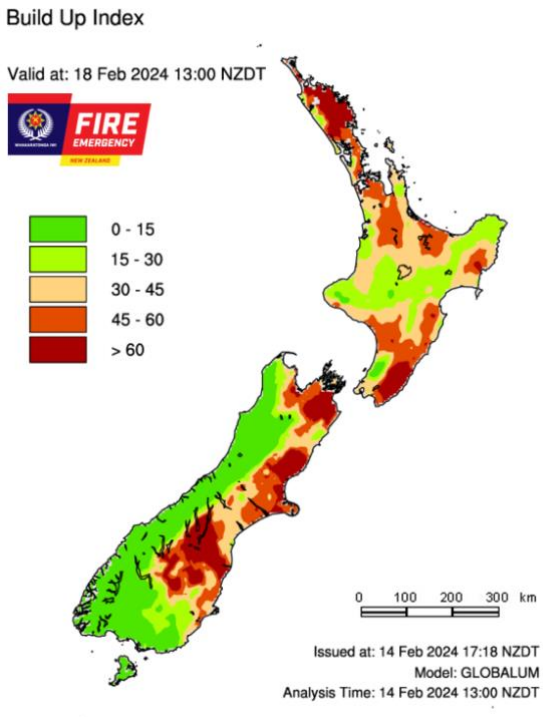



*Figure 1: Map of Buildup Index (BUI) values (indicator the total amount of fuel available for combustion) as of 14th February*

## Forecast climate and weather

The remainder of February is expected to feel like a traditional El Niño, with periods of wet weather in the west, and dry, hot weather in the east. Additionally, several rounds of strong westerly winds are expected. However, lots of dry and settled weather is also anticipated for the North Island, continuing to exacerbate areas that are experiencing dryness or meteorological drought.

February-April will favour a northwest air flow anomaly. Temperatures continue to look above average overall. 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.

For more information, see pages 4 and 5.

## The El Niño climate pattern

El Niño is a coupling of ocean and atmosphere leading to a shift of the normal seasonal climate patterns. El Niño is traditionally monitored with two indices. The first measures the oceanic response to El Niño, called the NINO3.4 index. The second measures the atmospheric response to El Niño, called the Southern Oscillation Index, SOI. The latest weekly NINO3.4 index is 1.5°C, down from the peak of 2.13°C in November but still well above the threshold of 0.7°C required for the classification of El Niño. The preliminary SOI so far this February is -2.1, well within the El Niño range, and a marked shift from January which had a positive SOI. Over the last month, the atmosphere leaned towards a more traditional El Niño response.

While we have passed the peak of oceanic El Niño, the climate driver will still have a significant impact on the weather systems seen in New Zealand over the next season. El Niño traditionally brings stronger westerly winds than normal, which result in wetter conditions in the west and drier conditions in the east of both islands.

## What to watch for

The areas to watch will be:

- the top of the North Island – especially if the moisture from the Madden-Julian Oscillation (MJO) misses these areas.
- Wairarapa, Marlborough, North and South Canterbury, and Otago, currently experiencing moisture codes showing extremely dry conditions, very cured grass areas and occasional strong winds which are likely to continue for the coming months.

Areas of cured (dead or browned off) grass can ignite easily and result in very fast-moving fires with surprisingly high fire intensities. Ahead of days of elevated fire danger, cured grasses should be removed from areas where an ignition could occur and from near vulnerable assets such as buildings.

Periods of elevated fire danger due strong winds and or low humidity. During these periods consideration should be given to:

- Avoiding or postponing activities such as mowing that occasionally or normally generate sparks such as mowing or grinding – especially during the heat of the day.
- Having a plan in place to ensure your safety in the event of a wildfire.
- Fire agencies and land managers consider increasing availability of firefighting resources.
- Issue warnings and if required use legislative tools for temporary activity restrictions

Forest fuels in many areas are becoming dryer meaning wildfires are more likely and when they do occur will have greater intensities, making them more destructive than fires in the wetter conditions we have seen over recent years. These forests will also remain relatively dry with elevated fire danger even after small to moderate amounts of rain. The risk will not reduce significantly until they have received substantial and sustained rain.

Drought codes in many areas are higher than they have been in past years and are likely to continue to climb. This means fires are more likely to burn deep into the ground. Fires burning deep can result in controlled burns resurfacing days, weeks, or occasionally months later, and it is likely to make full extinguishment of fires considerably more difficult than experienced in recent years.

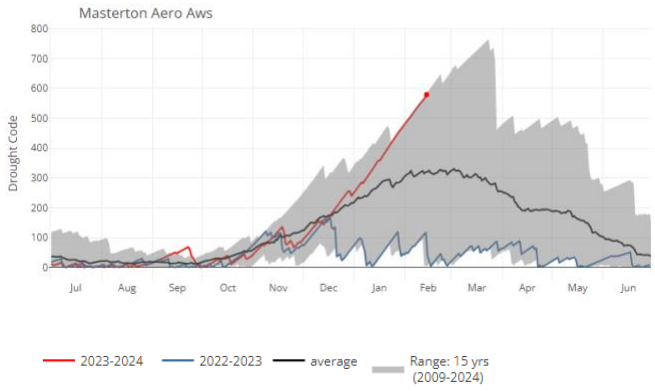



*Figure 2: Trend in the Drought Code (DC) for Masterton, showing the already elevated values as of 15 Feb note the stark contrast to last year's drought code in blue.*

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.

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 are reminded to check the conditions before they light, and if a permit is required via the "Check it's Alright" website.

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.

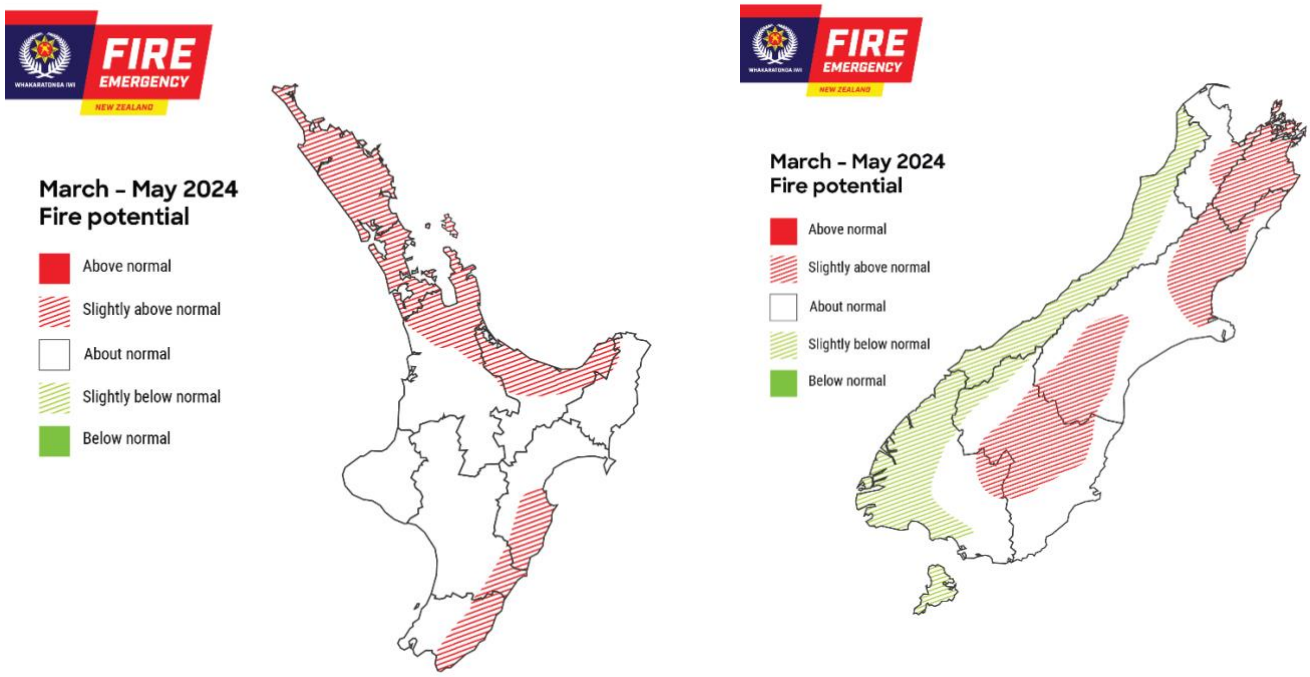



*Figure 3: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.*

*Image 1: Northland fire burning deep after two weeks*

## Current climate

In January, temperatures were above average (0.51-1.20°C above average) or well above average (>1.20°C above average) across most of the country. Temperatures were near average (±0.50°C of average) in western parts of Southland and Otago, and parts of Central Otago. So far in February, temperatures have been near average for large parts of the country, above average temperatures for parts of the upper North Island and lower North Island, as well as some pockets of the eastern South Island. Below average temperatures have been observed for some areas in the western South Island (Figure 4, right).

January rainfall was below normal (50-79% of normal) or well below normal (<50% of normal) rainfall was observed across northern, western, and southern parts of the North Island, and northern, eastern, and inland parts of the South Island. Above normal (120-149% of normal) or well above normal (>149% of normal) rainfall was observed across central and eastern parts of the North Island, and western parts of the South Island. So far in February, rainfall has been below normal or well below normal the northern and southern North Island, as well as about Taranaki, and the upper South Island and south Canterbury and Otago areas. Above normal or well-above normal rainfall has been seen in the lower South Island, and the central North Island, as well as pockets of the mid-Canterbury (Figure 4, middle).

As of 18 February (see Figure 4, left), soil moisture levels were below normal across most of the North Island except parts of the Central Plateau, Hawke's Bay and Gisborne ranges, as well as the upper South Island, eastern Otago, and south Canterbury. Above average soil moisture was seen in the central North Island, as well as the western and southern South Island. Near-normal soil moisture was seen for all other areas.

## Climate drivers

The NINO3.4 Index anomaly (which covers the west-central equatorial Pacific) over the last month (through 31 January 2024) was +1.79˚C, within the range of a strong El Niño (classified when the NINO3.4 Index is greater than +1.5˚C). Although the current El Niño event is past its peak oceanic intensity, atmospheric patterns will likely continue to show El Niño-like tendencies in the months ahead.

The Southern Oscillation Index (SOI) was in the neutral range during January (+0.3) and November-January (-0.4). This suggests that El Niño's reflection in the atmosphere has been atypical, particularly considering the oceanic intensity. In February, the SOI has returned to strongly negative values, signalling a change to more traditional El Niño-like atmospheric responses.

Of the models monitored by NIWA, there's around a 100% chance of El Niño continuing through April. ENSO neutral conditions are favoured to develop during May-July (around a 65% chance).

The subsurface equatorial Pacific is cooler than average across much of the basin below 100 m depth and the West Pacific is 0.5˚C to 1.5˚C below average near and west of the International Date Line. The east remains warmer than average, with the basin now showing more of a traditional El Niño-like signature, despite the El Niño event now being in its decay stage.

During January, convective forcing focused in the Indian Ocean, Maritime Continent, and western Pacific. Forcing was reduced over the eastern tropical Pacific and Africa. Overall, this configuration was La Niña-like and contributed to intraseasonal variability that was out of sync with El Niño (otherwise known as destructive interference).

The Madden-Julian Oscillation (MJO) is active in the west Pacific. During March, the MJO shows signs of continuing an eastward progression across the Indian Ocean and potentially into the Maritime Continent.

The possible MJO phase progression of 1-2-3 during March has been associated with above normal rainfall in the western South Island (phases 1-2), above normal rainfall in the northern and eastern North Island (phase 1), and the lower North Island and northern South Island (phase 3). Notably, none of these phases have historically produced above normal rainfall in the eastern South Island. Phases 2-3 also favour below normal rainfall in the eastern North Island.

As far as temperatures go, these MJO phases support variability in the South Island with occasional high heat extremes and Antarctic air masses both possible. Under the same phases, the northern North Island would have the warmest lean of any region.

Perhaps most notably, convective forcing near the International Date Line, which has been a major source of climatic variability over the last year, is expected to wane from February-April. This may mean that New Zealand becomes less exposed to northerly low pressure systems and that westerly winds become more common. Regions that have yet to experience persistent drier-than-normal conditions should remain prepared for that possibility as this change occurs.

A marine heatwave rapidly developed and strengthened during January, with anomalies of +1-3˚C near the North Island and northern and eastern South Island during the month. The most persistent marine heatwave conditions are currently found off the coast of much of the North Island, the upper South Island, and parts of the Canterbury/Otago coast. This feature will likely have an upward influence on air temperatures and humidity in the weeks and months ahead.

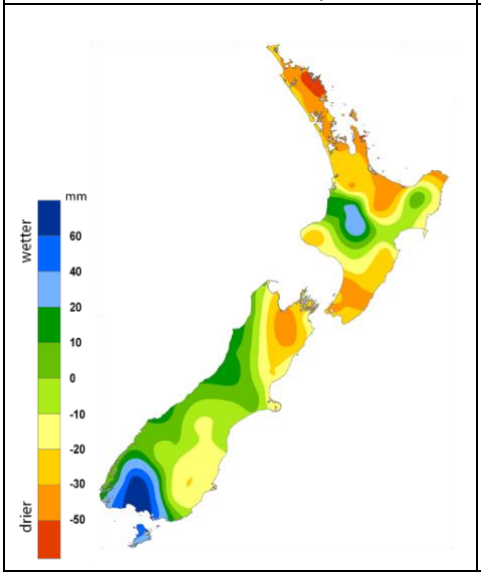
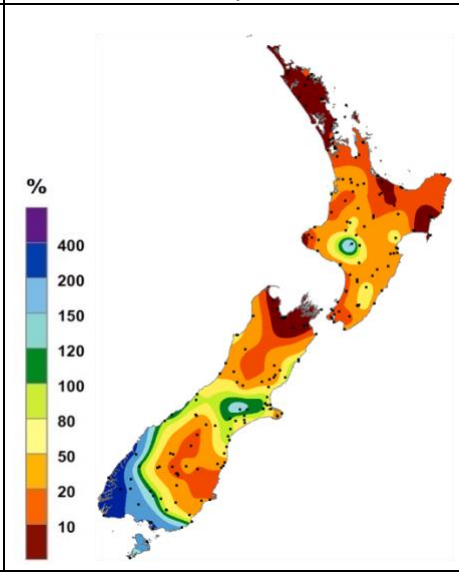
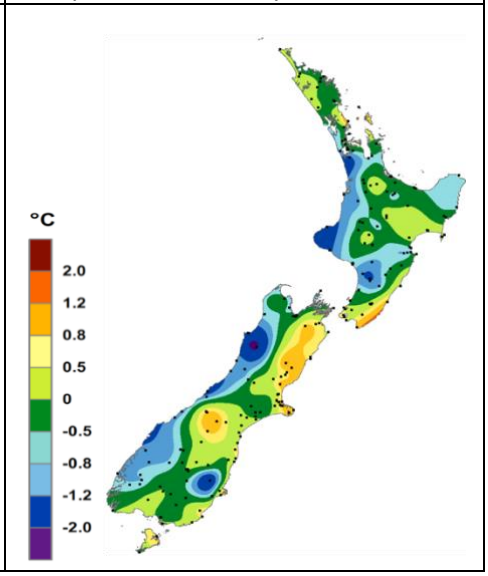
| Soil moisture anomaly: 18/02 | Rainfall anomaly: 03/02 – 18/02 | Temperature anomaly: 03/02 – 18/02 |
|---|---|---|
|  |  |  |



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

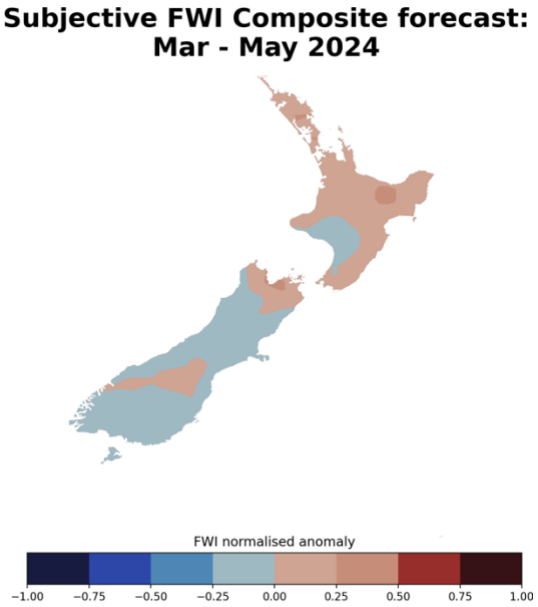
*Image 2: The Port Hills Fire, February 2024*

## Fire season analogues

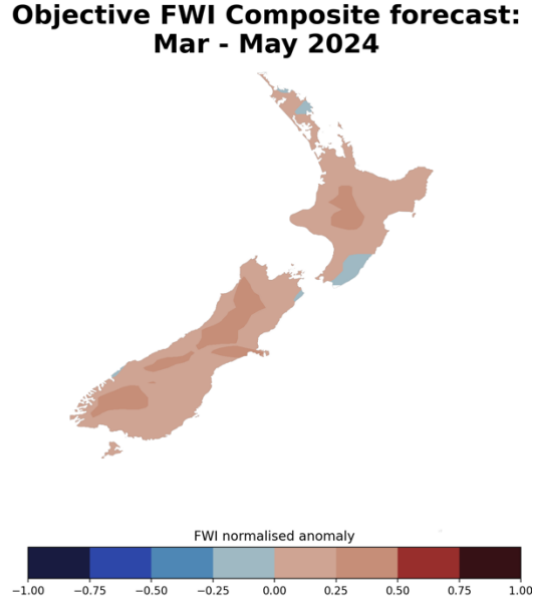
To help understand what fire weather conditions may be like this autumn, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

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.

With dry conditions already occurring for several areas, and the potential for drier conditions becoming more widespread during autumn, the fire weather threat looks to increase.




| Forecaster-selected analogue season - Mar to May |
|---|
| 2018 |
| 1994 |
| 1988 |
| 2014 |
| 2010 |
| 2002 |
| 1995 |
| 2005 |




| Machine-selected analogue season - Mar to May |
|---|
| 2012 |
| 2001 |
| 2019 |
| 2004 |
| 2007 |
| 2013 |
| 1989 |
| 1999 |

*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.

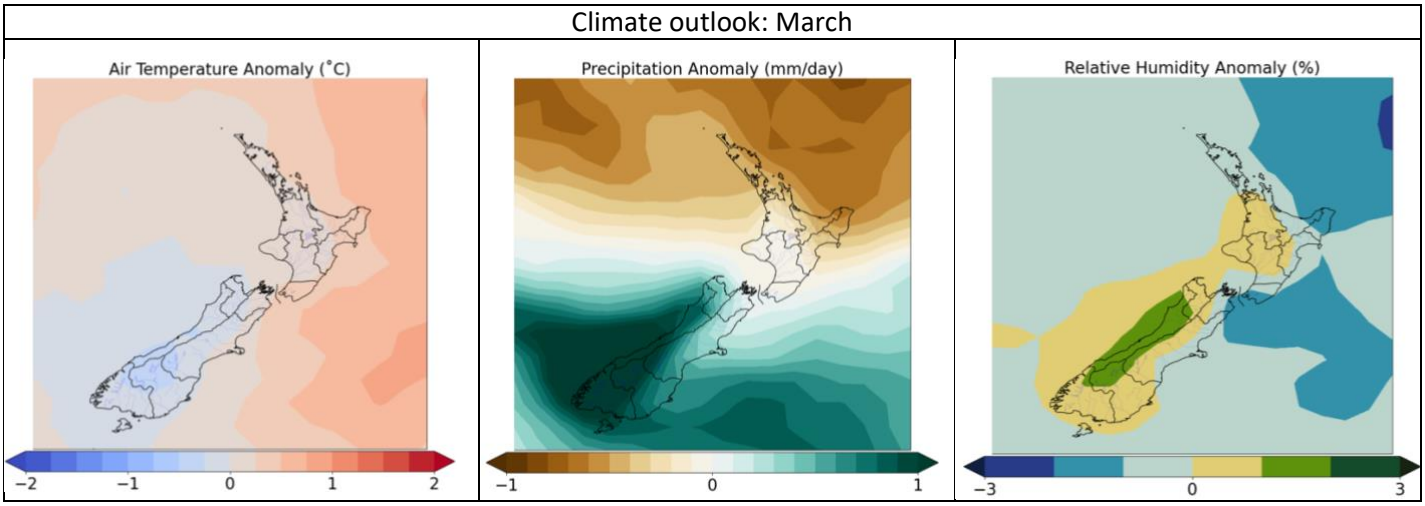



*Figure 6: Climate outlook for February showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.*

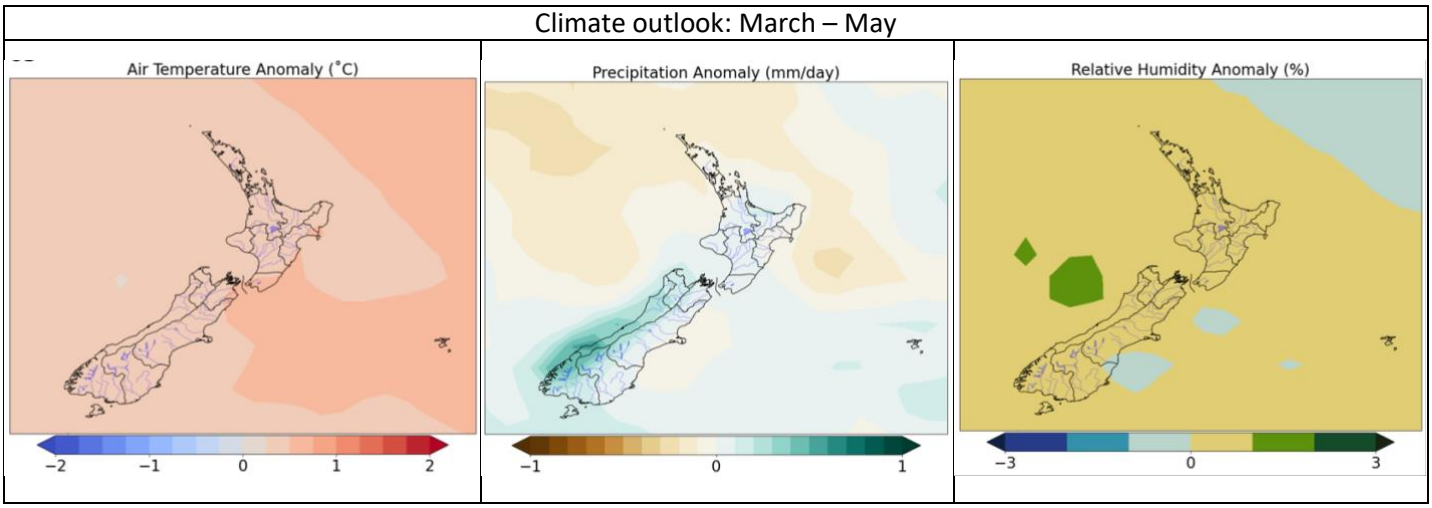



*Figure 7: Climate outlook for March-May showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.*

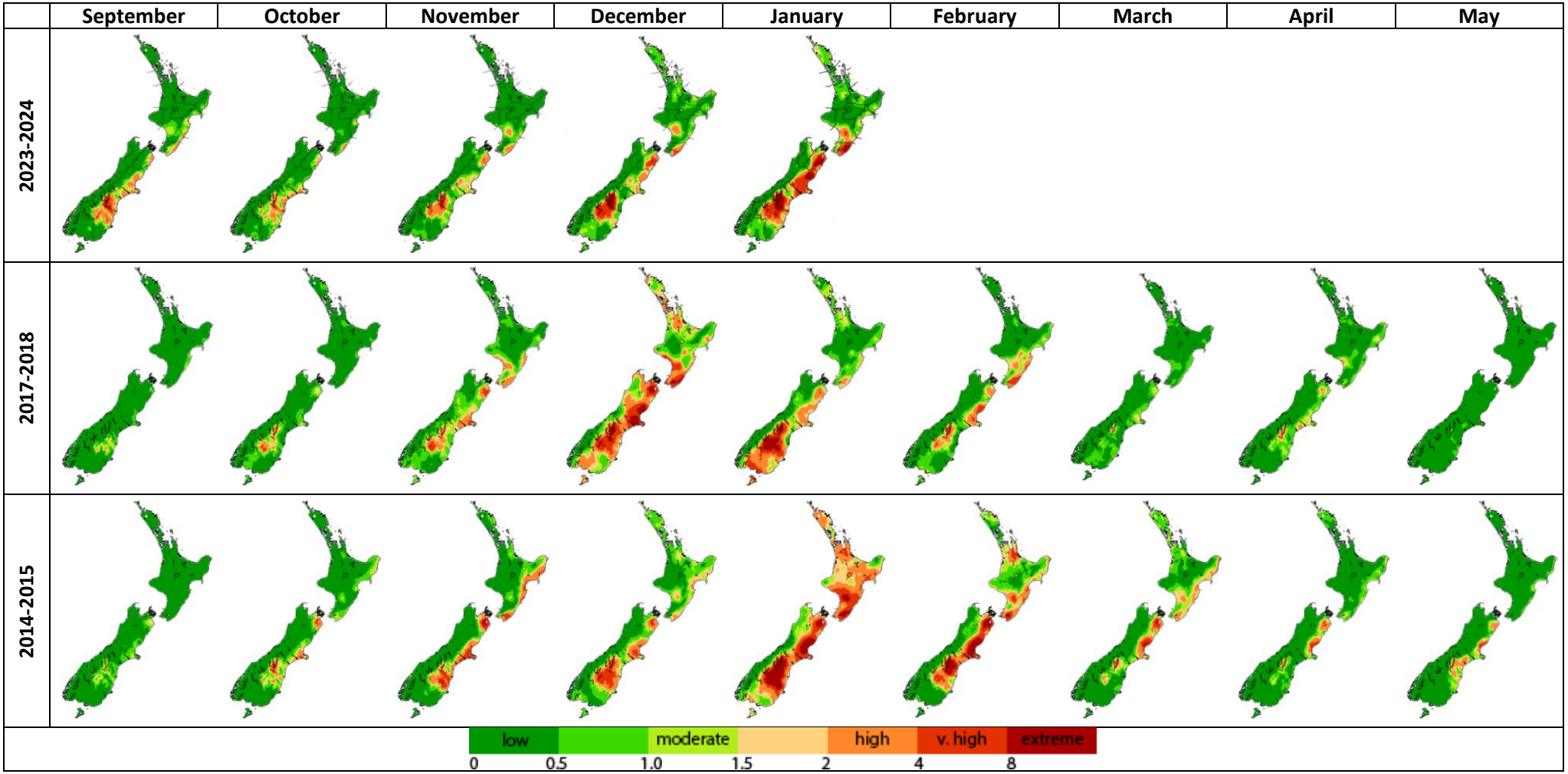



*Figure 8: Monthly average severity rating for the current year 2023/2024 and the comparative years of 2017/2018 and 2014/2015. These are analogue years for the current season and give us an insight into what the upcoming season may be like.*

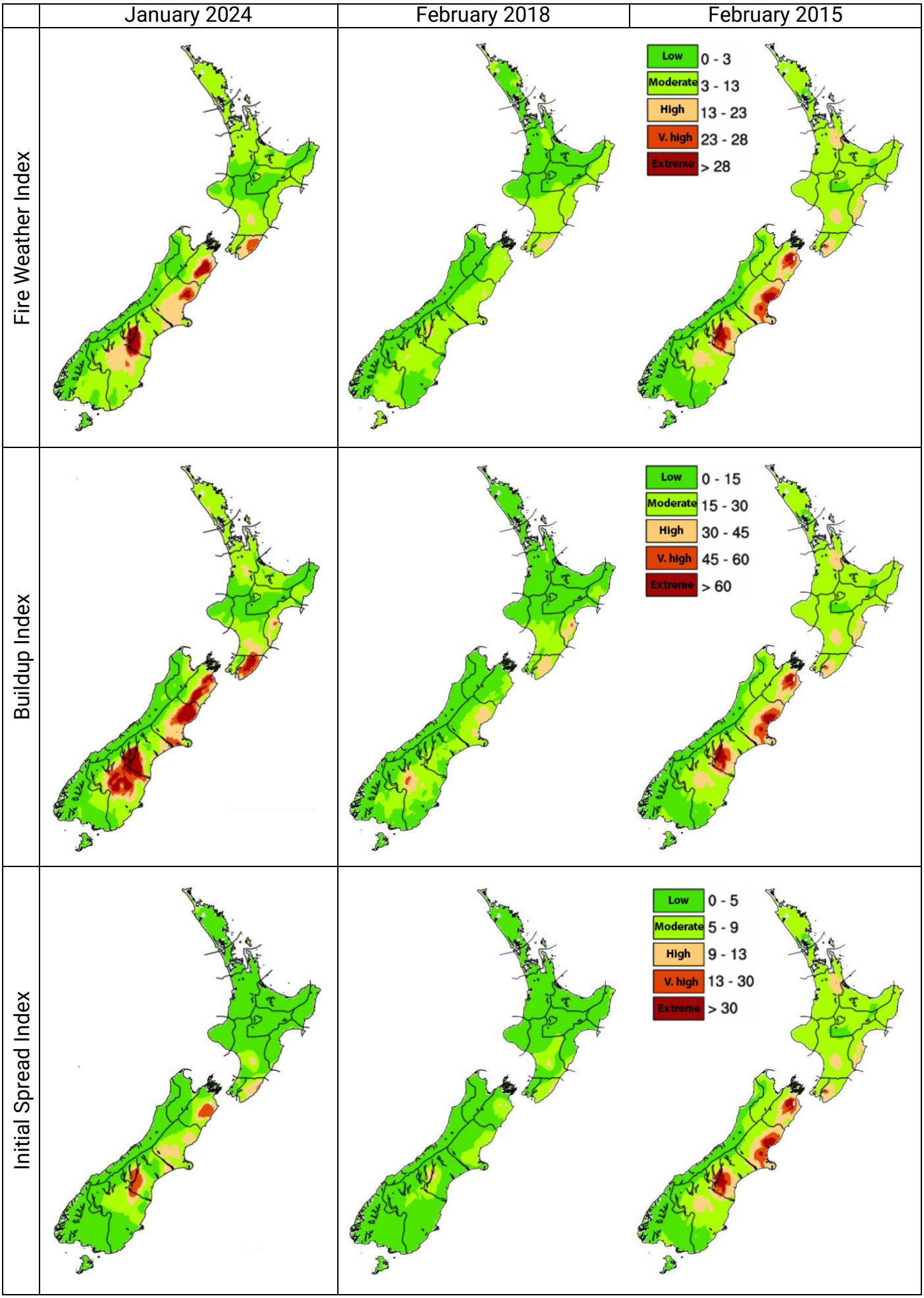



*Figure 9: The most recent observed month (left column) and analogue months for February (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom). Conor Knell*

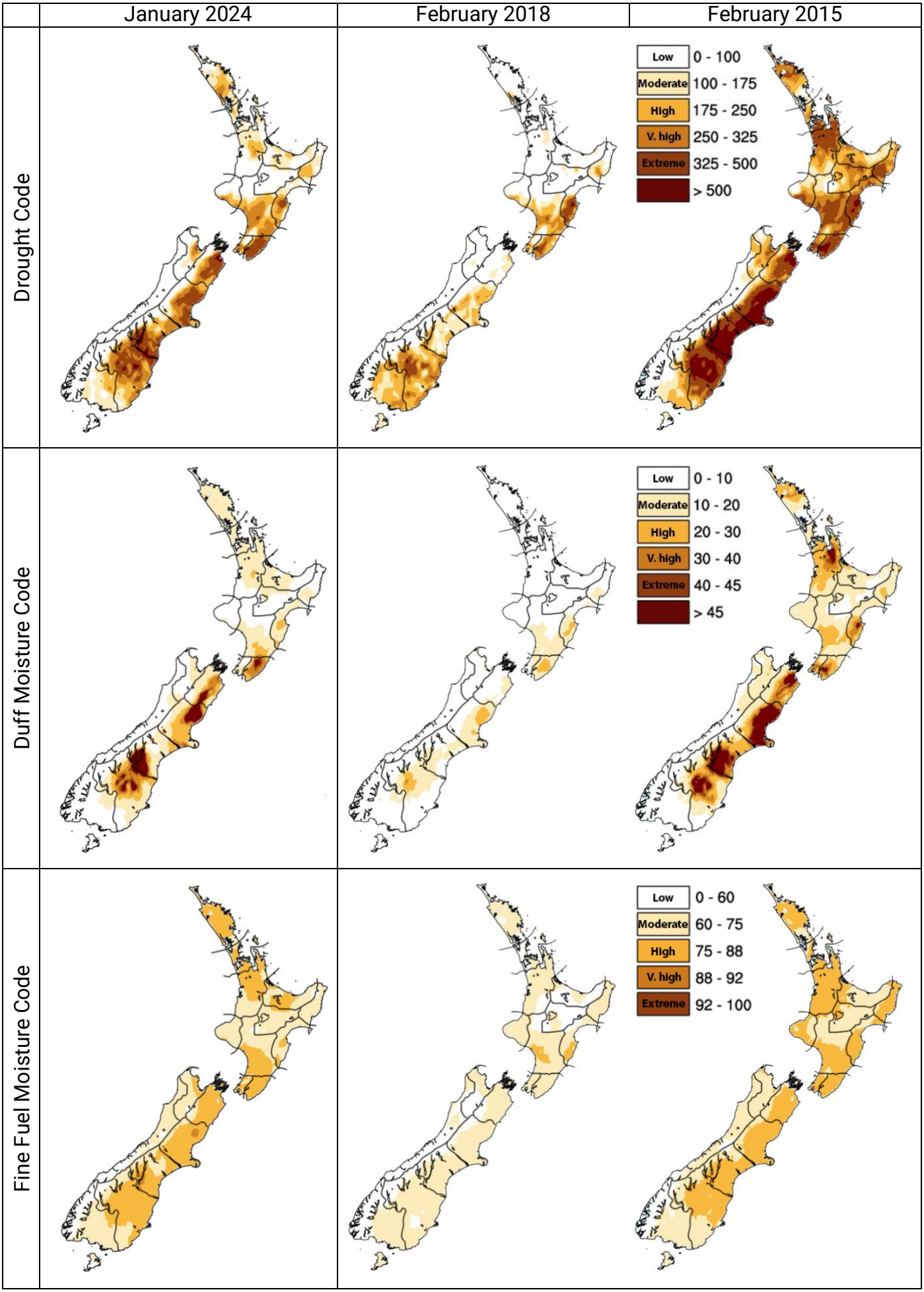



*Figure 10: The most recent observed month (left column) and analogue months for February (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).*

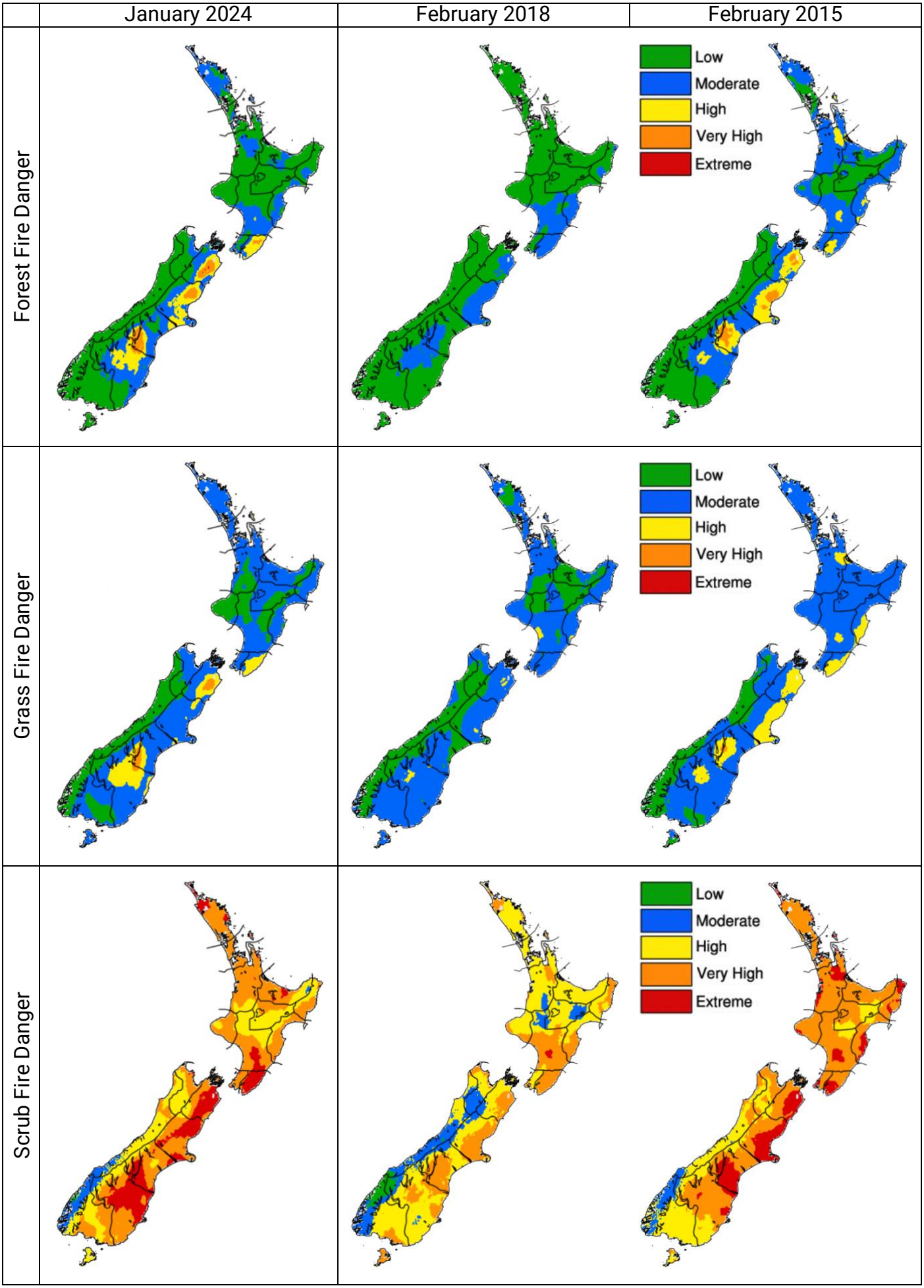



*Figure 11: The most recent observed month (left column) and analogue months for February (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).*

## 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