North Island Monthly Fire Danger Outlook (2022/2023 season)
Issue: February 2023

Current fire danger situation

February's various fire indices were generally all low (with the exception of scrub fire danger that was high to extreme in parts of the North Island as at 20 February), lower than normal for this time of year. See Figures 7-10 for more detail.

Current fuel and soil moisture status

As of 20 February (Figure 3, left), soil moisture levels are well above normal across a majority of the North Island. Near normal soil moisture is located in the Kāpiti Coast. The New Zealand Drought Index is currently showing no dryness or drought in the North Island.

Current fire dangers across the North Island are exceptionally low as a result of substantial rain since October. Even Palmerston North – Foxton, which is probably the driest part of the North Island, has a Drought Code (DC) that is below normal.

Current exceptionally low Buildup Index (BUI) values and contributing DCs and DMCs (Duff Moisture Codes) mean burning of moderate, heavy or subsurface fuels would be extremely uncommon across most of the North Island. However, the dryness of fine fuels (represented by Fine Fuel Moisture Code (FFMC) values) is more responsive to day-to-day weather and can become elevated even under short periods of warm, dry or windy conditions. This means in current conditions we are only likely to see fires in light flashy fuels and, although they can be intense where there are large quantities of fuels, we are unlikely to see deep-seated fires or fires in heavy fuels that are difficult to extinguish.

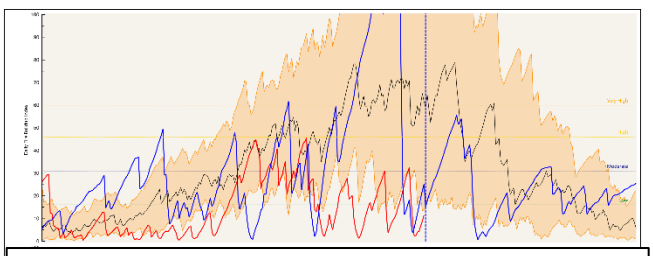


Figure 1. Graph of Drought Code (DC) for Bridge Pa (Napier). The redline shows generally very low DC values most of this summer. The black line is the median, and blue is last year (2021/22).

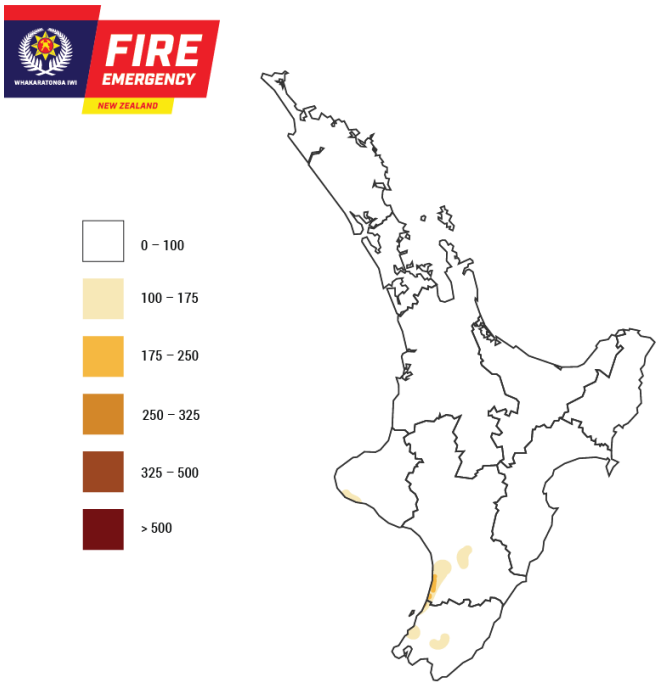


Figure 1: Map of Drought Code (an indicator of the availability of heavy fuels in a forest based on their expected moisture content) for the North Island as at 21st February.

Forecast climate and weather

The remainder of February looks to be generally drier than normal as high pressure is favoured in the New Zealand region, although the lower North Island may be slightly wetter. For March as a whole, more easterly winds than normal are expected as La Niña's influence continues, along with a likelihood for low pressure near and north of the North Island. This could result in near normal to above normal rainfall for much of the North

Island, with many locations (especially in the west) seeing warmer than average temperatures.

March-May will likely exhibit more easterly winds than usual, although La Niña is expected to transition to ENSO-neutral during early autumn, which may increase variability in air flows. There may be an increased chance for tropical cyclone activity during March. Temperatures overall look to be warmer than average, especially in western regions.

For more information, see pages 3 and 4.

What to watch for

- Rain over the past months means there are likely to be many burn piles that have not been burnt yet, plus in many areas there will be waste from damage by Cyclones Hale and Gabrielle to be burnt. This may result in increased burns in the coming months and into next summer. Although the conditions are not especially high risk, some people will no doubt not take reasonable caution – especially when the earlier rains lead some people to be complacent.

Flood debris – likely to result in increased number of burn offs which may not occur till next summer in order for material to dry out enough to burn, especially large logs or material that contains silt. Photo: East Coast MP Kiritapu Allan – from RNZ website.

- Spontaneous combustion due to warm, damp conditions. This could be in either fresh hay that has been baled and stacked before being fully dried, or older stacked hay that has become wet from the storm event. It could also occur in forestry skid sites (large piles of logging waste), especially large forestry skid piles that have lots of bark and smaller material including dirt that prevent airflow through the pile, and can also have pieces of metal or oily rags in the piles that aid heat build-up and ignition.
- Fires can still occur in light flashy scrub fuels. Because these are almost entirely made up of fine fuels, they can dry out very quickly and become available to burn at high intensities after just a day or two without rain or in windy conditions.

Many areas in the North Island currently have fire potential well below normal, but most are expected to trend up towards fire potential closer to normal over the coming months. Figure 2 shows expected fire potential for a couple of months' time rather than the current conditions. It is also based on the North Island not being impacted by further major rain events coming down from the tropics. If another major rain event does hit the North Island, we will likely see the fire dangers for most of the North Island remain well below normal.

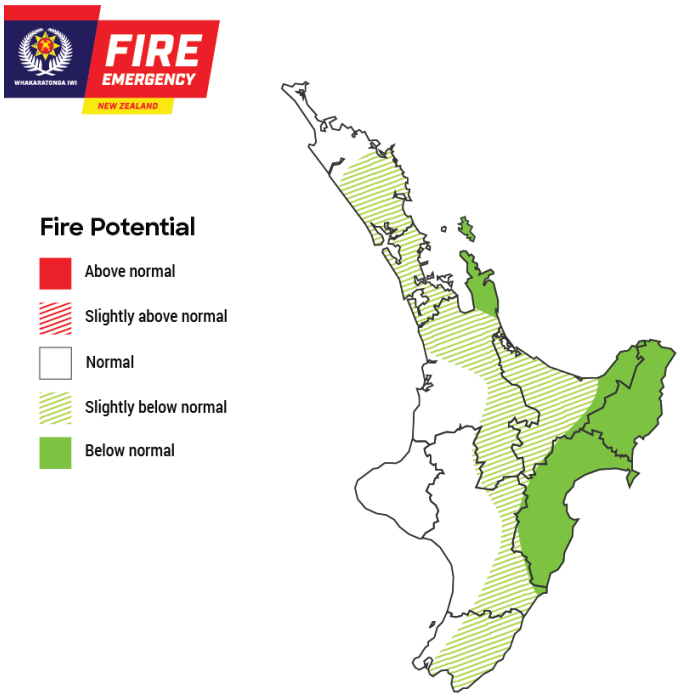


Figure 2: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

Current climate

January temperatures were above average (0.51-1.20°C above average) or well above average (>1.20°C above average) across most western, inland and northern parts of the North Island, generally near average (±0.50°C of average) along the eastern North Island, with patches of below average temperature (0.51-1.20°C below average) observed in coastal parts of Gisborne and Wairarapa. So far in February, temperatures have generally been above average in the western North Island, but closer to average in the east (Figure 3, right).

January rainfalls were above normal (120-149% of normal) or well above normal (>149% of normal) across most of the North Island. It was an exceptionally wet month for the southern half of Northland, Auckland, the Coromandel Peninsula, western Bay of Plenty and parts of Hawke's Bay, which all received at least 400% of normal January rainfall. Auckland observed its wettest ever month in records dating back to 1853. So far in February, rainfall has continued well above normal in most areas, particularly due to Cyclone Gabrielle (Figure 3, middle).

Soil moisture levels are well above normal across a majority of the North Island, but near normal soil moisture is located in the Kāpiti Coast (Figure 3, left).

Climate drivers

The NINO3.4 Index anomaly (in the central equatorial Pacific) during January was -0.69˚C (climatology: 1991-2020), close to the La Niña threshold. La Niña's intensity continued to wane during January, with the strongest cool water anomalies relative to average contracting into the central Pacific.

The January monthly Southern Oscillation Index (SOI) was +1.0 and +1.0 from November-January (climatology: 1991-2020), both at the La Niña threshold.

Trade winds were stronger than normal in the central and western equatorial Pacific and near normal or weaker than normal in the east. This enabled the continuation of the central Pacific-focused La Niña while SSTs increased in the east.

In the subsurface central equatorial Pacific, warmer than average water, associated with La Niña's weakening, has developed in the far eastern equatorial Pacific around 50 m depth. A remnant cool water anomaly is located near the surface in the central Pacific, which will likely allow a La Niña-like ocean signature to persist for another month or two.

NIWA's analysis indicates that La Niña will most likely transition to ENSO-neutral during February-April (80% chance), most likely by the end of March. During May-July, ENSO neutral is favoured at around a 50% chance. The chance for El Niño conditions increases to around 55% from August-October 2023. The last time El Niño conditions were observed during winter and spring was 2015.

Phases 4 and 5 of the Madden-Julian Oscillation (MJO), which may be prominent during March, favour above normal rainfall in the northern North Island (phase 4) and over much of the country aside from the lower South Island (phase 5).

New Zealand's coastal water temperatures became less unusually warm during January in all regions except the west and east of the South Island. At the end of January, marine heatwave conditions were widespread around the South Island and in parts of the western and lower North Island.

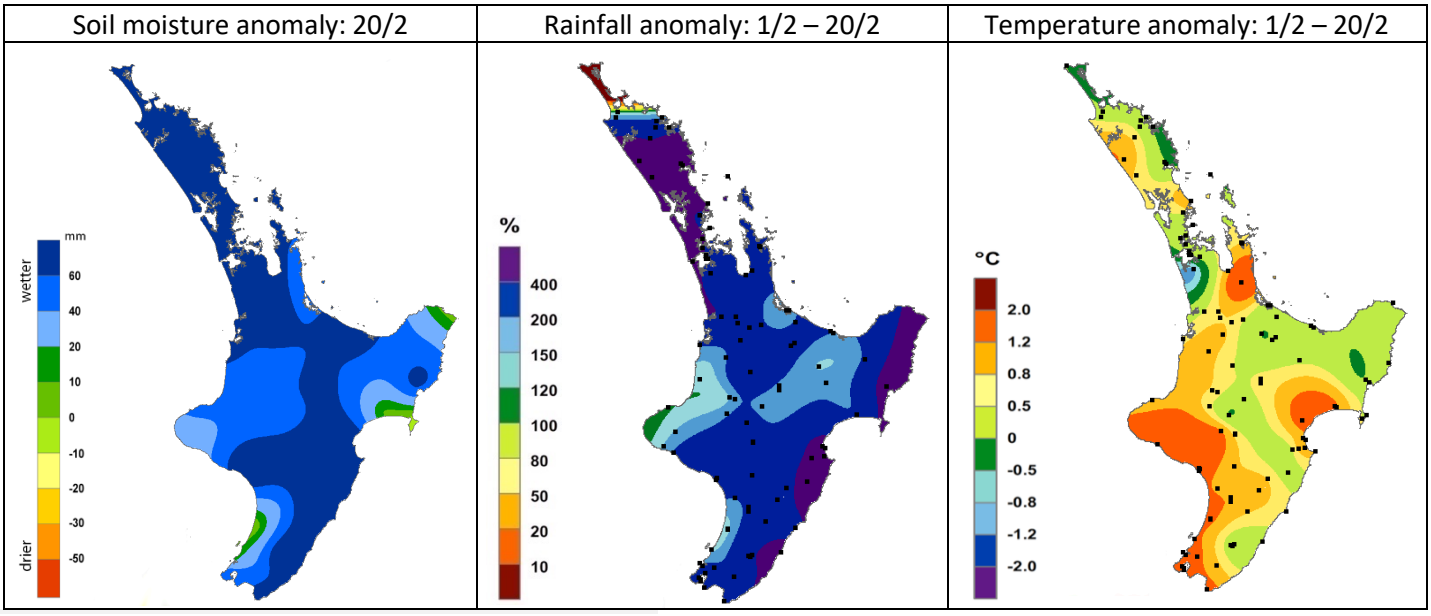


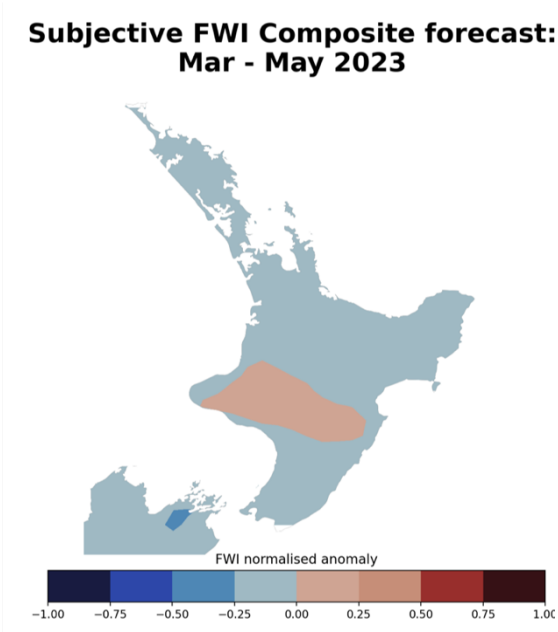
Figure 3: Maps showing the current soil moisture anomaly, as well as temperature and rainfall differences from normal since the start of the month.

Fire season analogues

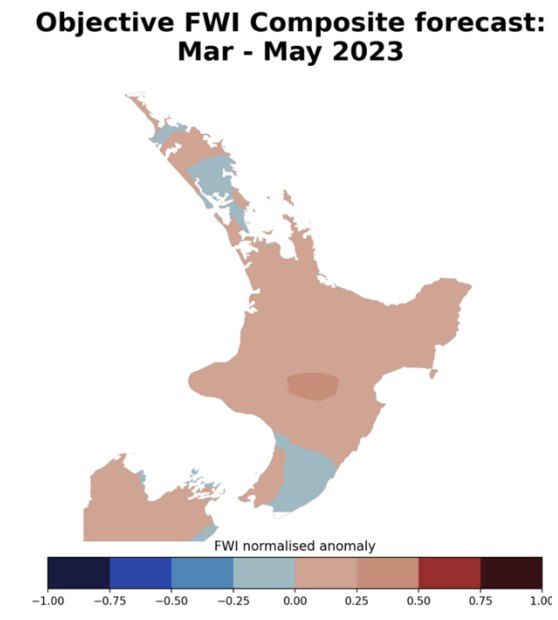
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

This season's analogue years featured historical years that had La Niña-like 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 signal favours the expert-selected years for autumn 2023. Most areas of the North Island are expected to have lower fire danger than normal during the season, although some western areas could see an elevated risk. The subjective expert-selected guidance agrees more with La Niña-like patterns and the current soil moisture situation, and is therefore favoured.



Forecaster-selected analogue season - Mar to May
2011
2017
2009
2008
2006
1986
2018
2013



Machine-selected analogue season - Mar to May
2012
2001
2004
2019
2007
1989
2006
2013

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: March 2023

March's air flows are generally expected to be more easterly than normal, continuing the trend of recent months. The signal is for a continued wetter than normal lean for the North Island, with an increased risk for further ex-tropical cyclones. Wind speeds are expected to be below normal for nearly all of the North Island. Above average temperatures appear likely, especially in the west. Relative humidity is forecast to be higher than normal in eastern areas and near normal or below normal in western areas (Figure 5).

Climate outlook: March – May 2023

Although La Niña is expected to ease to neutral during early autumn, the atmosphere may continue to behave in a La Niña-like fashion, with lower-than-normal air pressure near the North Island and in the Tasman Sea. Temperatures overall look to be warmer than average, especially in western regions (Figure 6). Rainfall looks to be near normal or above normal for most of the North Island. Above normal relative humidity is expected in the east, although relative humidity is forecast to be slightly below normal in western areas. Wind speeds continue to look lower than normal for most of the North Island.

The tropical cyclone season for the Southern Hemisphere runs through April. The chance for tropical cyclone activity may again be elevated during March.

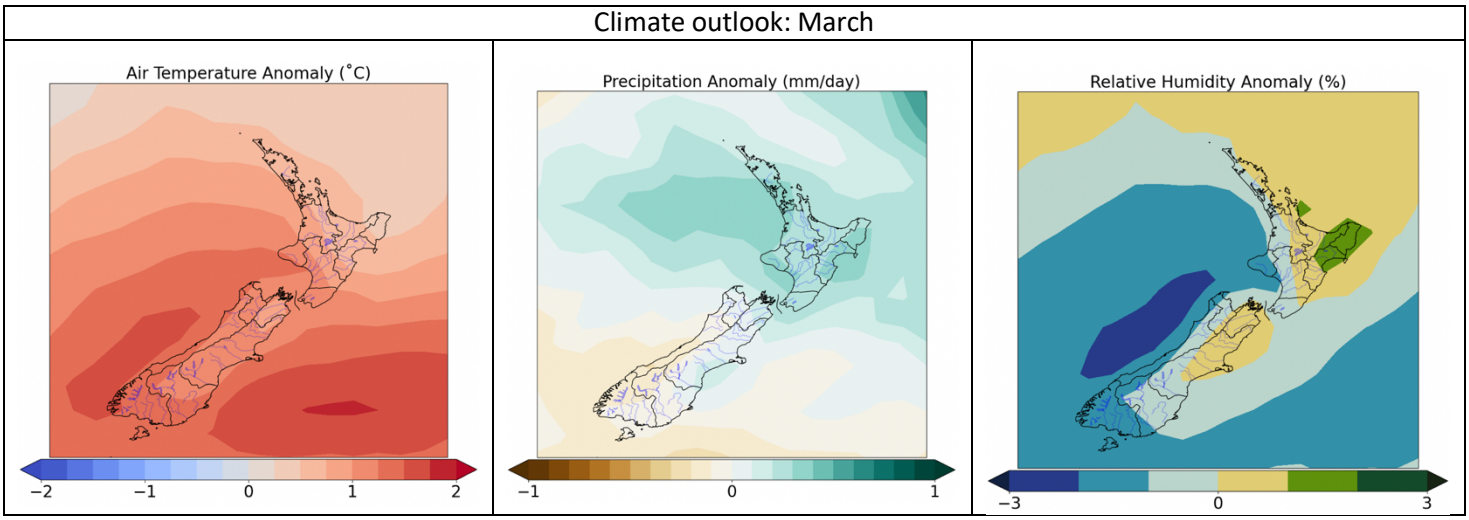


Figure 5: Climate outlook for March showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

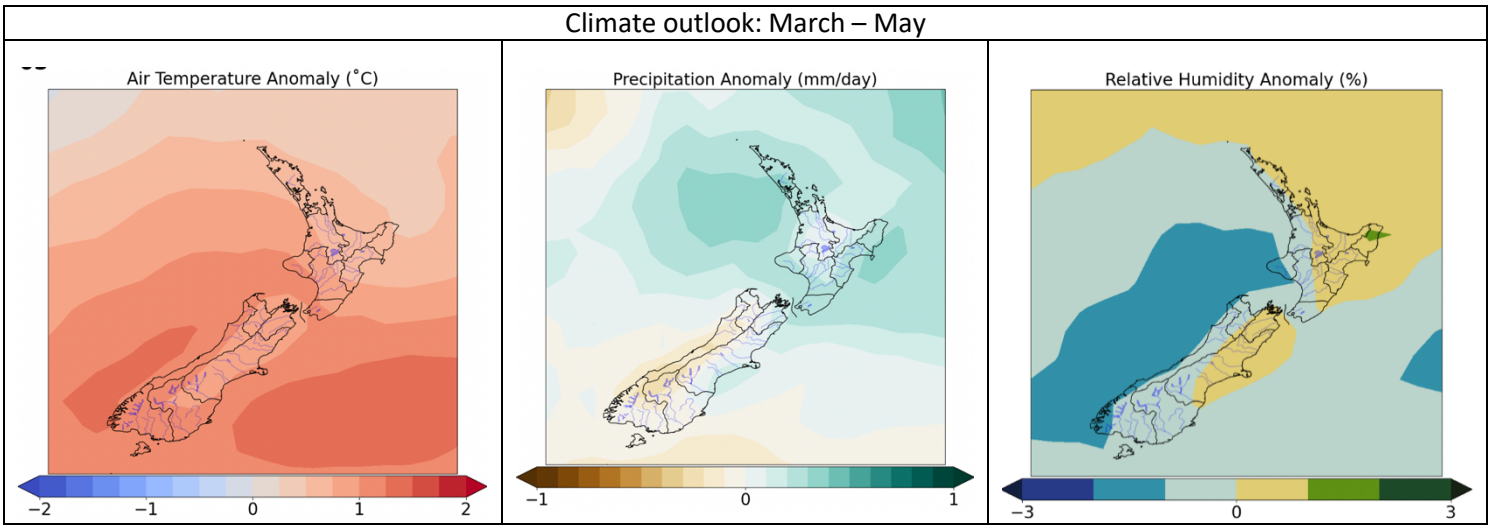


Figure 6: Climate outlook for March-May showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

Expected impact on fuels and fire danger

Fine fuel moisture is critically important to fire behaviour, with lower moisture contents meaning drier fuels which result in easier ignitions and faster spread rates. Fine fuel moistures are affected by temperature, wind, humidity and precipitation. Based on the outlook above, it is anticipated that drying rates will be increased by warmer temperatures in most parts of the North Island, but this will be offset in the east by normal or above normal humidity and precipitation in eastern areas.

Anticipated lower wind speeds are likely to see less frequent wind-driven fires and generally reduced spread rates, although the reduction may be offset by drier than normal fine fuels in the west and north as described above.

Current very high fuel moistures for medium and heavy fuels in most areas of the North Island (see Figure 1) mean relatively low forest fuel availability. These medium and heavy fuel moistures are expected to reduce as these fuels dry, thus increasing forest fuel availability to some extent. But given current moisture levels across the North Island these medium and heavy fuels are not expected to have lower than normal fuel moistures, especially eastern parts.

The net effect of the climatic outlook is that by about late March, the Far North and western parts of the North Island are likely to have normal fire potential while the eastern parts experiencing increased easterly wind flows are expected to continue to receive more humidity and precipitation and have slightly below normal fire potential. Tairawhiti and Hawkes Bay, with their vulnerability to heavy rain from tropical depressions, is likely to have lower than normal fire potential (see Figure 2).

There will however still be periods when the westerly winds return and, if they are strong and not accompanied by precipitation, they will result in spikes in the fire danger, especially in the southeast of the North Island and for scrub fuels.

Low levels of grass curing typical of the North Island.

Grass growth & curing

Most fires start in fine fuels such as grasses, which ignite easily and promote fire spread to other fuels. Grass fuel loads and curing rates should therefore be closely monitored as a critical factor in assessing fire danger.

Most of the North Island has experienced good growing conditions over the past few months, with a warm winter and abundant spring and summer rainfall. As a result, we can expect increased grass fuel loads in many areas, especially where grazing has not kept up with grass growth.

If grasses are less than 50% cured (i.e. less than 50% brown or dead material), grass fuels will generally only burn in exceptional conditions (low humidity and high winds). But subject to weather and topography influences, grass fire ease of ignition, spread rates and fire intensity will increase steadily as the curing percentage increases. At 50% cured, grasslands produce slow-moving fires with small flames; but at 80-100% cured, grassfires are able to ignite easily, spread rapidly and produce extreme flame lengths and intensities.

With this year being exceptionally wet through to mid-February, we are now starting to run out of time for grasses across the North Island to cure. So unless we get an unforeseen dry spell we are unlikely to have significant grass fire risk in the North Island this season.

Crews in the North Island haven't had so many opportunities to main their fire fighting skills this summer – except chainsaw skills. Forestry fire crew clearing roads during Gabrielle.

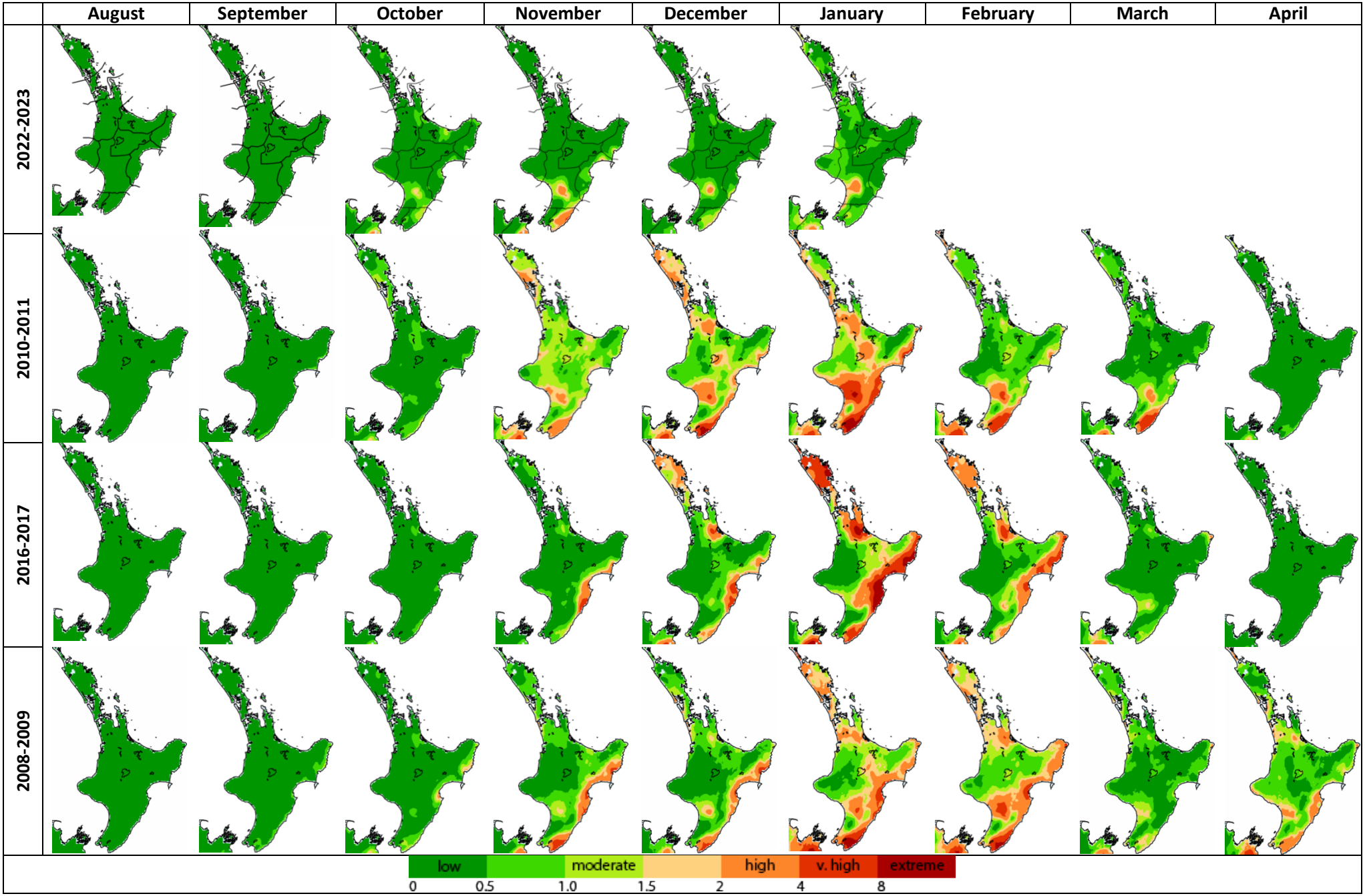


Figure 7: Monthly average severity rating for 2022-2023 up to and including January and the comparative years of 2010/2011, 2016/2017, and 2008/2009. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

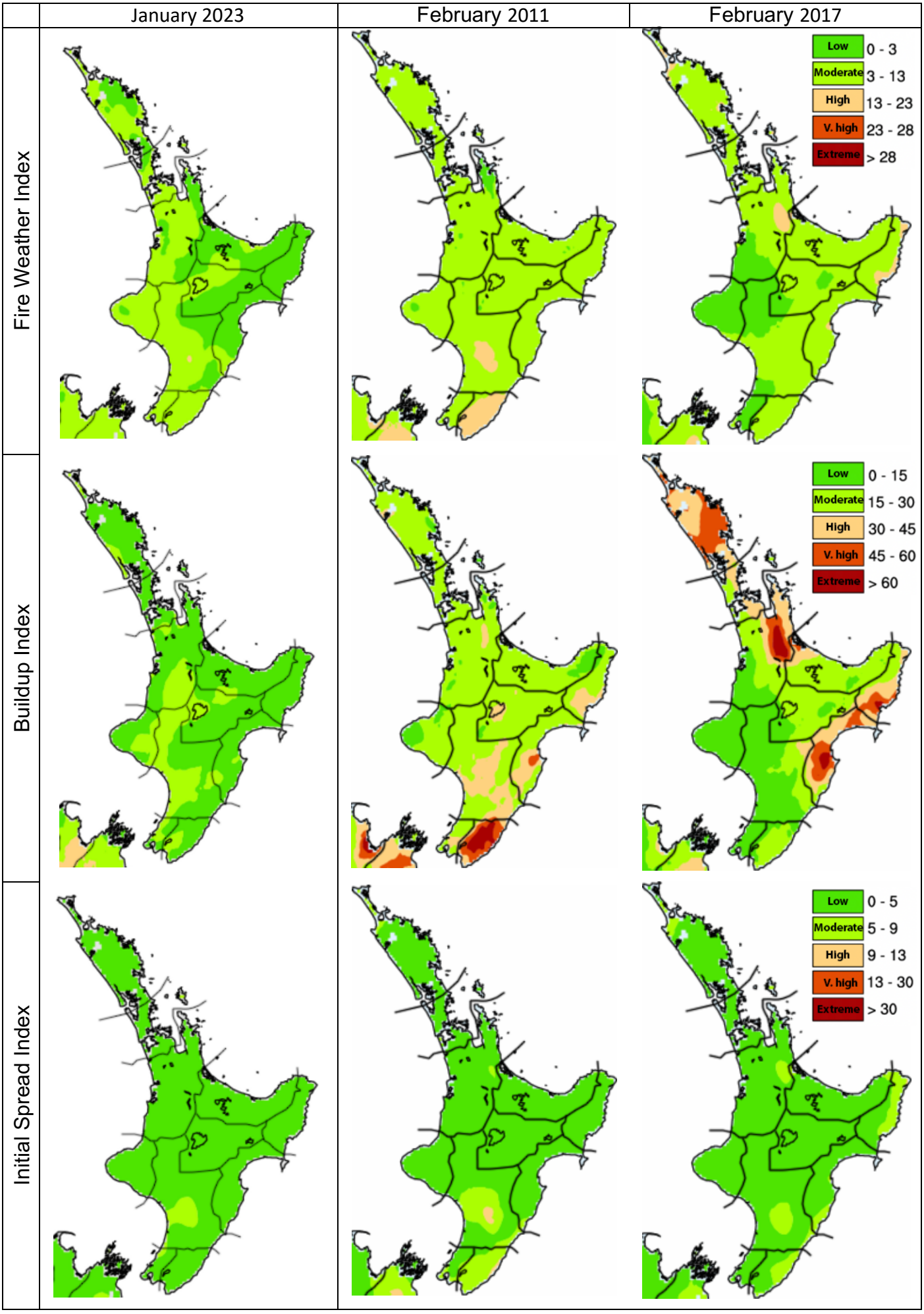


Figure 8: The most recent observed month (left column) and analogue months for February (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

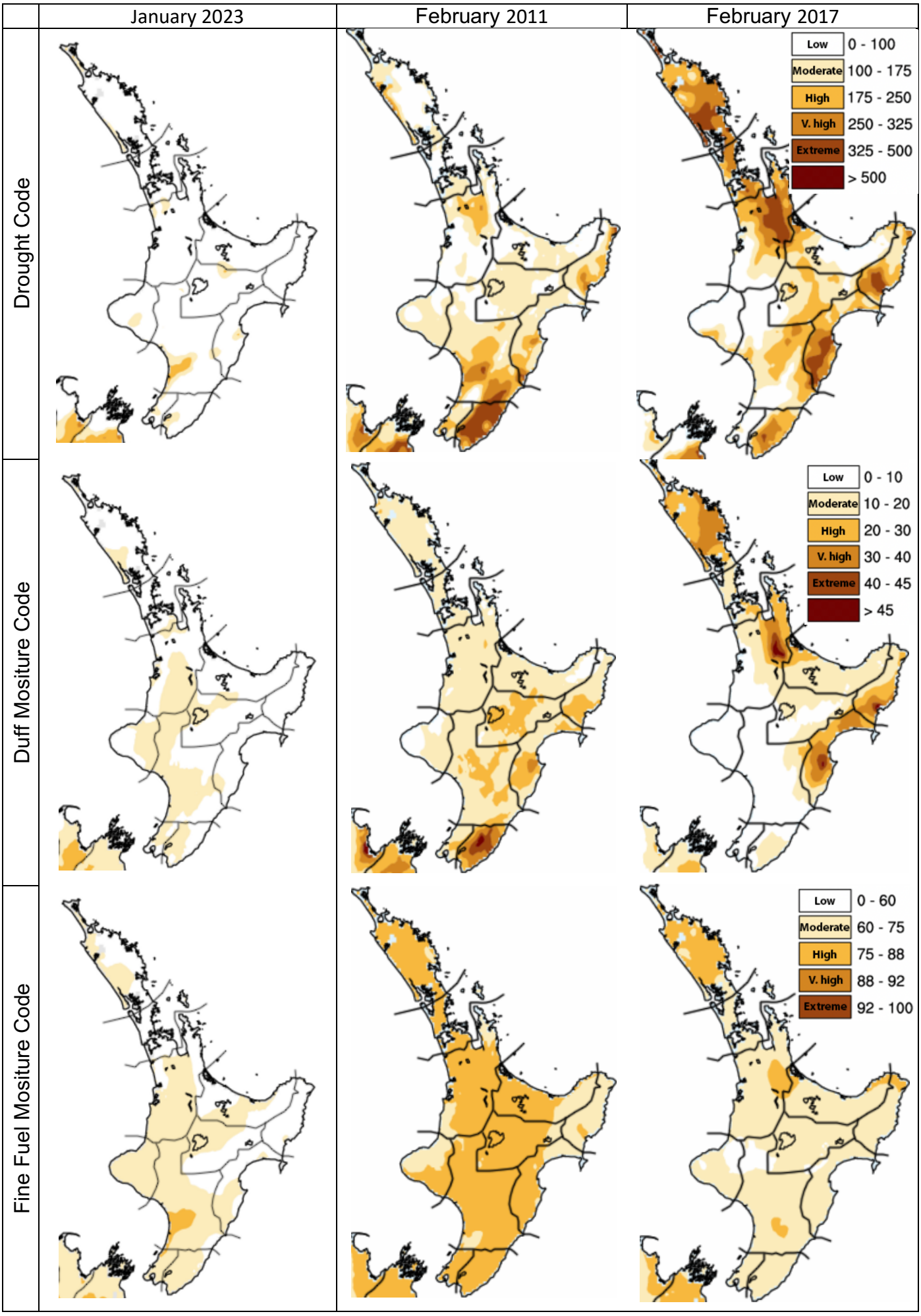


Figure 9: The most recent observed month (left column) and analogue months for February (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

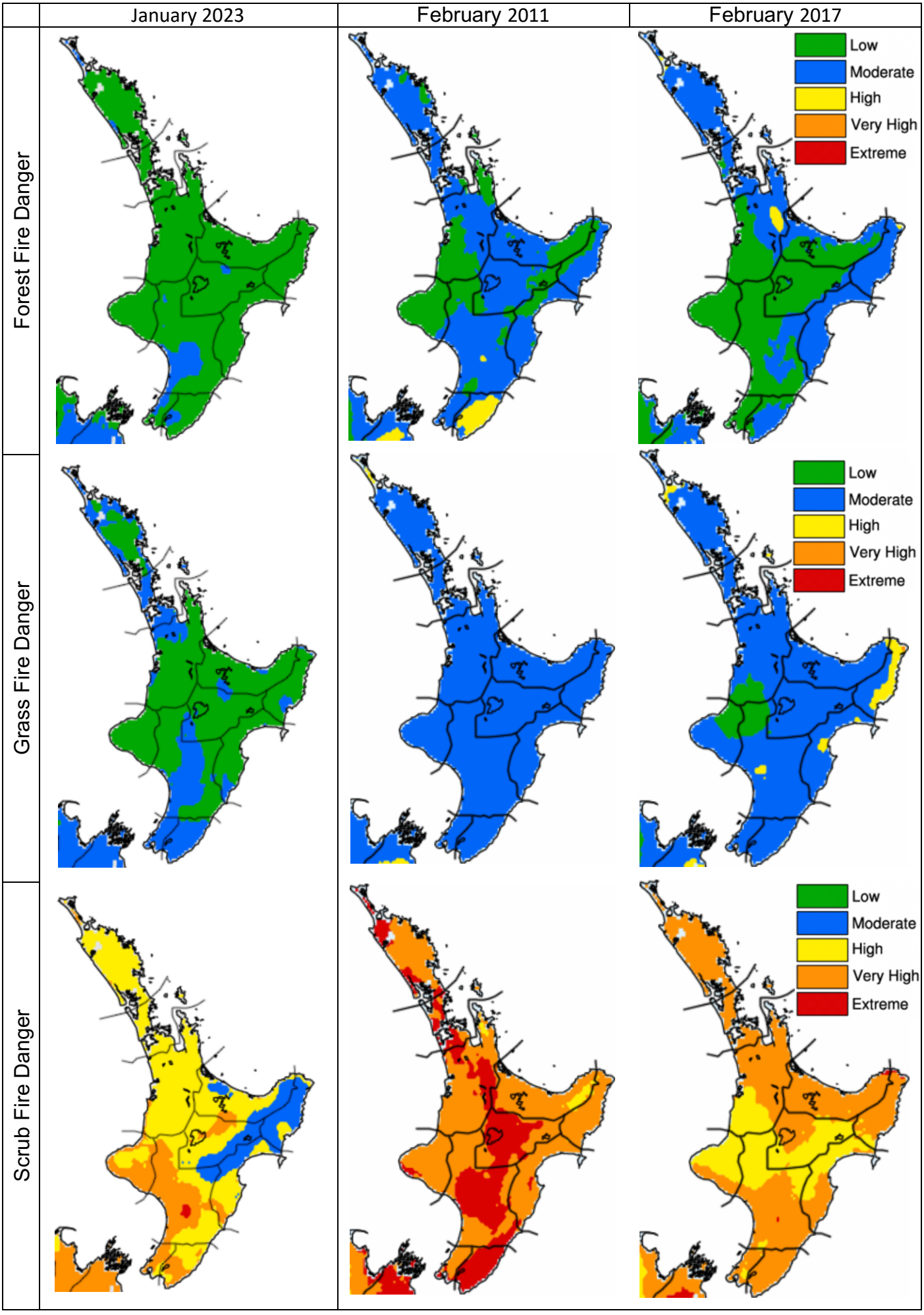


Figure 10: The most recent observed month (left column) and analogue months for February (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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