North Island Monthly Fire Danger Outlook (2021/2022 season)
Issue: March 2022

Current fire danger situation

In general, February's monthly fire danger and fire climate severity improved substantially compared to January, due to heavy rainfall in the first half of February. However, very dry conditions have returned during the past 4-5 weeks. Fire danger indices are currently highest in the upper North Island (Figures 8-11).

Current fuel and soil moisture status

As of 17 March (Figure 4, left), soil moisture levels are below normal or well below normal across nearly all of the upper and central North Island, and above normal in parts of Wellington-Wairarapa. "Dry" and "Very Dry" conditions are found from Northland to northern Waikato on the New Zealand Drought Index map, with some "Extremely Dry" areas found in Auckland.

The above normal rainfall in February saw significant reductions in Fire Weather System Codes and indices (BUI, DC and DMC – refer to appendix for definitions), especially across the eastern and southern areas of the North Island. However, elevated BUI and DMC values (Figure 1) remain across areas further north that missed much of the rainfall and have experienced continued dry conditions into March.

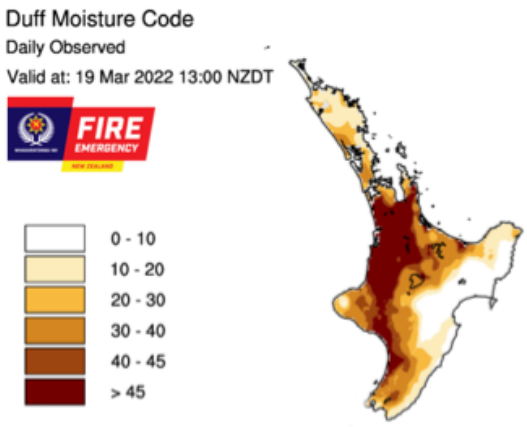


Figure 1: Map of Duff Moisture Code (an indicator of dryness in shallow organic soil layers and medium-sized woody material) for the North Island as at 19 March.

The dry start to March and higher than normal temperatures have seen fire dangers quickly return to normal or above normal levels in many areas, especially in the upper North Island. Figure 2 shows the current BUI trend for Athol Raws in the southern Waikato, where values have fallen from near record high levels, but rapidly increased again to values well above average for this time of year.

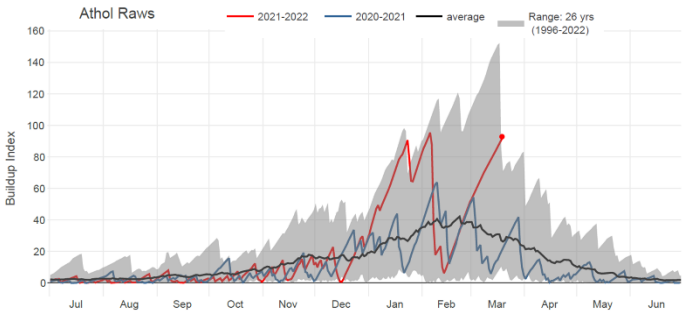


Figure 2: Trend in Buildup Index (BUI) code values for Athol Raws in southern Waikato comparing current values (2021/22, red line) with previous seasons (2020/21 (blue line), average (black line), and range (grey shading)).

Forecast climate and weather

Late March and early April may bring a period of more unsettled weather due to a return of the Madden-Julian Oscillation (MJO) to the western Pacific. For April as a whole, more easterly winds than normal are once again expected. This could result in near average to above average rainfall for much of the North Island, although precipitation in central and western regions may be intermittent.

Mid-autumn through early winter (April-June) is forecast to have more easterly winds than normal as the effect of La Niña continues, with near normal or above normal rainfall favoured. Rainfall may be intermittent, although occasional heavy rain events could bring flooding to northern and eastern areas. For more information, see pages 3 and 4.

What to watch for

- In the short term, heavy rainfall, especially over the top half of the North Island, reducing fire dangers significantly and removing remaining soil dryness.
- Areas that miss the forecast rain, such as in the Far North or possibly the Central North Island, where underlying dry conditions already exist.
- Areas of the Far North (Aupori Peninsula), and possibly south Waikato, are most likely to experience slightly above normal fire danger over the coming months as depicted in Figure 3.
- Dry spells, causing soil and fuel moistures to increase from present low levels to more normal or above normal levels.
- Areas with high grass curing, although grasses will be greening up in many regions.
- Occasional periods of strong winds, with potential to cause flare-ups or re-ignitions of going fires or burns.

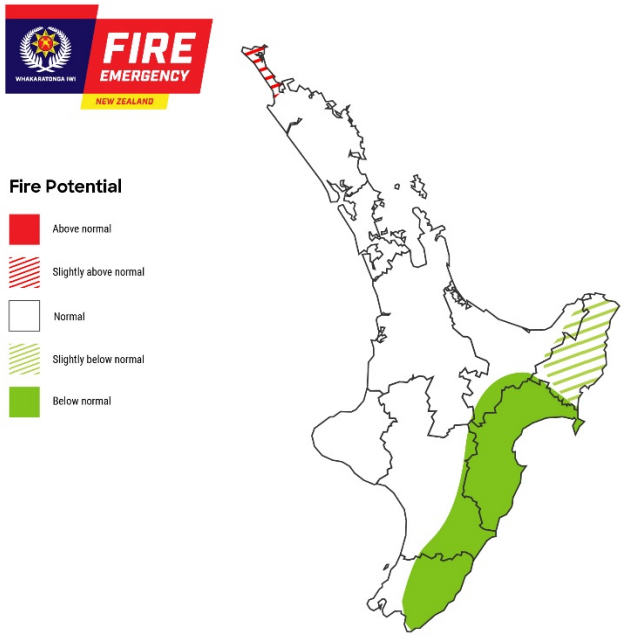


Figure 3: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

Fires such as this in light flashy fuels like cured grass, scrub and wetland vegetation do not require extended dry periods and can dry out and spread rapidly under the influence of wind.

Current climate

February temperatures were above average (0.51-1.20°C above average) or well above average (>1.20°C above average) across nearly all of the North Island. However, near average (±0.50°C of average) temperatures were observed in parts of Wellington. This very warm trend has generally continued into the first half of March (Figure 4, right).

February rainfall was above normal (120-149% of normal) or well above normal (>149% of normal) across most of the central and lower North Island. Below normal rainfall (50-79% of normal) or well below normal rainfall (<50% of normal) was observed in parts of the Far North. Elsewhere, near normal rainfall (80-119% of normal) was observed. Very dry conditions have been observed island-wide thus far in March (Figure 4, middle).

Soil moisture levels are below normal or well below normal across nearly all of the upper and central North Island, and above normal in parts of Wellington-Wairarapa (Figure 4, left).

Climate drivers

The NINO3.4 Index anomaly (in the central Pacific) for February was -0.60˚C, slightly below the La Niña threshold. The monthly Southern Oscillation Index (SOI) was +0.7 and the three-month average SOI was +0.8, the latter near the La Niña threshold, but decreasing.

During February, upper-oceanic heat content increased in the western and central Pacific for the second consecutive month. For the first time since early last winter, conditions in the upper 300 m of the equatorial Pacific were generally warmer than average.

During February, rainfall and convection favoured the eastern Indian Ocean, Maritime Continent, and western Pacific. Convective forcing from the Madden-Julian Oscillation (MJO) was superimposed with the continued effect of La Niña. The South Pacific Convergence Zone was displaced southwest of its climatological position, consistent with the continuation of La Niña.

Pulses of the Madden-Julien Oscillation (MJO) and Kelvin Wave activity are expected to move across the Pacific during late March and early April. During late March, the MJO may pass through phases 4-6 before moving into phases 7-1 in April.

La Niña remains the dominant climate driver for now, but it is expected to ease as autumn progresses.

New Zealand's coastal water temperature anomalies decreased in all regions during February except for the west of the South Island. This likely means that the peak of the marine heatwave (MHW) has passed, although climate model guidance remains consistent in its expectation for warmer than average conditions to carry on through autumn. Warmer than average coastal sea temperatures will likely delay the seasonal transition to cooler temperatures around the country.

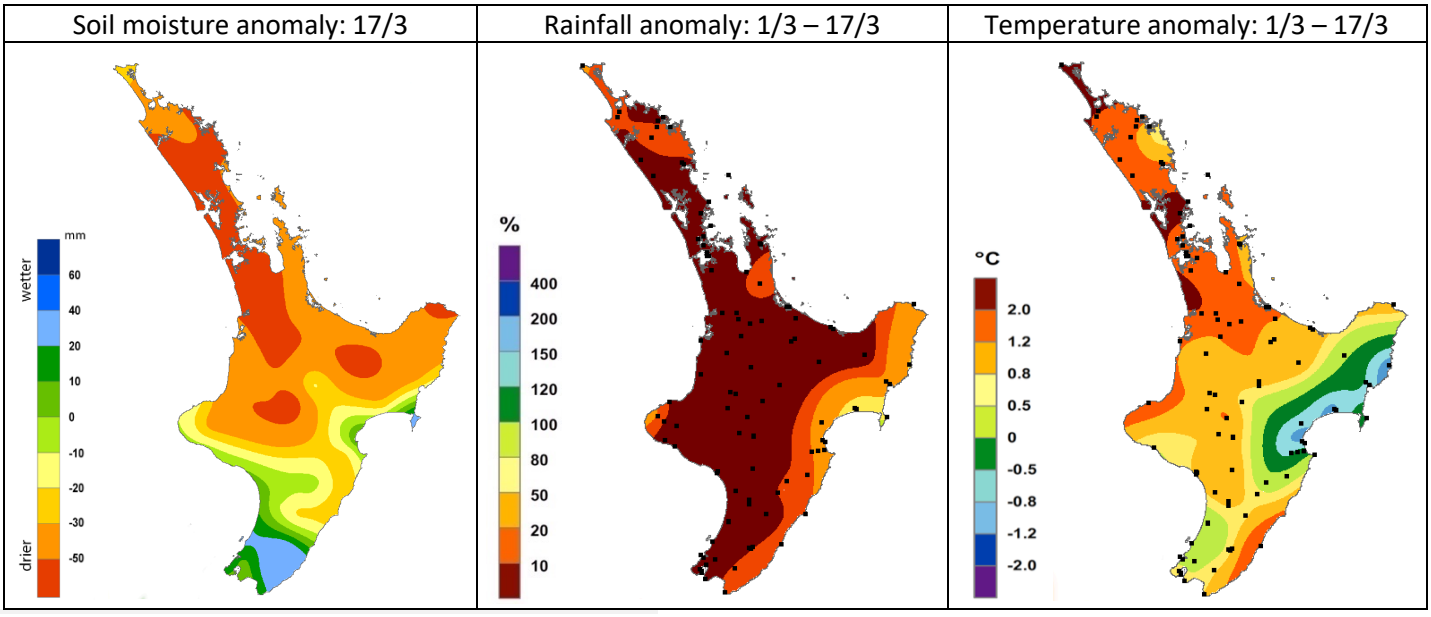


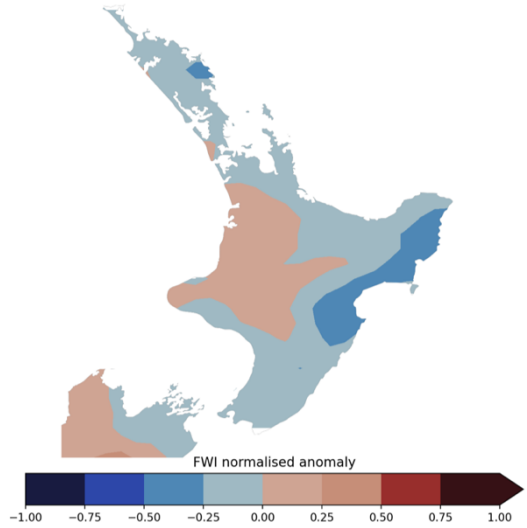
Figure 4: Maps showing the current soil moisture anomaly, as well as temperature and rainfall differences from normal since the start of the month.

Fire season analogues

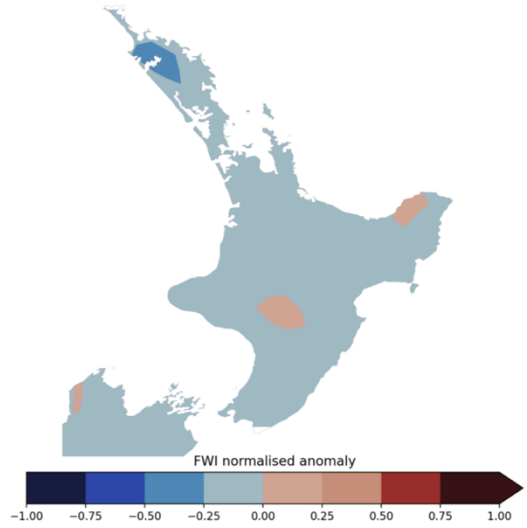
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

This season's analogue years featured historical years that had La Niña-like patterns in the ocean and/or atmosphere (Figure 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 signal is for a mid-autumn to early winter season with higher fire weather indices relative to the long-term average across the western North Island, but perhaps lower than the long-term average along the east coast. Overall, this indicates that some regions will need to be prepared for elevated fire weather conditions to continue.



Forecaster-selected analogue season - Apr to Jun
2021
2017
2010
2006
1999
1988
2011
2008



Machine-selected analogue season - Apr to Jun
2004
2001
1981
2000
2011
2013
1990
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: April

April's air flows are generally expected to be easterly, continuing the trend of recent months. The signal is for a wetter than normal month in eastern areas, although rainfall may be more intermittent in the central and western North Island. Wind speeds are expected to be slightly below normal in the lower North Island, although slightly above normal winds may occur in Northland. Above average temperatures again appear very likely, especially in the west. Relative humidity is forecast to be higher than normal in eastern areas and lower in western areas (Figure 6).

Climate outlook: April - June

Mid-autumn to early winter is still expected to have more easterly winds than normal. Temperatures overall look to be mild for the time of year (Figure 7). Rainfall may be near normal to above normal for much of the North Island, although with stretches of dry weather in between rainier periods. Somewhat humid conditions may continue in the east, although relative humidity is forecast to be slightly below normal in western areas. Wind speeds continue to look lighter than normal except potentially in the Far North. These climate anomalies continue to be well-aligned with La Niña conditions.

The tropical cyclone season for the Southern Hemisphere runs through to April, with the odd tropical cyclone occurring outside this period. On average, at least one ex-tropical cyclone passes within 550 km of New Zealand each year. This season the risk is considered elevated compared to normal.

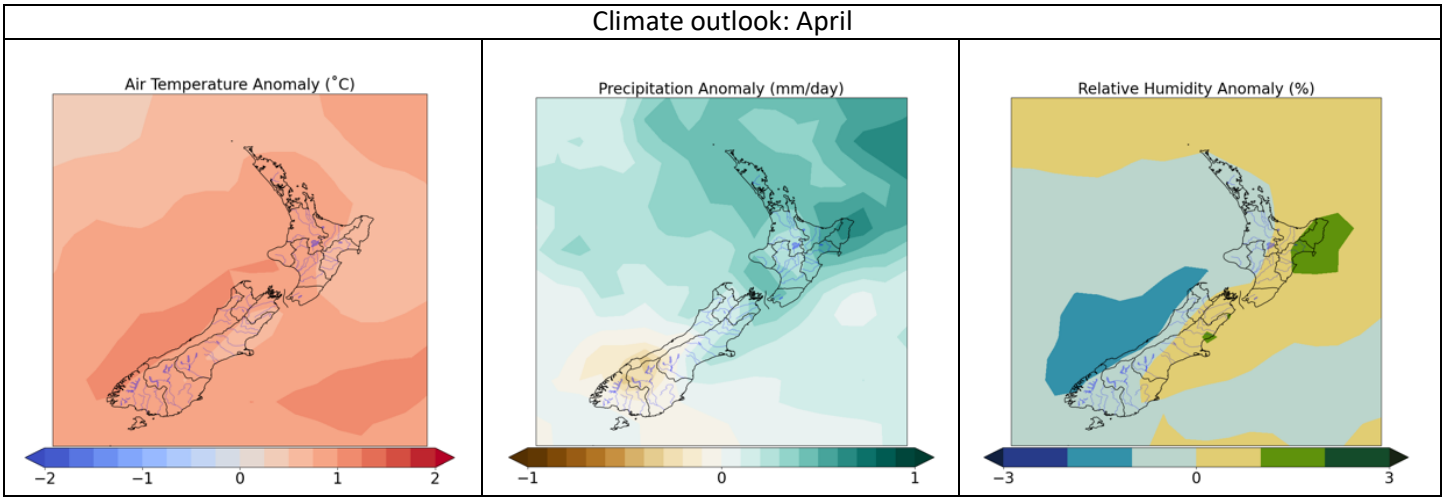


Figure 6: Climate outlook for March showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

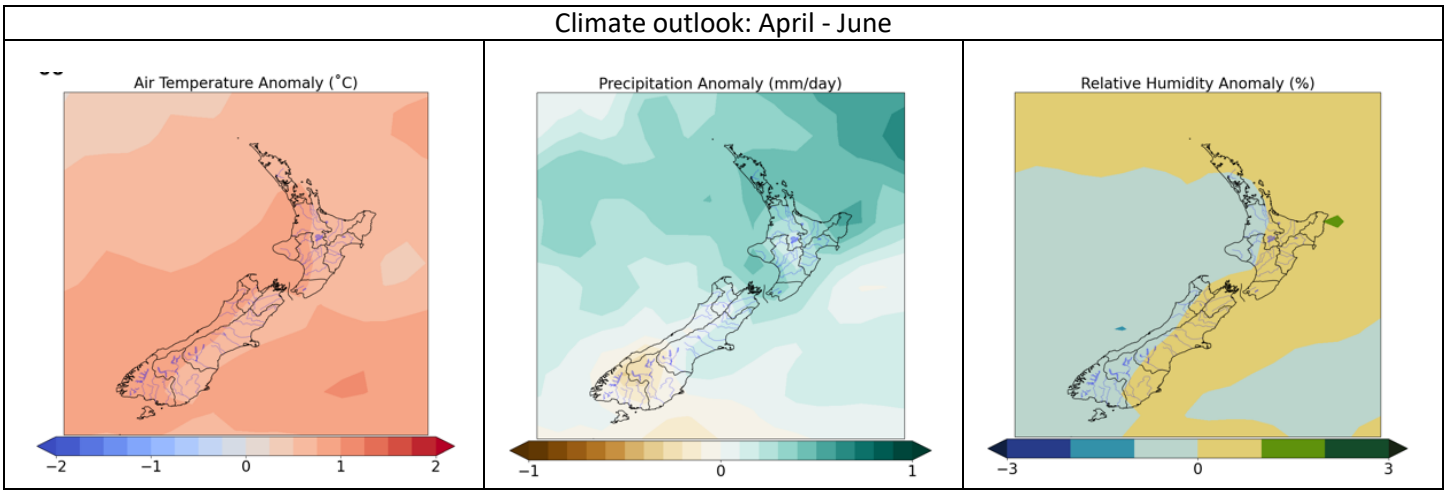


Figure 7: Climate outlook for March-May showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

Expected impact on fuels and fire danger

Heavy rainfall over the top half of the North Island forecast for the next few days will see fire dangers reduce in most areas. This includes in the Northland, Auckland, Waikato and Central North island regions, where remaining areas with elevated DMC and BUI will return to more normal levels. Possible exceptions to this are in the Far North (Aupori Peninsula) and southern Waikato areas which may miss the heaviest falls.

In areas where underlying dryness remains, or following dry periods between rain events, fire dangers will increase again to more normal or even slightly above normal levels. Drying will be exacerbated by warmer than normal temperatures, lower humidity and wind. Elevated DMC and BUI levels mean that fires can still involve medium and subsurface fuels. While having less impact on fire spread rates, these fuels increase fire intensity and make suppression more difficult.

Fine fuels are also critically important to fire behaviour, with lower fine fuel moistures resulting in easier ignitions and faster spread rates. Fine fuels are affected by temperature, wind, humidity and precipitation. Based on the outlook above, it is anticipated that drying rates will continue to be high due to the warmer temperatures in most parts of the North Island. This may be exacerbated in the west by lower humidity values, but offset in the east by higher humidity associated with more onshore easterly winds. In the absence of rain, fine fuels will quickly dry out again, increasing the risk of ignition and fire spread.

Scrub fuels in particular respond very quickly and can produce extreme fire behaviour within relatively short periods since recent rain. Grass fuels may also still have high amounts of dead material present, although will begin to green up in many areas if they haven't already. Vigilance therefore needs to be maintained around communities and high value sites where the prevailing surrounding fuel are scrub or grasses with higher than normal fuel loads.

The net effect of the climatic outlook is that northern parts of the North Island, and possibly central regions, are likely to have normal to slightly above normal fire danger. Regions with currently elevated values that may miss most of the forecast heavy rainfall, such as the Far North and south Waikato, will quickly return to normal or slightly above normal levels in the absence of further rainfall. Remaining areas across the southern half of the North Island are likely to see more normal or below normal fire danger levels, especially in the east (Hawkes Bay and Wairarapa). However, even these areas will still experience periods of elevated fire danger, associated with stronger winds or dry periods between rainfall events, when wildfire ignition and spread potential could be high.

Grass growth & curing

Most fires start in fine fuels such as grass, which ignite easily and rapidly 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 continued to experience good growing conditions as a result of the above average temperatures, and higher than normal summer rainfall. This has resulted in increased grass fuel loads in many areas, especially where grazing has not kept up with the grass growth. As summer has progressed, these grass fuels have died off and dried out in many areas.

But as we move into autumn with its generally cooler and damper conditions, these grass fuels will begin to green up again. This will be encouraged by the occurrence of rain and may already be underway in some areas. However, in drier parts of the island, a significant proportion of dead grass material may remain, including as dead thatch beneath new green growth, so that curing levels remain high.

Subject to weather and topography influences, grass fire ease of ignition, intensity and spread rates increase steadily as the curing percentage increases. Whereas a fire in <50% cured grass (with less than 50% brown or dead material present) will be slow-moving fires and produce small flames, a fire in >60% cured grass is able to spread faster and produce higher flame lengths and fire intensities.

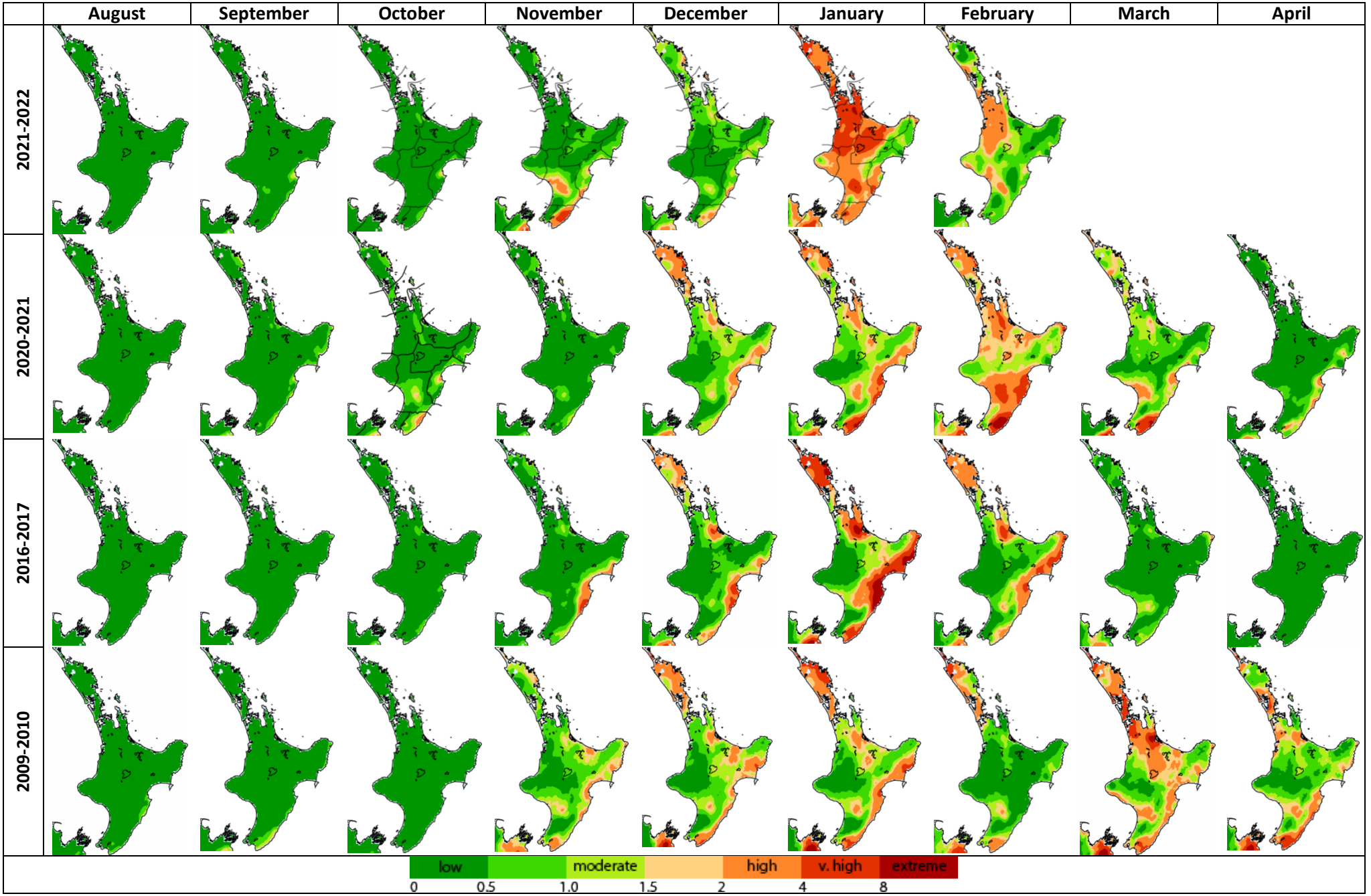


Figure 8: Monthly average severity rating for 2021-2022 up to and including February and the comparative years of 2020/2021, 2016/2017 and 2009/2010. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

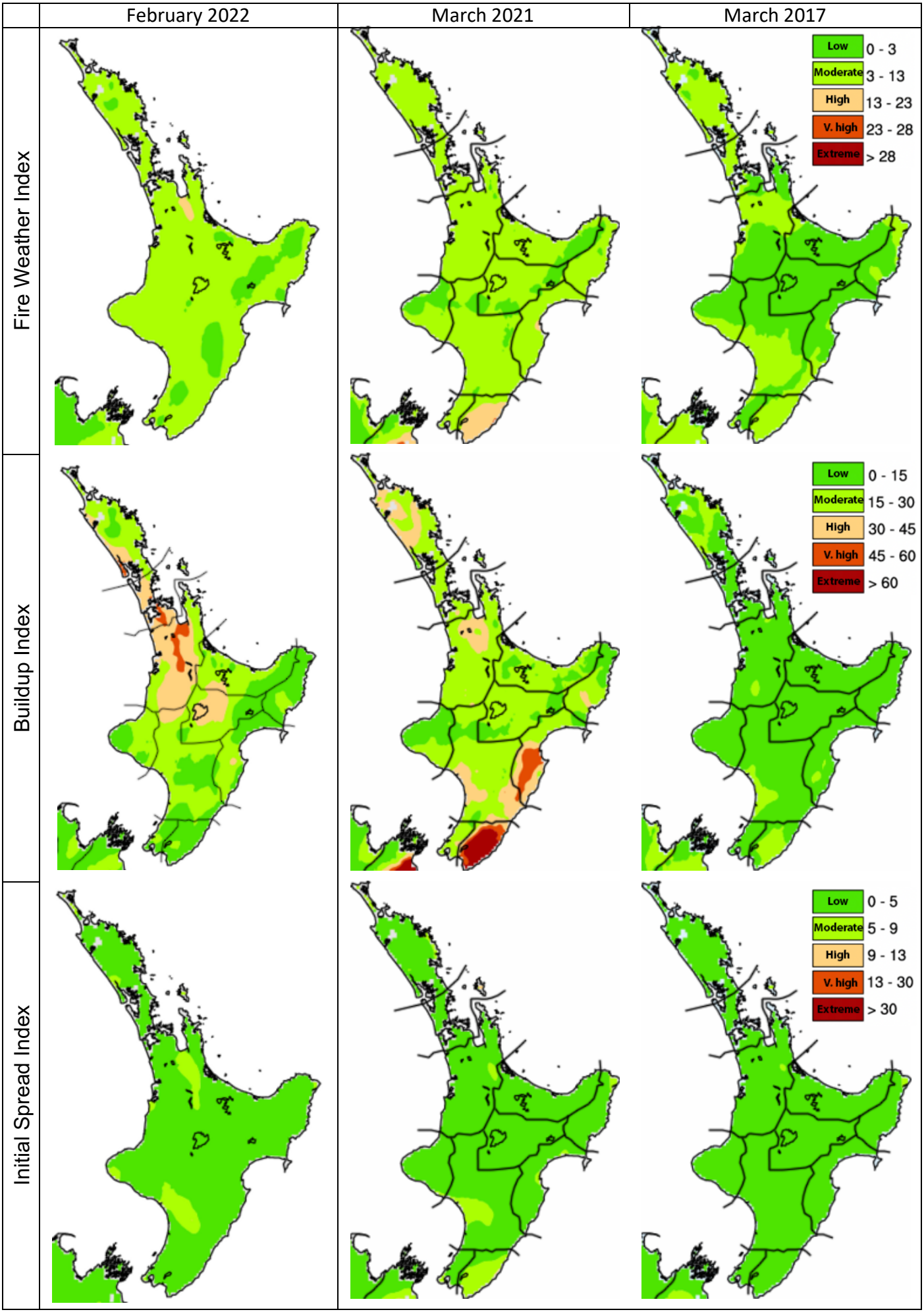


Figure 9: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

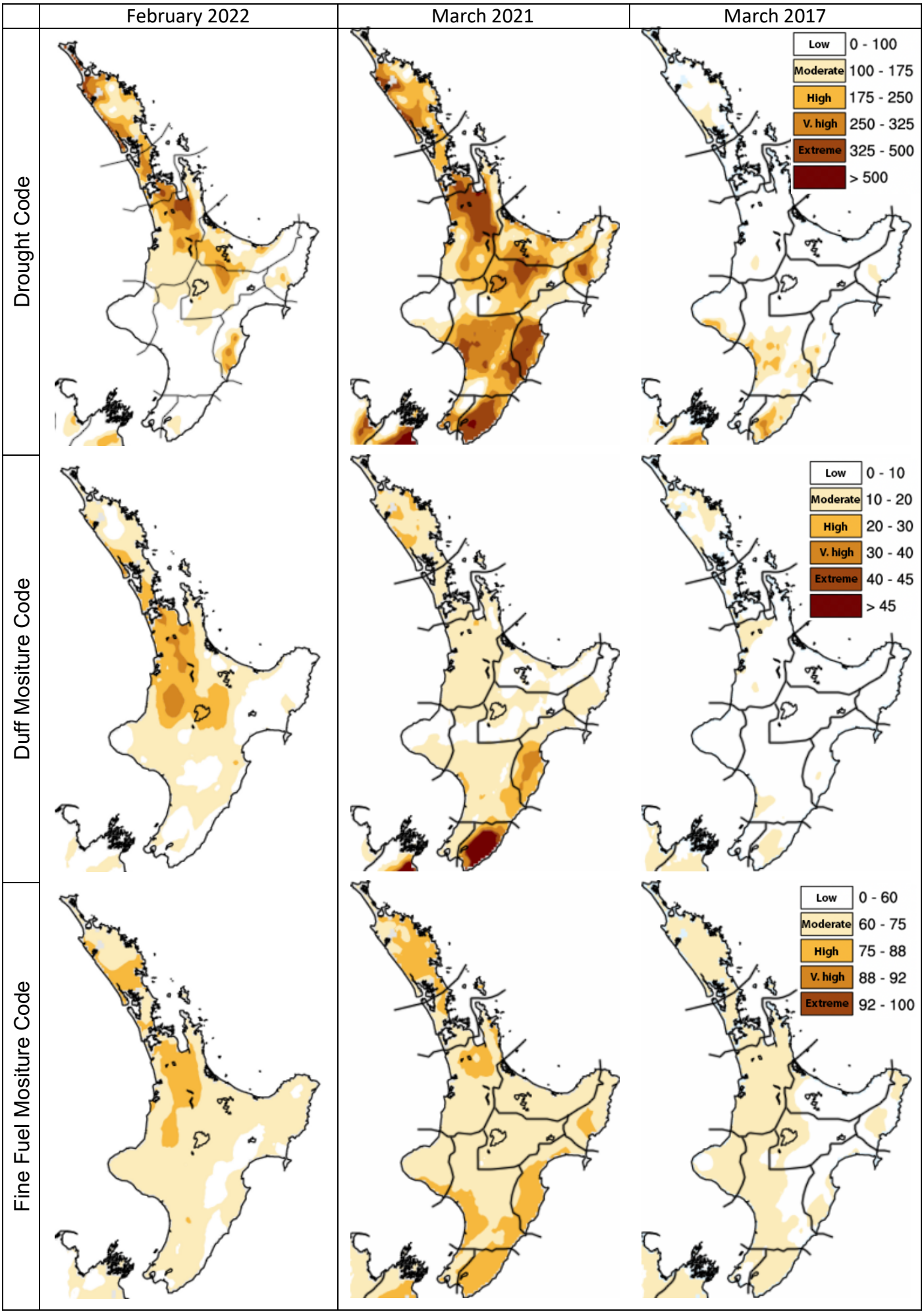


Figure 10: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

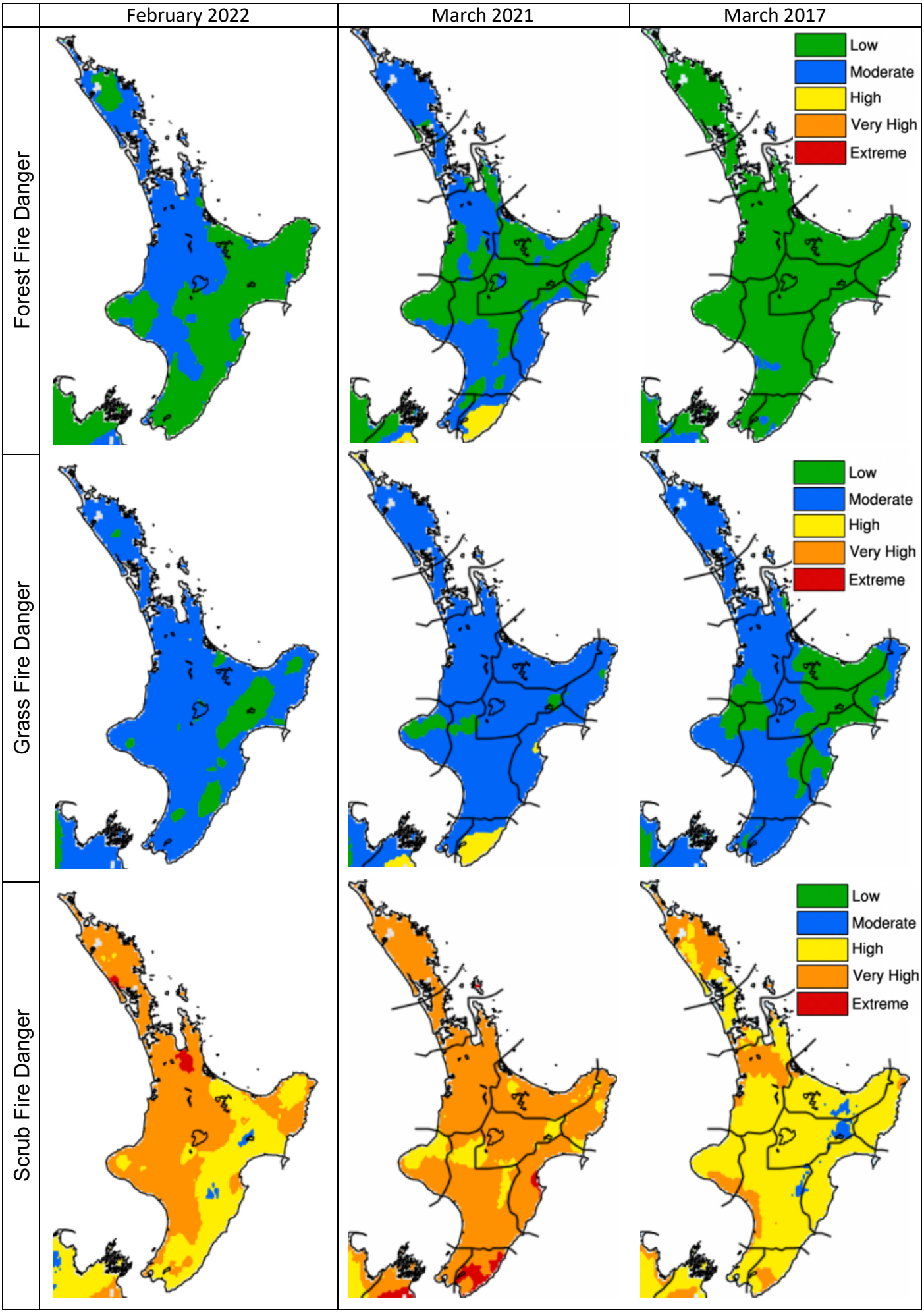


Figure 11: The most recent observed month (left column) and analogue months for February (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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