South 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 were much-improved compared to January, mostly due to heavy rainfall that occurred in the first half of February. However, many of these indices remain elevated in the lower South Island due to long-term dryness there (Figures 8-11).

Current fuel and soil moisture status

As of 17 March (Figure 4, left), soil moisture levels are below normal in Tasman, the upper West Coast, Southland, and Stewart Island, while above normal soil moisture is located in Marlborough Sounds and northern Canterbury. "Dry" to "Extremely Dry" conditions are currently found in coastal Otago, much of Southland, and Stewart Island on the New Zealand Drought Index map, with parts of Stewart Island now observing meteorological drought.

The above normal rainfall in February resulted in significant reductions in Fire Weather System Codes and indices (BUI, DC and DMC – refer to appendix for definitions) in most areas, especially across the northern and western parts of the South Island; the exception being in the far south, where dry conditions continued in Southland and coastal Otago (see Figure 9).

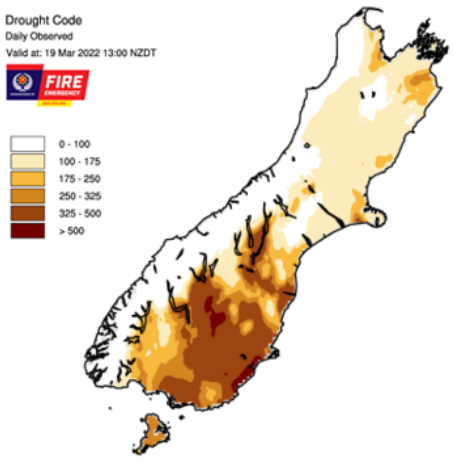


Figure 1: Map of Drought Code (an indicator of dryness of forest fuels and amount of smouldering in deep duff layers and large logs) for the South Island as at 19 March.

However, more widespread dry conditions during the first half of March have caused fire dangers to increase again, as evidenced by current DC values (Figure 1), especially in the south. These elevated DCs are the result of values remaining high, and increasing further during dry periods between rain events, as seen at Tuatapere (Figure 2) where they are well above normal for this time of year.

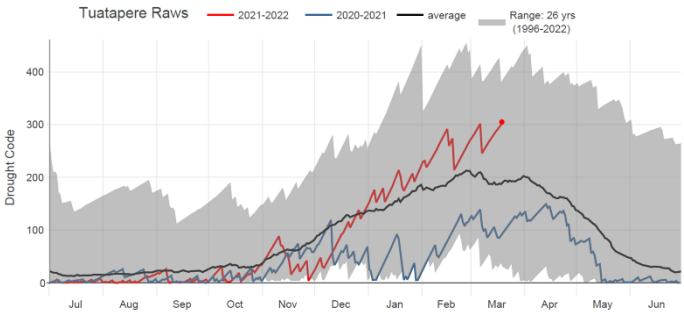


Figure 2: Trend in Drought Code (DC) code values for Tuatapere Raws in Southland comparing current values (2021/22, red line) with previous seasons (2020/21 (blue line), average (black line), and range (grey shading)).

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 normal to above normal rainfall in the upper and eastern South Island, although precipitation in the west and south could remain below normal.

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 in the upper and eastern South Island. However, below normal rainfall remains a concern in the south and west. For more information, see pages 3 and 4.

What to watch for

- Southern areas of Southland and Otago are most likely to experience slightly above normal fire dangers in the coming months due to underlying dry or very dry soils, continuing warmer-than-normal temperatures and lower-than-normal rainfall.
- Areas that miss forecasted rain, especially in the south (Southland and coastal Otago, and possibly also Central Otago and the Mackenzie Basin), that have received lower rainfall over the past months compared to other parts and have existing elevated DC and BUI levels.
- Dry spells, causing soil and fuel moistures to increase from present levels to more normal or slightly above normal levels.
- Areas with high grass curing, although grasses will be greening up in some areas.
- Occasional periods of strong winds, with potential to cause flare-ups or re-ignitions from going fires or burns.

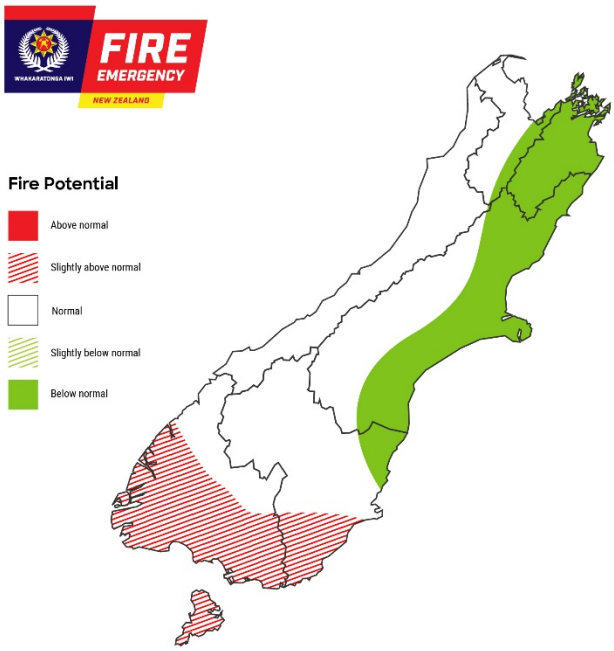


Figure 3: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

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 Tasman, the West Coast, and Fiordland. However, near average (±0.50°C of average) temperatures were widespread in Nelson, Marlborough, Canterbury, Otago, and Southland. In addition, small pockets of below average temperatures (0.51-1.20°C below average) were observed in Canterbury and interior Otago. This pattern has generally continued in 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 a majority of the South Island. Below normal rainfall (50-79% of normal) or well below normal rainfall (<50% of normal) was observed in parts of coastal Southland and Stewart Island. Elsewhere, near normal rainfall (80-119% of normal) was observed. Almost all locations have observed very dry conditions in the first half of March (Figure 4, middle).

Soil moisture levels are below normal in Tasman, the upper West Coast, Southland, and Stewart Island, while above normal soil moisture is located in Marlborough Sounds and northern Canterbury (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.

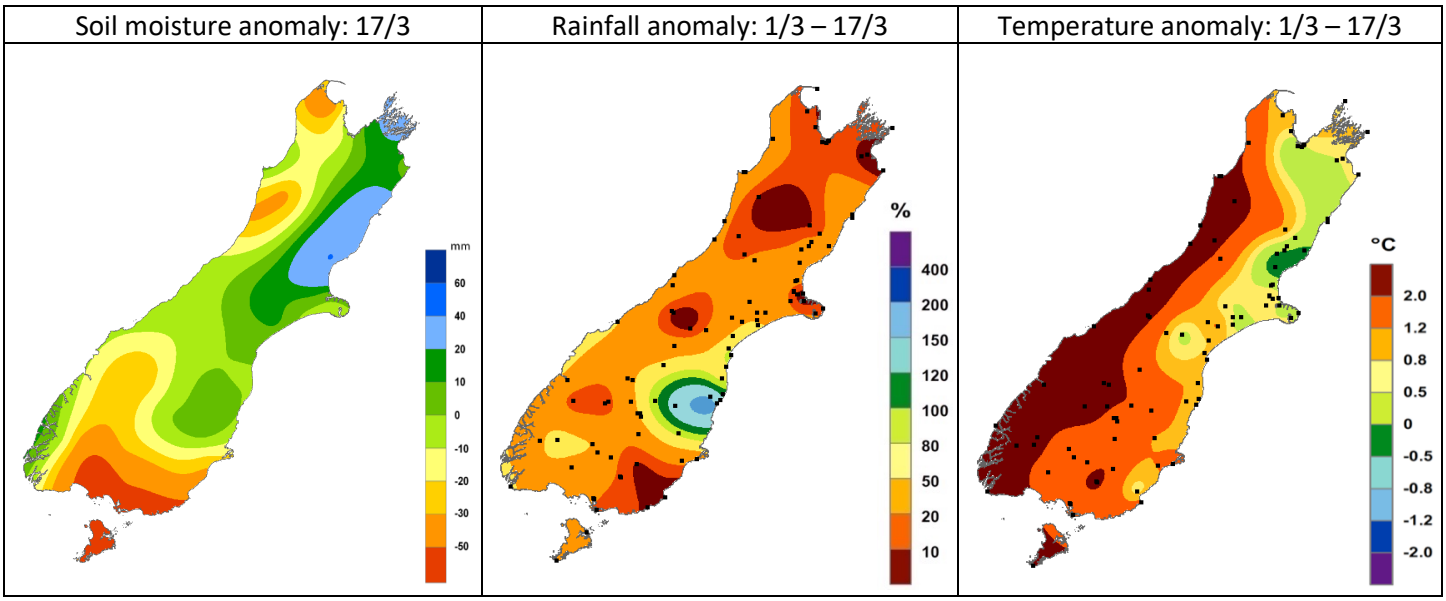


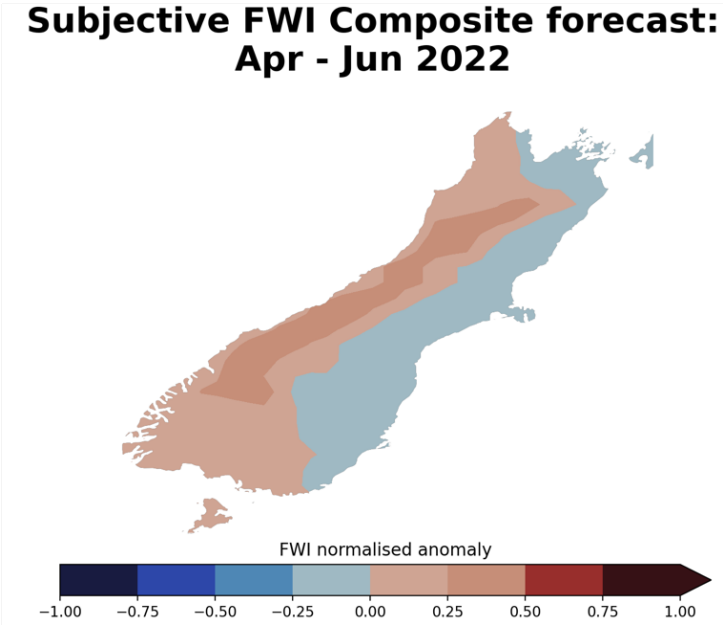
Figure 4: Maps showing the current soil moisture anomaly as well as temperature and rainfall differences from normal since the start of the month.

Fire season analogues

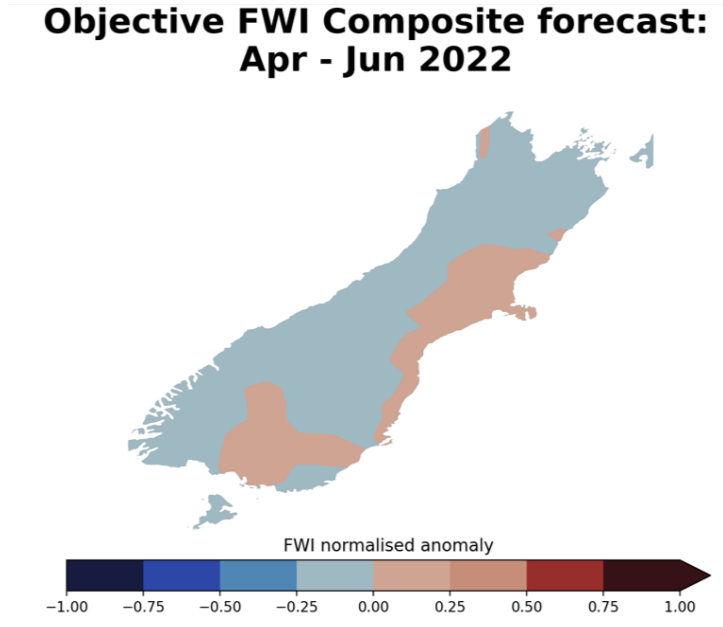
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

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 and southern South Island. However, indices may be lower than average in the north and east, partly due to the prevalence of onshore easterly winds. Overall, this indicates that some regions across the island (especially in the south and west) will need to be prepared for long dry periods that can enhance fire weather conditions.



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, similar to recent months. The signal is for a normal or wetter than normal month in the upper and eastern South Island. However, southern and western areas continue to look drier than normal. Wind speeds are expected to be below normal across the South Island. Above average temperatures again appear very likely in the west and south, although onshore winds may result in temperatures closer to average along the east coast. Relative humidity is forecast to be slightly higher than normal in eastern areas and lower than normal in western and southern areas (Figure 6).

Climate outlook: April - June

The season is again expected to have more easterly winds than normal. Above average temperatures remain likely, particularly in the western and southern South Island. Rainfall is favoured to be below normal in the south and west, but perhaps near normal to above normal in the north and east (Figure 7). However, extended dry spells may occur between periods of rainfall. Above average temperatures will be likely, with a reduction of westerly winds. Relative humidity is forecast to be below normal in western areas, and perhaps higher than normal in the east. Below normal wind speeds continue to be favoured. These climate anomalies remain 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.

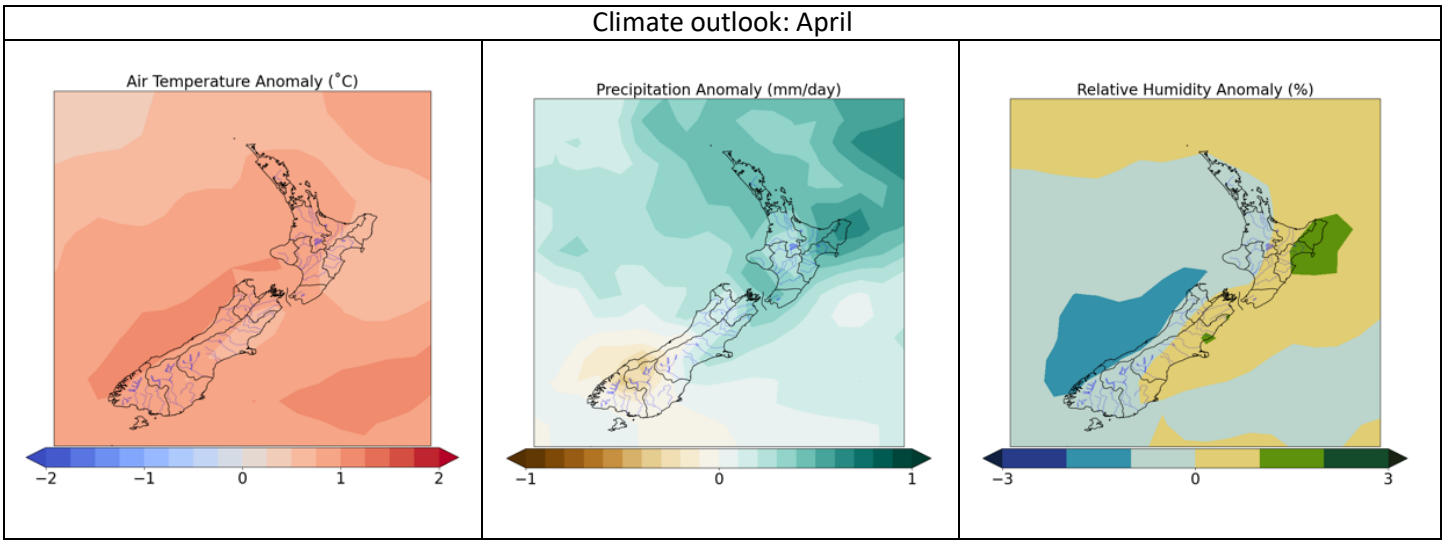


Figure 6: Climate outlook for March showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

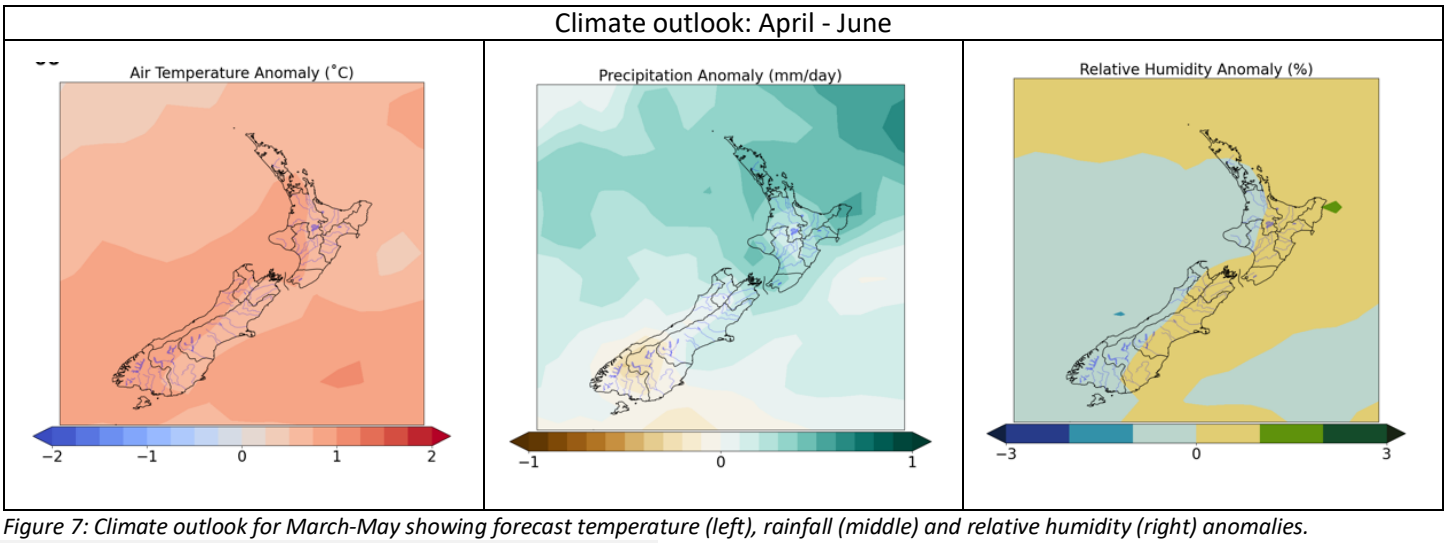


Figure 7: Climate outlook for March-May showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

Expected impact on fuels and fire danger

Significant rainfall over most of the South Island forecast for the next week will see fire dangers reduce further in most areas. This includes Tasman and inland South Canterbury, where remaining areas with elevated DC and BUI values will return to more normal levels. Possible exceptions to this are in the south (coastal and central Otago, and Southland) which may again 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 DC and BUI levels mean that fires can still involve large woody and subsurface fuels. While having less impact on fire spread rates, these fuels increase fire intensity and make suppression more difficult.

Fine fuels are critically important to fire behaviour with lower fine fuel moistures resulting 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 continue to be high in the south of the South Island due to the warmer temperatures and lower humidity, but lower in the east due to higher humidity and 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 southern areas of the South Island are likely to have normal to slightly above normal fire danger. Regions with currently elevated values that have missed most of the recent rainfall, such as Southland and coastal South Otago, will continue to have above normal fire danger levels in the absence of further rain events. Areas slightly further north in Central Otago and inland South Canterbury could also see slightly above normal fire potential. Remaining areas in the west and north of the South Island are likely to see more normal fire danger levels, with areas along the east coast below normal fire dangers. However, even these areas could still experience periods of elevated fire danger, associated with stronger winds or dry periods between rainfall events, when wildfire ignition and spread potential will 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 South 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 are died off 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 much faster and produce extreme flame lengths and fire intensities.

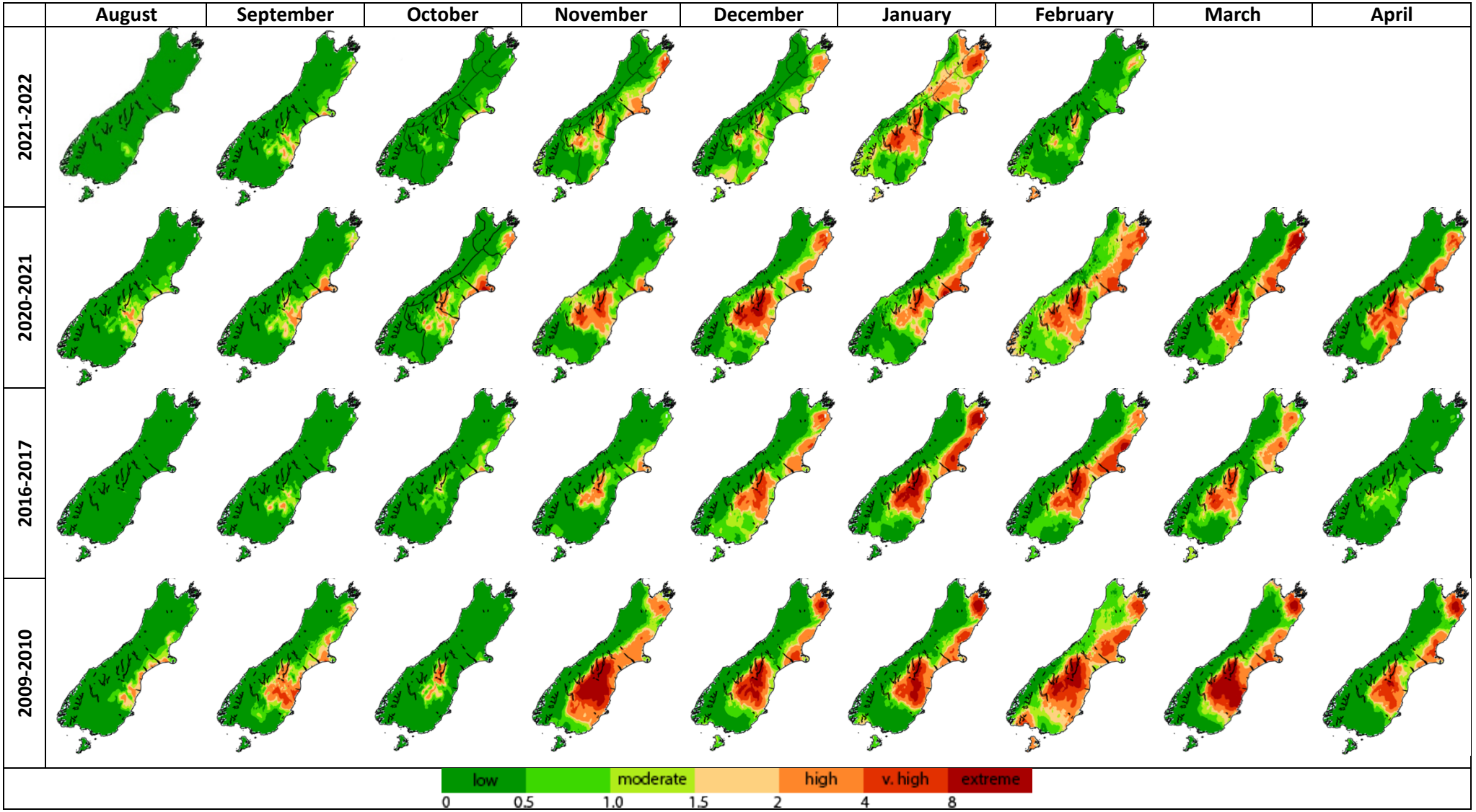


Figure 8: Monthly average severity rating for 2021-2022 up to and including January and the comparative years of 2020/2021, 2016/2017 and 2009/2010. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

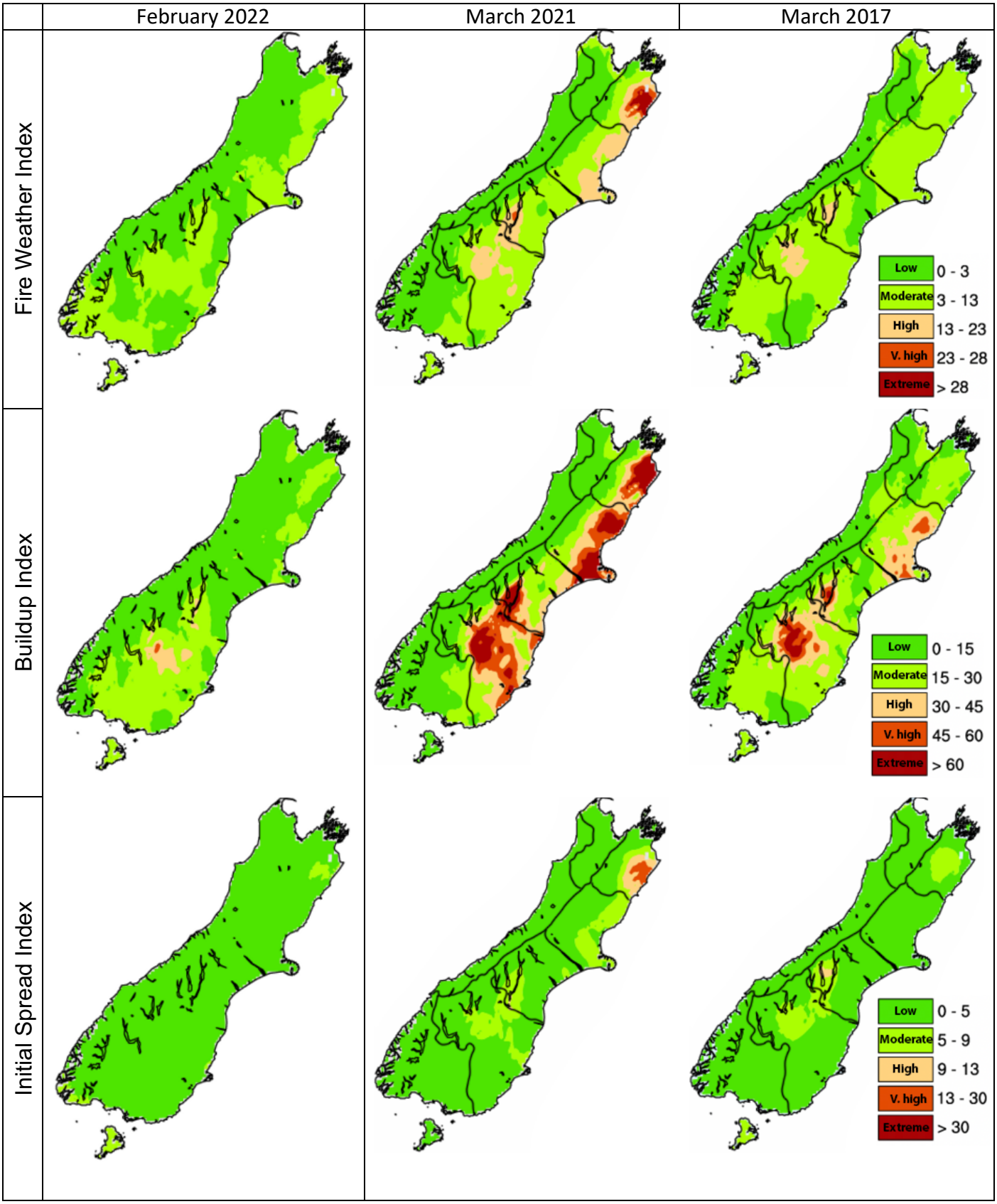


Figure 9: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

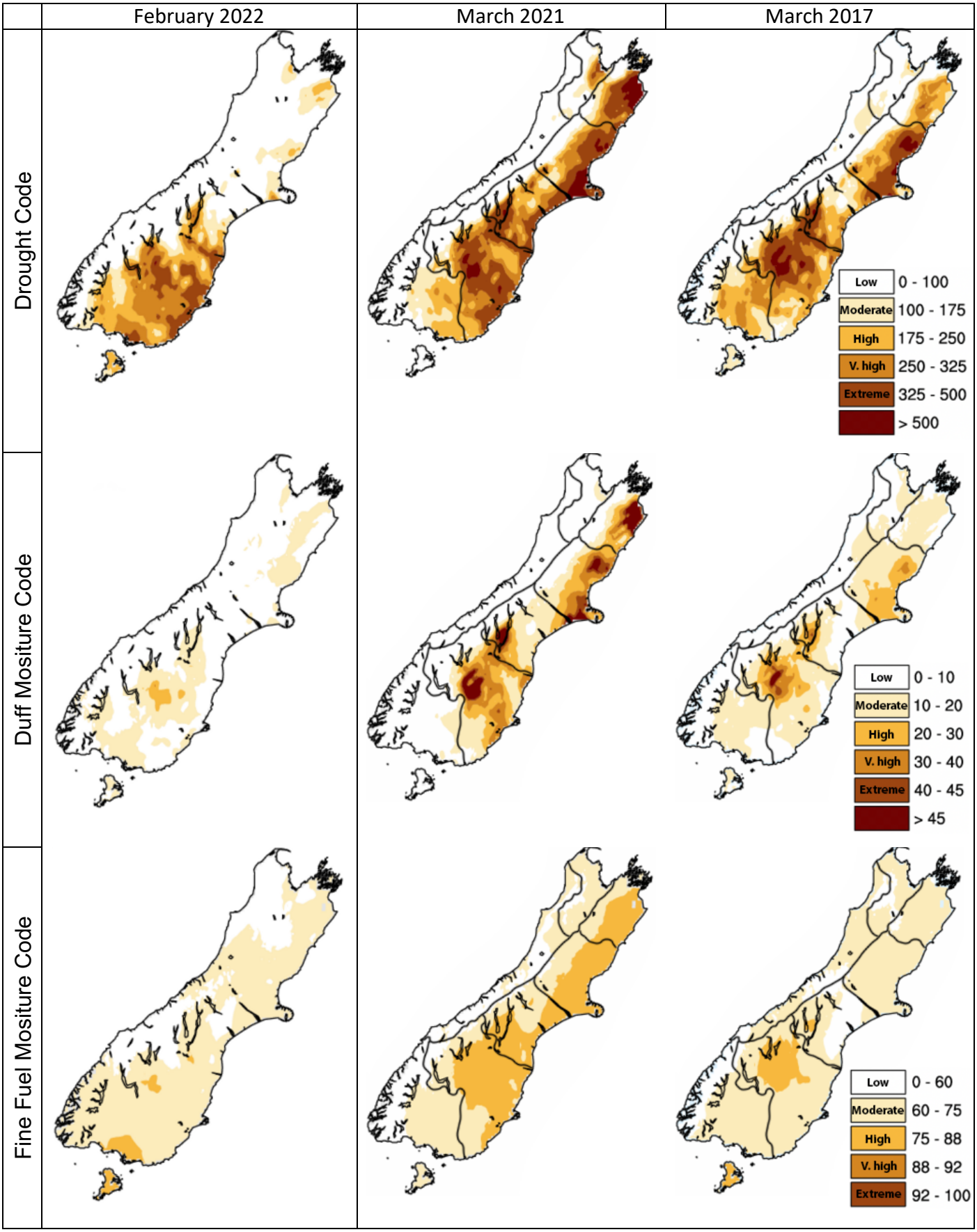


Figure 10: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

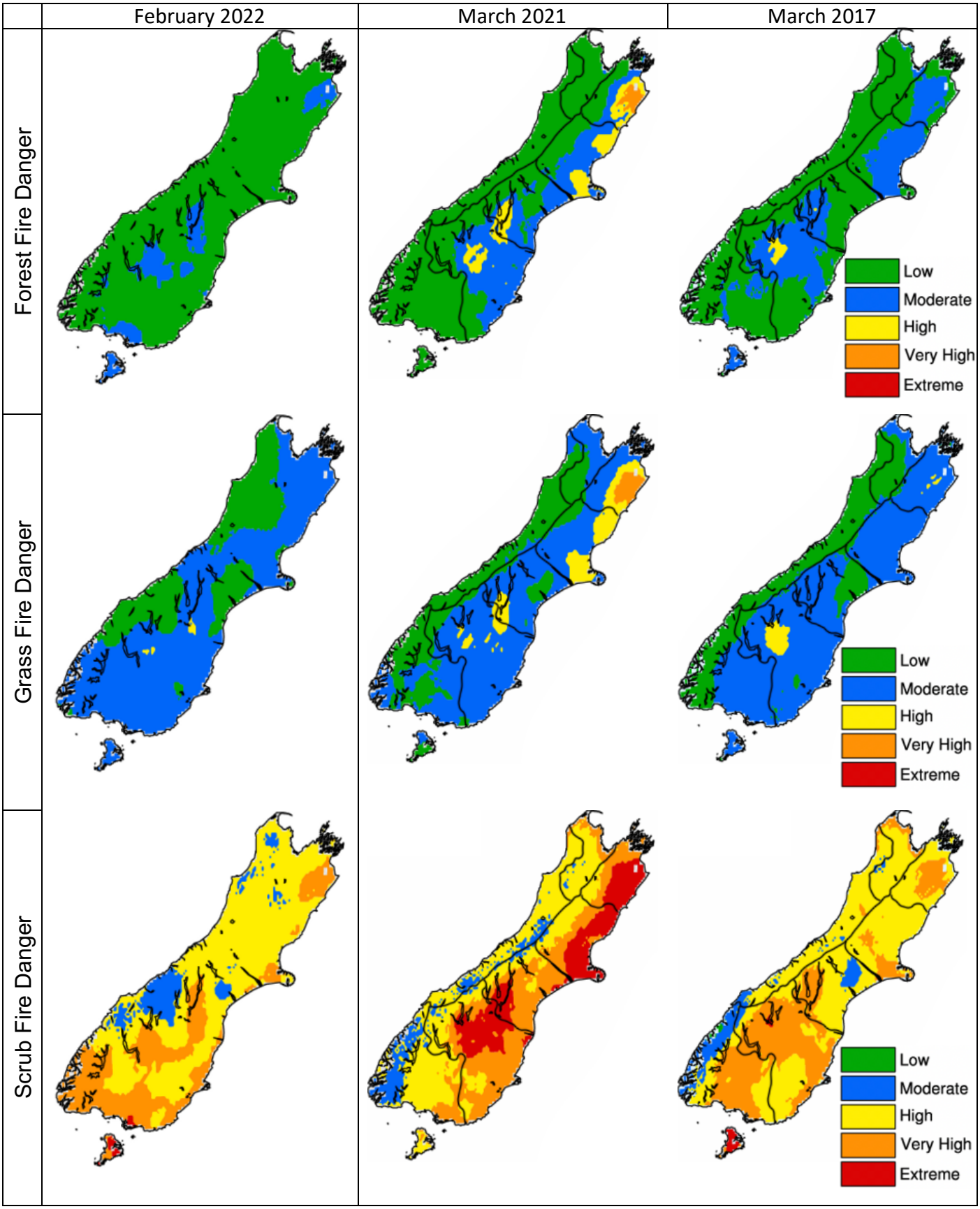


Figure 11: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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