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

Current fire danger situation

February's various indices mostly show moderate to very high values across the upper and eastern South Island, although some extreme values are observed in parts of southern Canterbury and Otago. See Figures 7-10 for more detail.

Current fuel and soil moisture status

As of 20 February (Figure 3, left), soil moisture levels are below to well below normal across much of the western and southern South Island, along with southern Canterbury. Soil moisture levels are near normal to above normal from Marlborough to Banks Peninsula. The New Zealand Drought Index is currently showing dry to extremely dry conditions in the upper West Coast, Banks Peninsula, nearly the entire lower South Island, and Stewart Island. Meteorological drought has recently emerged in small parts of eastern Otago.

The South Island is currently experiencing variable conditions, with elevated Buildup Index (BUI) values (an indicator of fuel availability due to drying of medium and heavy fuels in forest) south of Timaru, and patches in inland Mid-South Canterbury and around Reefton. Meanwhile eastern parts through North Canterbury and the Kaikoura coast have received rain as a result of the frequent easterlies. Note: Rain is forecast to dampen and reduce fire danger temporarily for many parts of the South Island shortly after the writing of this document.

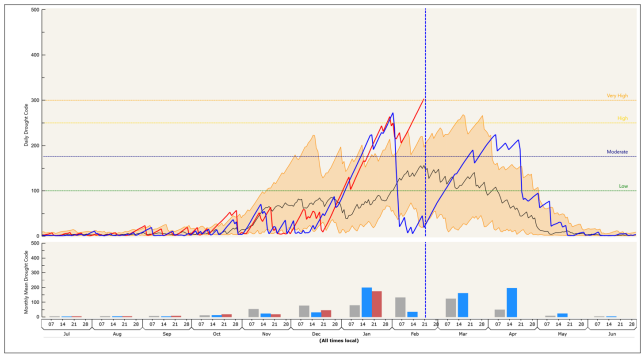


Figure 1. Elevated Drought Code (DC) values for Reefton. The redline shows the current year, the black line is the median, and blue is last year (2021/22).

The areas with higher Buildup Index (BUI) values (Figure 1), and contributing Drought Code (DC) and Duff Moisture Code (DMC) values, will have greater fuel available to burn in forests. This greater fuel availability results in fires of greater intensities, as well as deeper burning into the ground which makes complete extinguishment of fires very difficult.

Although the BUI is elevated for a number of eastern and southern areas, the hot dry fohn winds from the northwest have been less frequent, meaning less days where ignitions are easy and spread rates elevated. However, a fohn wind in reverse direction to normal has frequently been seen so far this summer, where the easterlies have been delivering warm dry conditions to parts of the West Coast.

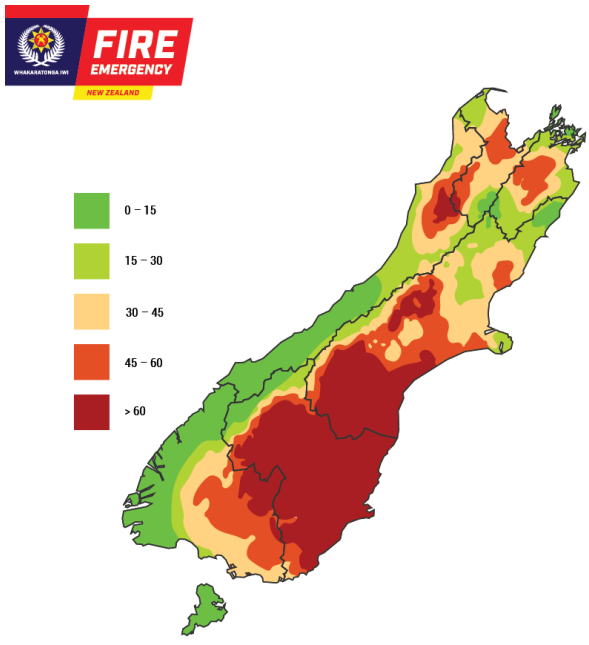


Figure 1: Map of Build Up Index (an indicator of fuel availability due to drying of medium and heavy fuels in forest) for the South Island as at 21st February.

Forecast climate and weather

Late February will feature a front bringing moderate to heavy rainfall to many areas this week before a return to generally dry weather. For March as a whole, more easterly winds than normal are expected, with a reduction in westerlies. Rainfall may be slightly reduced in the lower and western South Island, but anomalies don't look as profound as recent months.

March-May will likely continue to exhibit more easterly winds than usual. South Island rainfall totals look closer to normal, although a reduction in the typical westerly fronts could lead to drier conditions in the west. 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

- Areas of the South Island most likely to experience above normal or slightly above normal fire potential over the next few months are in the south and west (Southland, Otago and Westland).
- Parts of inland Canterbury and the east coast north of Kaikoura have had higher than normal soil moistures which have resulted in substantial grass growth, meaning the grass fuel loading is much higher than normal. Grasses in these areas are generally annual grasses that cure off without drought conditions and will still burn. Although the northwesterly winds are likely to be less frequent, when they do occur there is potential for some very intense grass fires ahead of the winter months.
- Small amounts of rain such as that forecast for the 21st and 22 will only briefing result in a small decrease to fire dangers but may lead to complacency.
- Fires in West Coast areas that do not typically get wildfires. Complacency again, this time from people burning, could be a problem because the conditions are such that fires may escape from burns in locations that they do not usually escape from.
- Crop stubble burns will be occurring over the coming months in many areas, and have potential to escape under windy conditions.
- Flare-ups or re-ignitions of old burns may also occur, especially during periods with strong winds.
- With cured grass across most of the South Island, accidental ignitions from spark hazardous activities will become easy, especially in warm conditions with lower humidity.

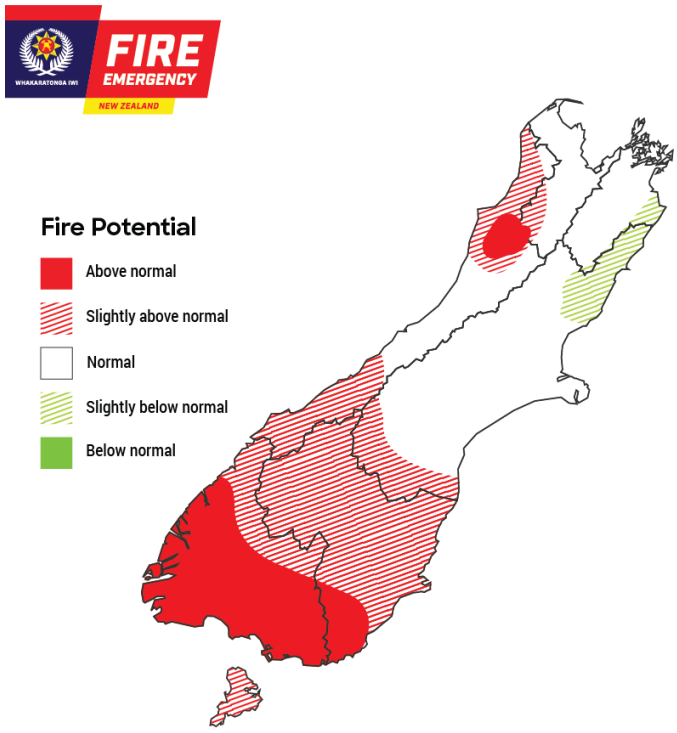


Figure 2: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

Current climate

January temperatures were above average (0.51-1.20°C above average) or well above average (>1.20°C above average) across the majority of the South Island, and generally near average (±0.50°C of average) in Marlborough and coastal North Canterbury. So far in February, temperatures have been well above average across nearly the entire South Island (Figure 3, right).

January rainfalls were above normal (120-149% of normal) or well above normal (>149% of normal) across northern Tasman and eastern Marlborough, while below normal (50-79% of normal) or well below normal (<50% of normal) rainfall was observed across the majority of the South Island. So far in February, rainfall has been above normal in the northeast and southwest, but well below normal in southern Canterbury and Otago (Figure 3, middle).

Soil moisture levels are below to well below normal across much of the western and southern South Island, along with southern Canterbury. Soil moisture levels are near normal to above normal from Marlborough to Banks Peninsula. The New Zealand Drought Index is currently showing dry to extremely dry conditions in the upper West Coast, Banks Peninsula, nearly the entire lower South Island, and Stewart Island. Meteorological drought has recently emerged in small parts of eastern Otago (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.

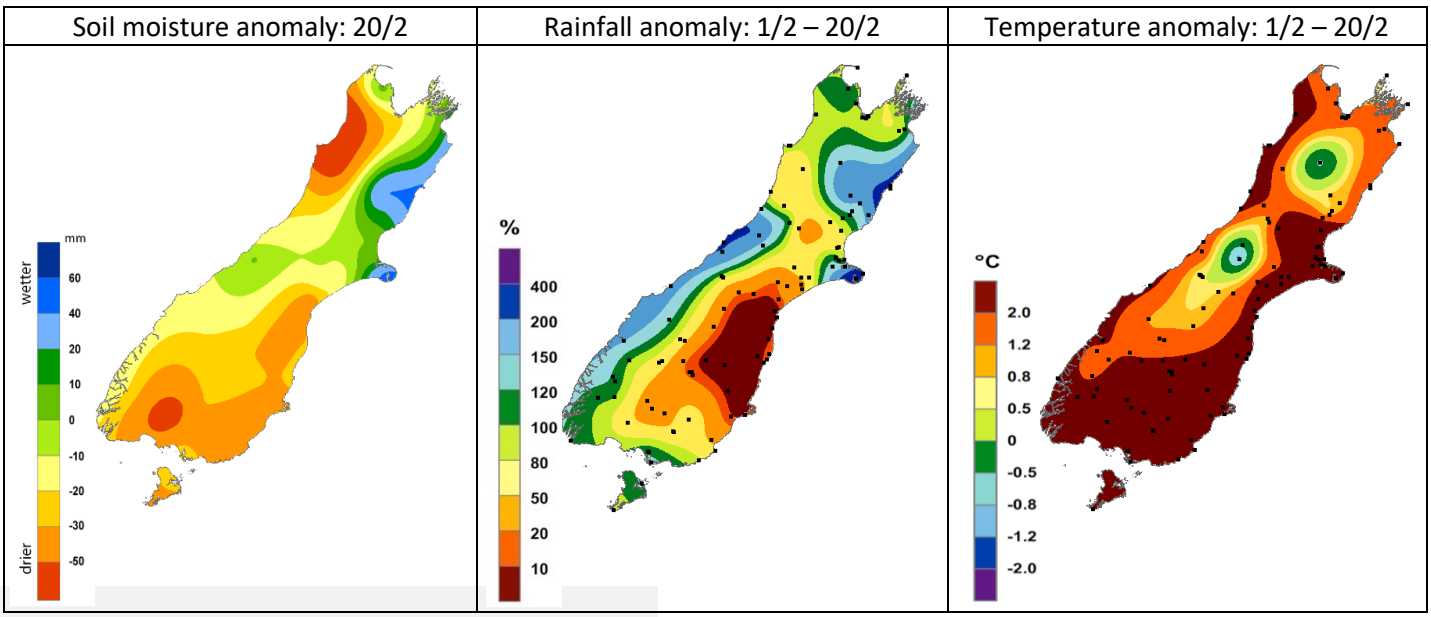


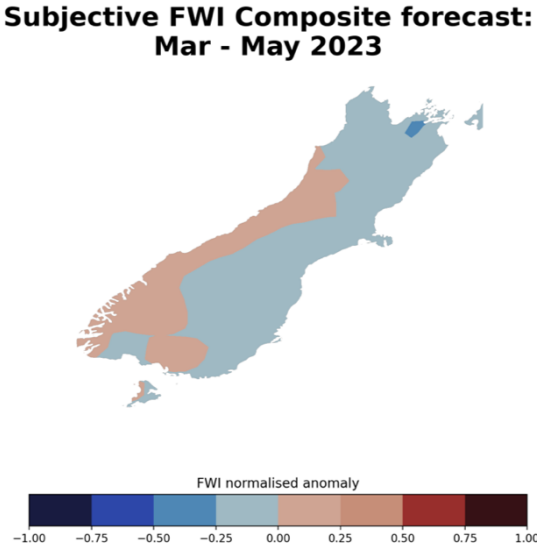
Figure 3: Maps showing the current soil moisture anomaly, as well as temperature and rainfall differences from normal since the start of the month.

Fire season analogues

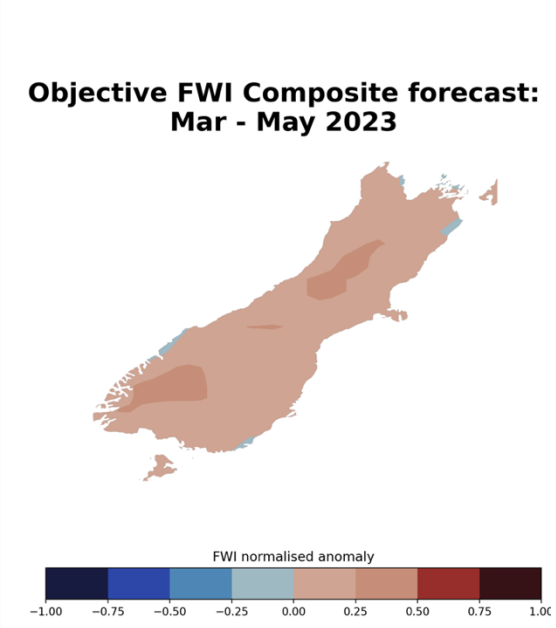
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

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 a mix between the expert-selected years and objective analysis for the South Island for autumn 2023. Western and southern regions are expected to have higher fire danger than normal as the season progresses. The subjective expert-selected guidance is generally favoured, although an elevated fire threat may be observed in southern Canterbury, Otago, and Southland.



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. Rainfall may be slightly reduced in the lower and western South Island, but anomalies don't look as profound as recent months. The risk for further ex-tropical cyclones looks enhanced during March. Wind speeds are expected to be below normal during March. Above average temperatures appear likely, especially in the south and west. Relative humidity may be slightly higher than normal in northeastern areas and below normal in western and southern areas (Figure 5).

Climate outlook: March – May 2023

Guidance suggests that March-May South Island rainfall totals look closer to normal, although a reduction in the typical westerly fronts could lead to drier conditions in the west. La Niña is expected to transition to ENSO-neutral during autumn, which may increase variability in air flows. Temperatures overall look to be warmer than average, especially in southwestern regions (Figure 6). Slightly above normal relative humidity is possible in the east, but it is expected to be below normal in western and southern regions. Wind speeds continue to look lower than normal across the South Island.

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

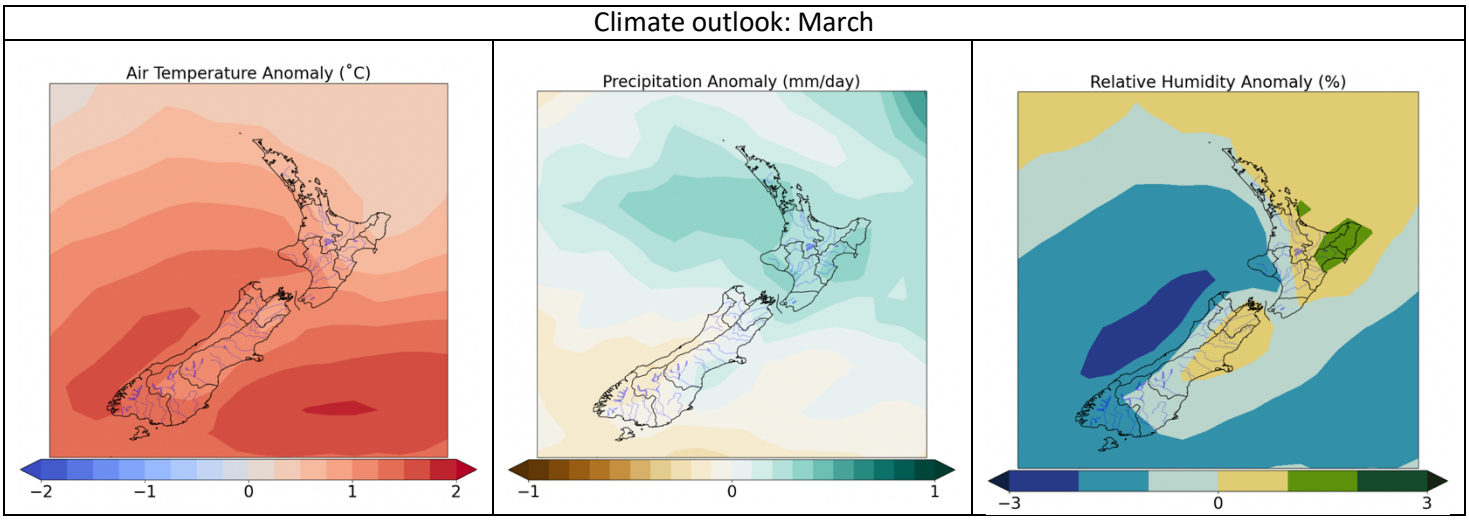


Figure 5: Climate outlook for March showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

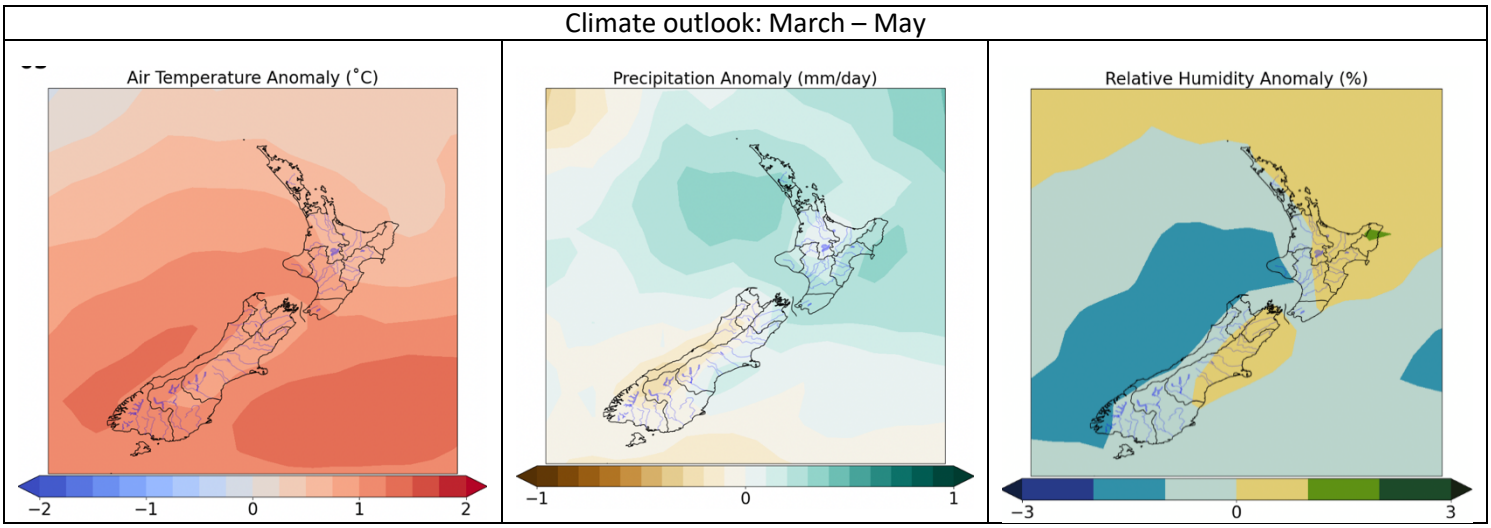


Figure 6: Climate outlook for March-May showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

Expected impact on fuels and fire danger

Looking to March and beyond, the availability of medium, heavy and subsurface fuels is likely to continue to be above normal for parts of Southland, Otago and the West Coast, and below normal for northeastern parts of the South Island with normal in other areas. The moisture of these medium and heavy fuels has a fairly small impact on fire spread rates, but as they dry the fuel availability increases resulting in greater fire intensity and making suppression more difficult. The drying of these fuels is dependent on temperature, precipitation and to some degree humidity.

Fine fuel moisture is critically important to fire behaviour, with lower moisture contents resulting in drier fuels and therefore easier ignitions and faster spread, with wind speeds also contributing to spread rates. Fine fuel moistures are affected by temperature, wind, humidity and precipitation. Based on the outlook above, it is anticipated that fine fuel moistures will be lower than normal in the south-west and higher than normal in the north-east. Most notably, the spikes in fire danger in eastern parts due to the fohn wind creating drier fine fuels will be less frequent than normal, but will still occasionally occur. In the opposite direction to normal, the fohn effect of more frequent easterlies will however cause drier fine fuels on the West Coast more often this summer.

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 south of the South Island as described above.

The net effect of the climatic outlook is that western and southern parts of the South Island are likely to have higher than normal fire dangers, while northeastern areas experiencing increased easterly wind flows are expected to receive more humidity and precipitation and have slightly below normal fire danger.

There will however still be periods when the westerly flows return and, especially if they are strong and not accompanied by precipitation, they are likely to result in spikes in the fire danger (especially grass fire danger) in the east.

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.

Parts of Canterbury and the northeast of the South Island have had particularly good grass growth. As a result, we can expect higher than normal grass fuel loads in some areas, especially where grazing has not kept up with grass growth. Many of these areas are dominated by annual grasses that cure even without exposure to drought conditions.

Curing for most grass species occurs as a natural process with summer drying and seed set, the timing of which will vary between regions and seasons. We are now seeing these grass fuels rapidly dying off and drying out in many areas.

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.

Otago – highly cured grass.

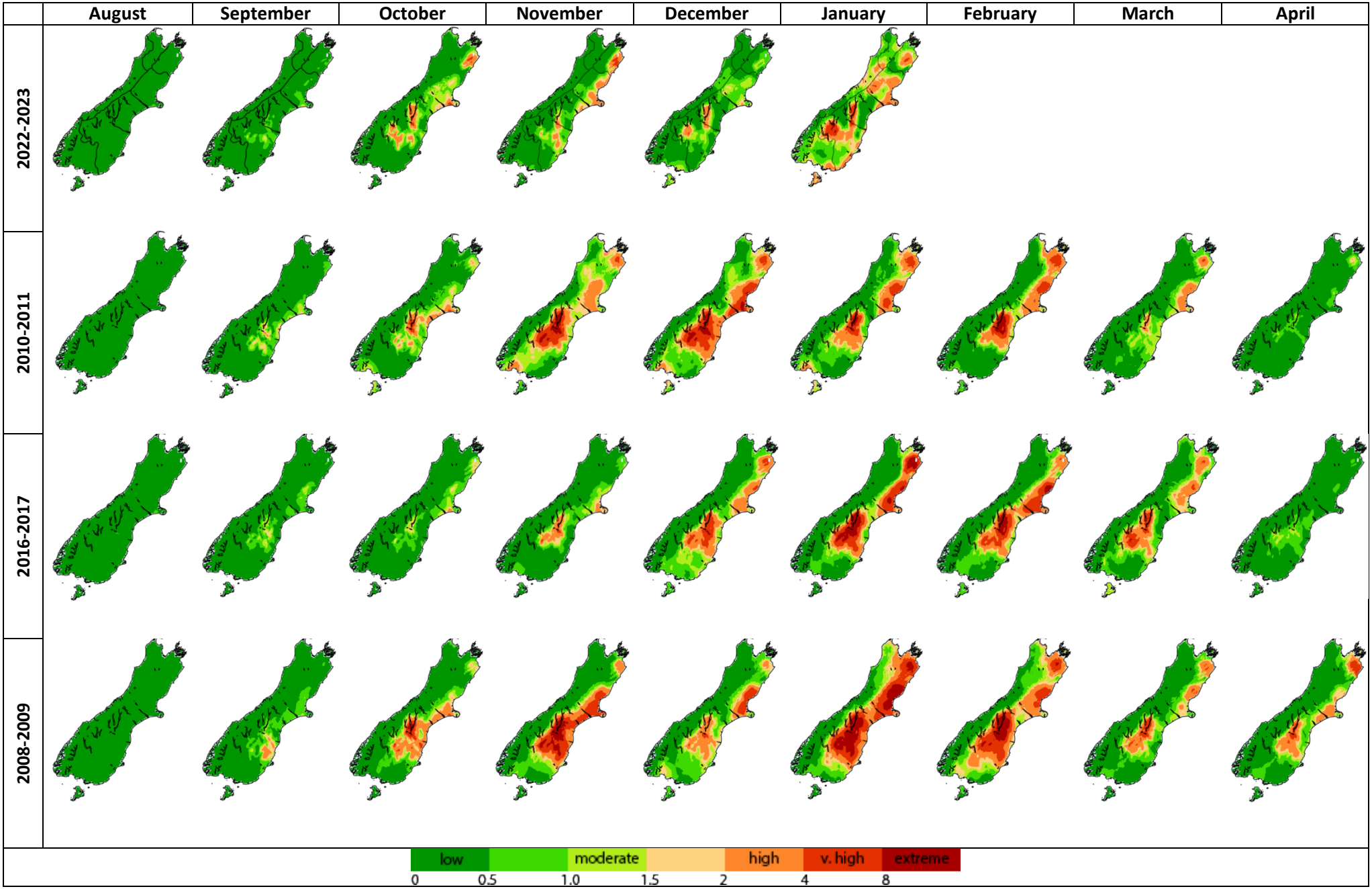


Figure 7: Monthly average severity rating for 2022-2023 up to and including January and the comparative years of 2010/2011, 2016/2017, and 2008/2009. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

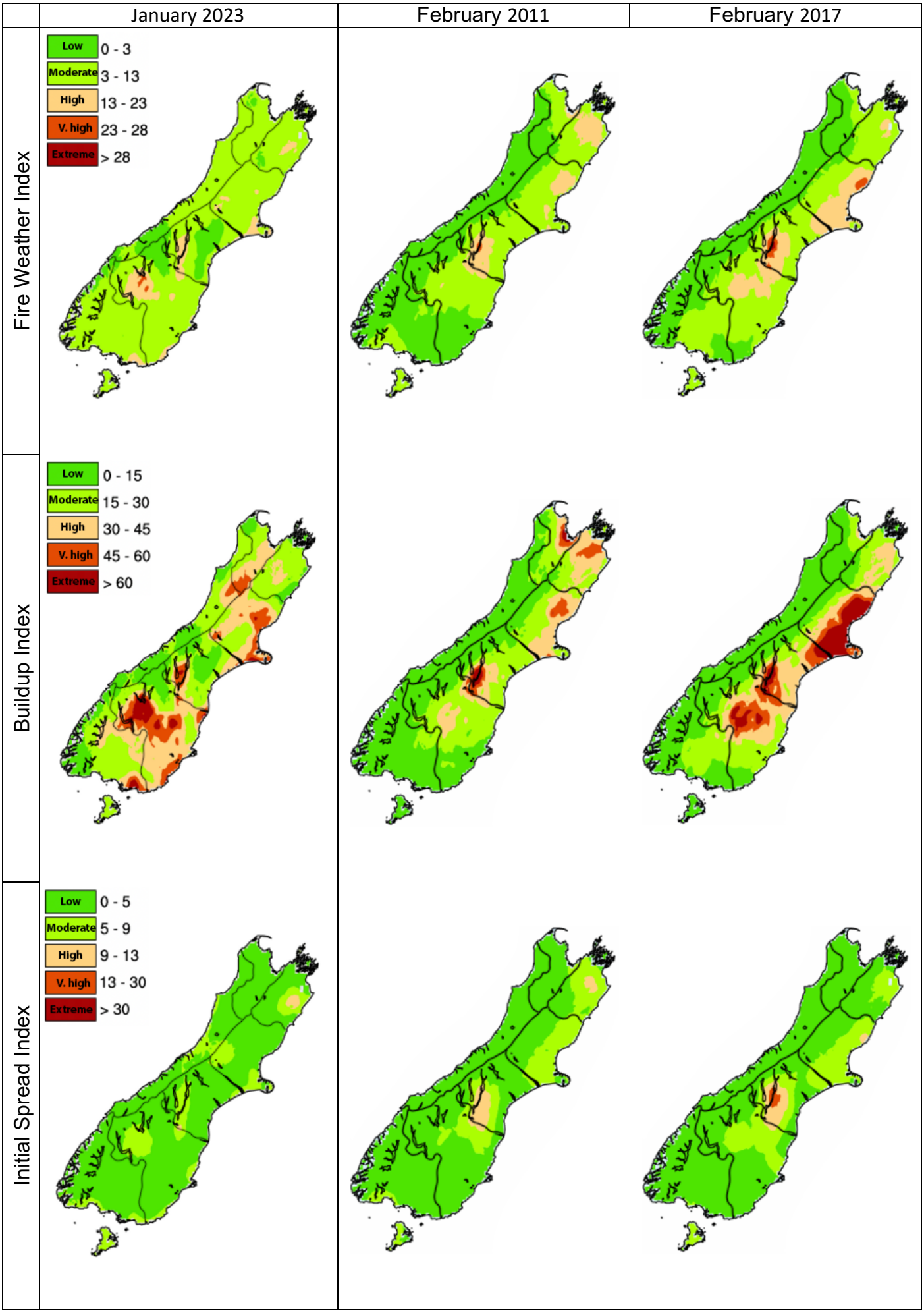


Figure 8: The most recent observed month (left column) and analogue months for February (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

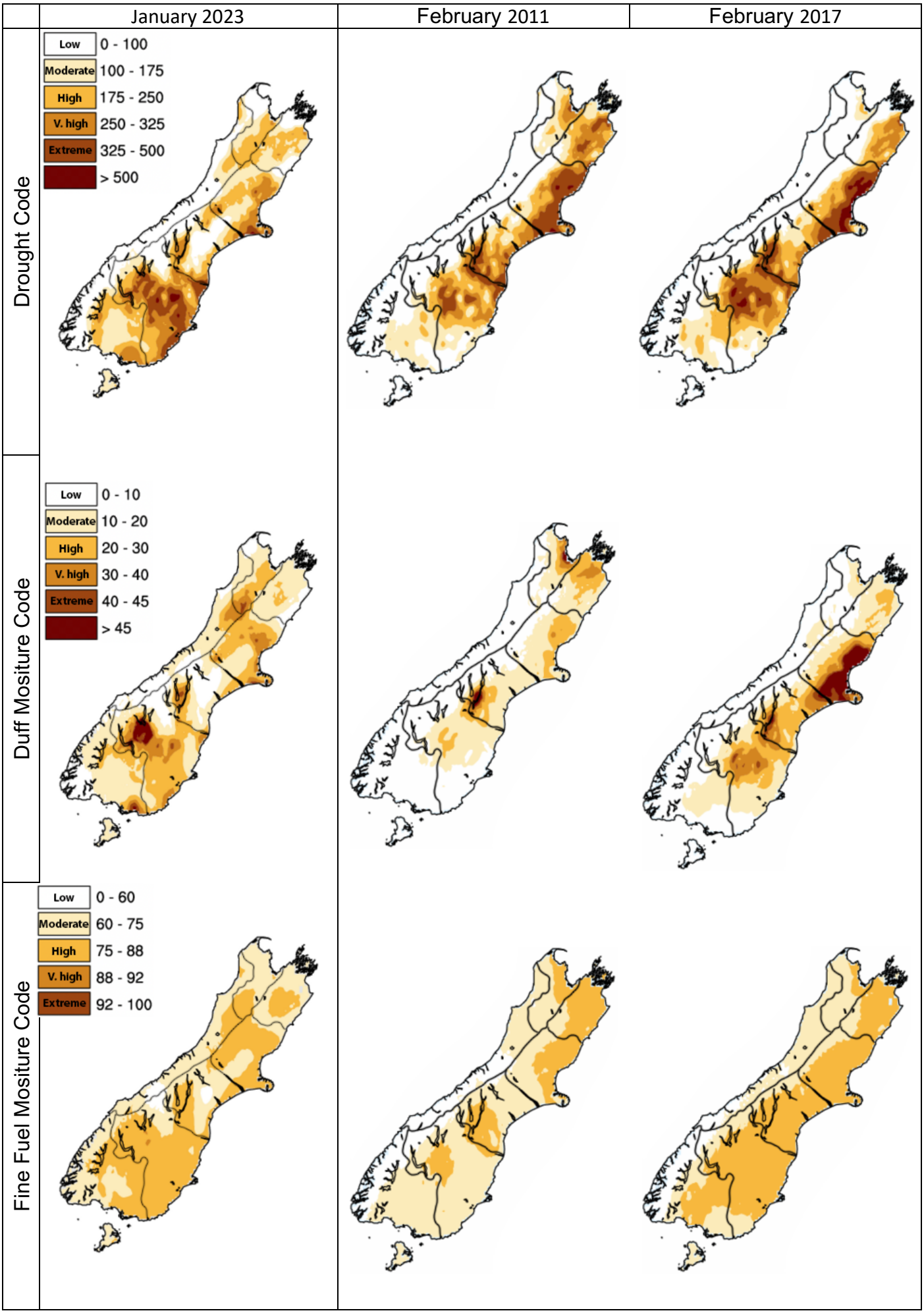


Figure 9: The most recent observed month (left column) and analogue months for February (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

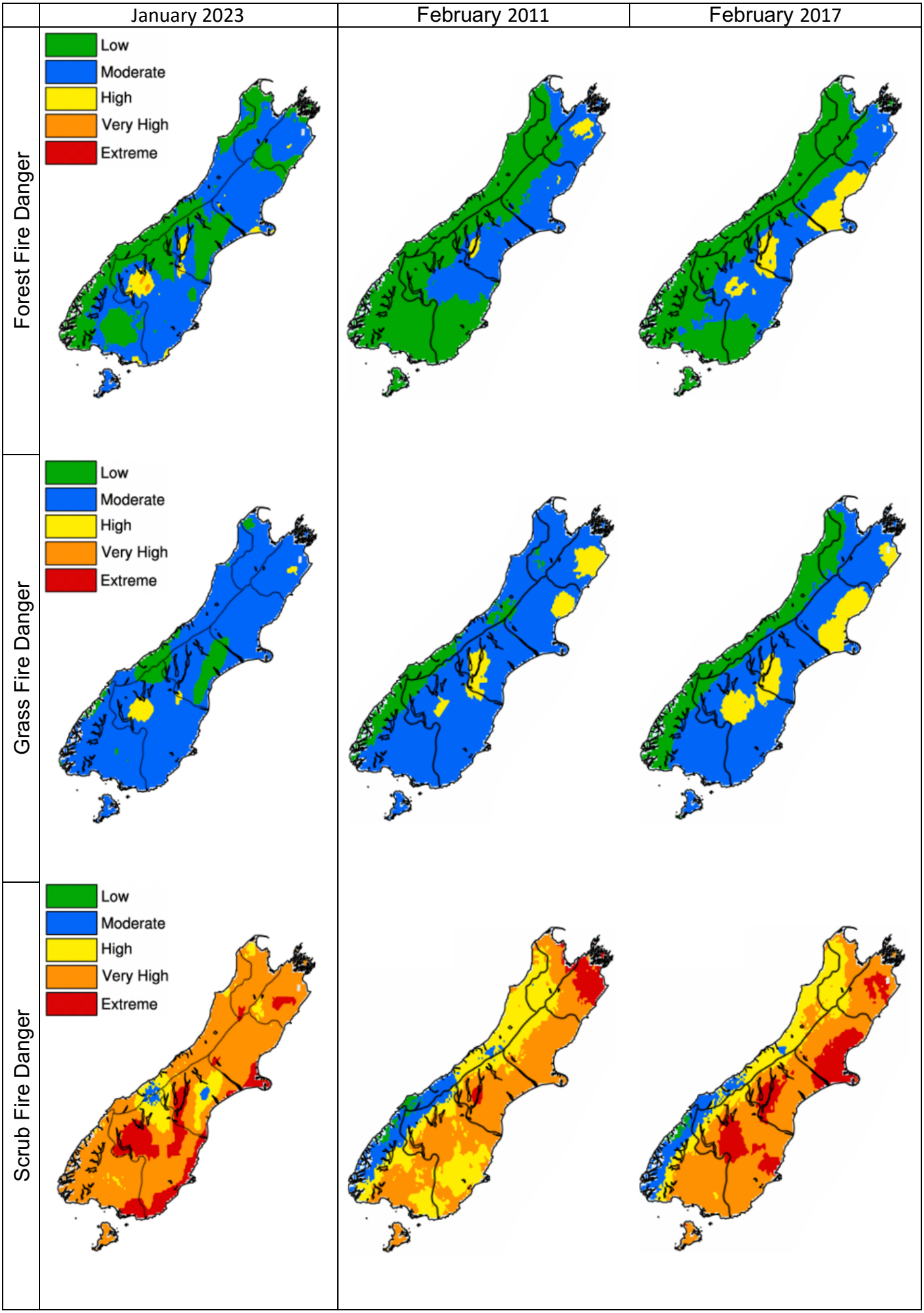


Figure 10: The most recent observed month (left column) and analogue months for February (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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