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

Current fire danger situation

October's various indices mostly showed low to moderate values across the South Island, although some high values were observed from Marlborough south to Otago (including Fine Fuel Moisture Code and Scrub Fire Danger). See Figures 7-10 for more detail.

Current fuel and soil moisture status

As of 17 November (Figure 3, left), soil moisture levels are below normal across much of the upper, central, and western parts of the South Island. Soil moisture levels are near normal in much of Otago and Southland. The New Zealand Drought Index is currently showing dry to very dry conditions in parts of central Canterbury and Otago.

Most of the South Island is currently experiencing low to moderate fire danger due to the low to moderate Fire Weather System Codes and indices (BUI, DC, DMC and FFMC – refer appendix for definitions) that have resulted from winter and spring precipitation, and normal to below normal temperatures (slower drying rates).

The lower BUIs and contributing DC and DMC values (Figure 1) mean minimal burning of medium, heavy or subsurface fuels is likely. However, the dryness of fine fuels (represented by FFMC values) is more responsive to day-to-day weather and can become elevated even under short periods of warm, dry or windy conditions, which can result in fire ignitions and spread in these fine fuels.

The exceptions for the South Island are areas around North, Mid- and coastal South Canterbury, and North and Central Otago, where DMC values are elevated, although not unusually so for the time of year for these areas. This could mean some potential for burning of medium and shallow soil organic fuels. More significantly, this could mean they have a head start on the drying process as we move toward summer.

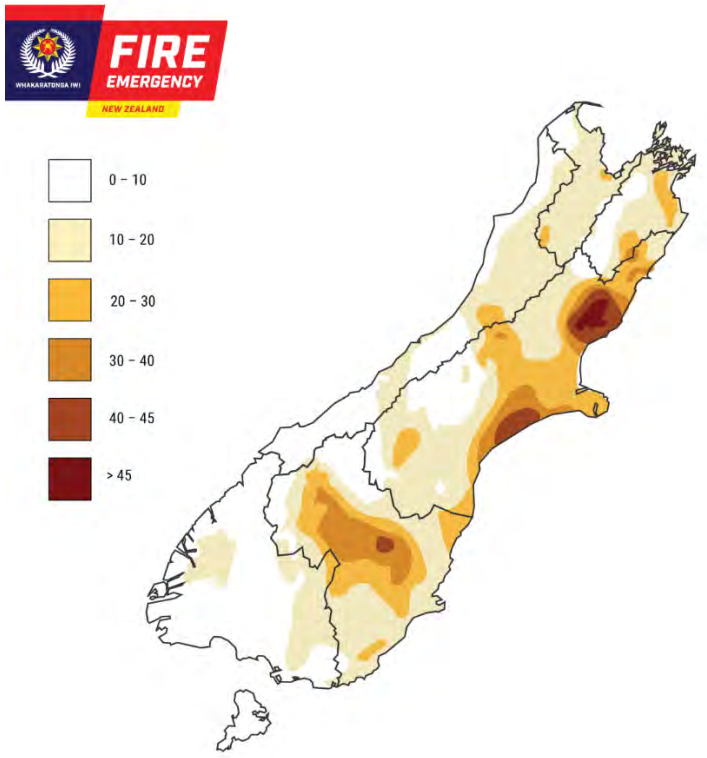


Figure 1: Map of Duff Moisture Code (an indicator of dryness in shallow organic soil layers and medium-sized woody material) for the South Island as at 17 November.

Forecast climate and weather

Late November looks to be somewhat unsettled for the South Island (especially the West Coast) as low pressure sets up in the Tasman Sea. This will likely result in substantial rainfall, especially for western regions over the next several days. However, a return to drier conditions is favoured in the last few days of November. For December as a whole, more easterly winds than

normal are expected as La Niña remains in place. This could result in near normal to above normal rainfall for Marlborough and Canterbury, although precipitation in the West Coast and lower South Island may be below or well below normal.

The summer season is expected to continue the trend of more easterly winds than normal as La Niña continues. Higher-than-normal rainfall is possible for northeastern areas, with more dryness favoured in the west and southwest. However, occasional heavy rain events from tropical systems could bring flooding to parts of the South Island, as the risk of an early-season tropical cyclone is enhanced this season. For more information, see pages 3 and 4.

What to watch for

Another La Niña summer (see below) means we may see conditions very similar to the past two seasons, which brought above normal fire dangers to the south and west of the South Island, and below normal fire dangers along the east coast of the South Island.

Although still very early in the fire season, the areas of the South Island most likely to experience above normal or slightly above normal fire potential over the next few months are again in the south and west (Southland, Fiordland and Westland). Eastern areas (coastal Marlborough/ Kaikoura and Canterbury) are most likely to see slightly below normal fire potential (see Figure 2).

- Watch for areas where grass fuel loads are higher than normal due to good growing conditions, and grass curing more advanced than normal due to dead "thatch" layers or frost curing. Together with elevated FFMCs and warm, dry windy conditions, these can contribute to easy ignition and spread of grassfires.
- Property owners undertaking burning may be complacent due to the low prevailing fire danger conditions, so escapes may be more likely, especially under windy conditions.
- Flare-ups or re-ignitions of old burns may also occur, especially during periods with strong winds.

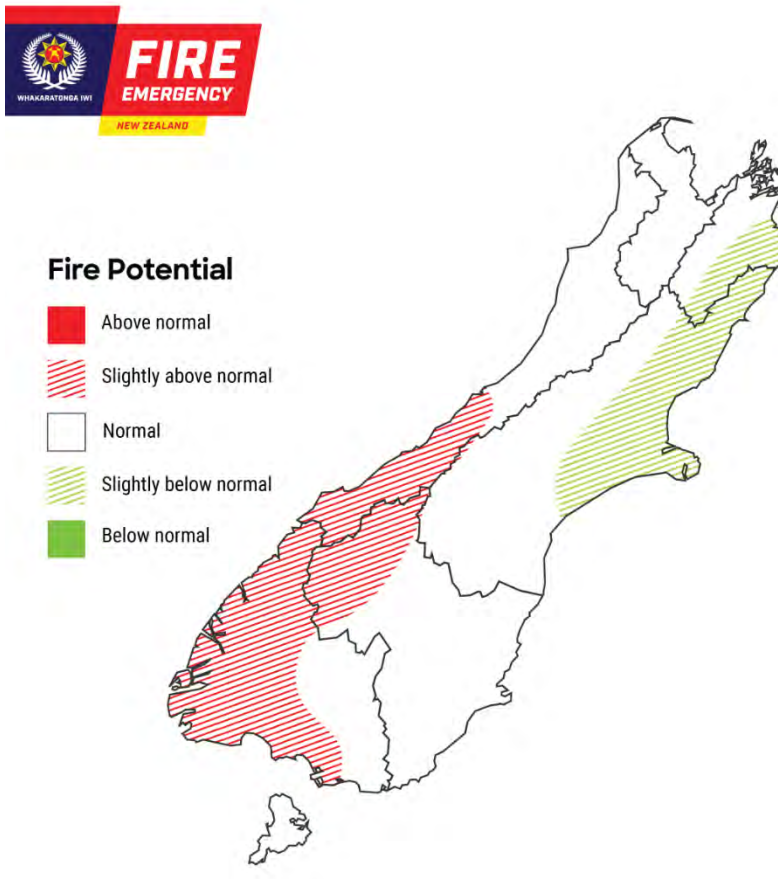


Figure 2: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

The Mt Crichton fire of 7 Oct. 2022 spread rapidly in fine flashy tussock and scrub fuels.

Current climate

October temperatures were near average (±0.50°C of average) for much of the country, with below average temperatures (0.51°C to 1.20°C below average) for parts of eastern Canterbury and the southern South Island. Temperatures were above average (0.51°C to 1.20°C above average) in parts of the West Coast. So far in November, temperatures have been above average (0.51°C to 1.20°C above average) to well above average (>1.20°C above average) across the entire South Island (Figure 3, right).

October rainfall was below normal (50-79% of normal) or well below normal (<50% of normal) for much of the South Island. In contrast, rainfall was above normal (120-149% of normal) or well above normal (>149% of normal) in inland parts of Otago and Southland. So far in November, rainfall has been below normal to well below normal in most of the east coast and Fiordland, with near normal to above normal rainfall for much of the West Coast and interior Otago (Figure 3, middle).

Soil moisture levels are below normal across much of the upper, central, and western parts of the South Island. Soil moisture levels are near normal in much of Otago and Southland. The New Zealand Drought Index is currently showing dry to very dry conditions in parts of central Canterbury (Figure 3, left).

Climate drivers

The NINO3.4 Index anomaly (in the central equatorial Pacific) during October was -0.80˚C (climatology: 1991-2020), in the La Niña range.

The October monthly Southern Oscillation Index (SOI) was +1.8 and +1.6 from August-October (climatology: 1991-2020), both well within the La Niña range.

Trade winds were much stronger than normal across the central and western equatorial Pacific during October, maintaining a moderate La Niña strength.

In the subsurface central equatorial Pacific, October conditions mirrored those of September. Sub-surface anomalies of -3˚C to -5˚C spanned from just below the surface in the east to 150 m depth in the central. This was juxtaposed by a particularly strong West Pacific warm pool.

A SST seesaw in the Indian Ocean, called the Indian Ocean Dipole (IOD), continued in its negative phase during October, contributing to lower air pressure around Australia and the wider Maritime Continent along with greater moisture availability. New Zealand was largely shielded from these moisture plumes due to high pressure. Forcing from the IOD is expected to last through most of November.

However, as the negative IOD eases from November-December, La Niña will become the main driver of seasonal climate variability in the tropics, with typical impacts for New Zealand including more easterly to northeasterly winds, warmer temperatures, lower rainfall about inland and western parts of both islands, and less frequent hot days in the east of both islands. This may also be conducive to early season tropical cyclone activity in the Southwest Pacific. This will be the first "triple dip" La Niña (three consecutive La Niña events from 2020-2022) since 1998-2000.

New Zealand's coastal water temperatures became less unusually warm during October in all regions except the west of the South Island. This was linked to more south-east winds than normal. Despite this, marine heatwave (MHW) conditions were still occurring near the northern North Island and western South Island. There is the potential for MHW conditions to last well into the new year.

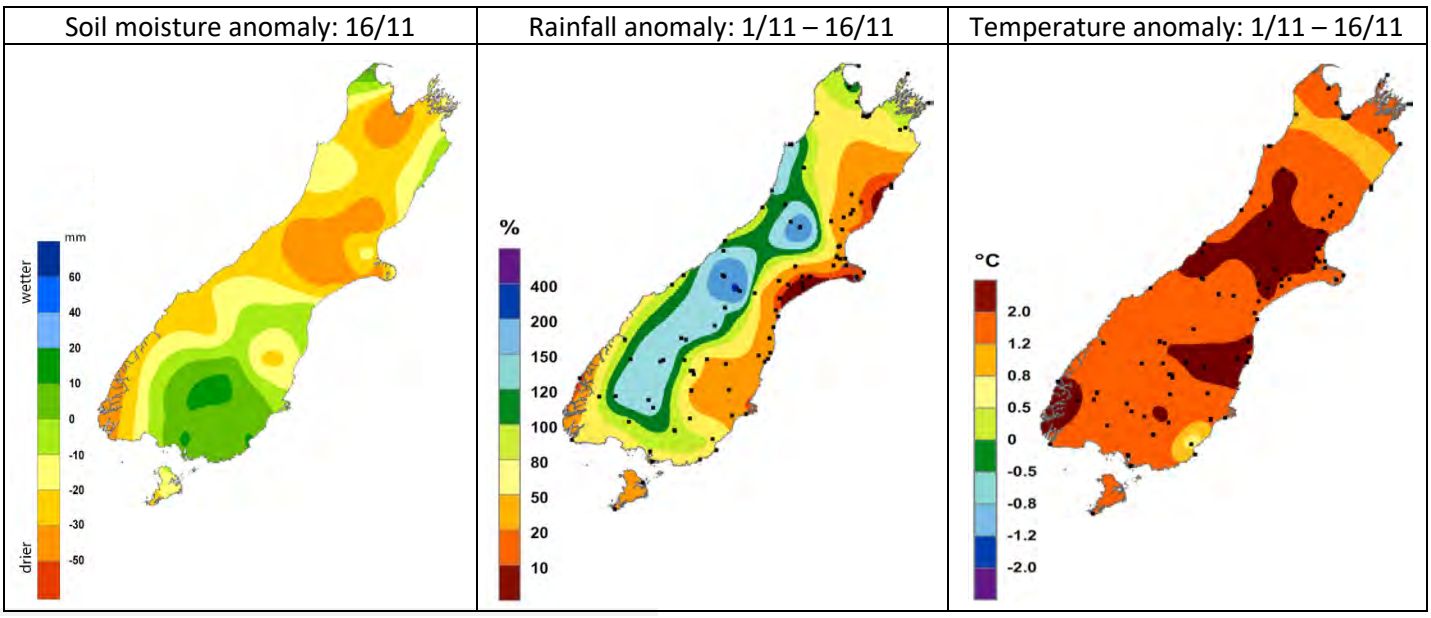


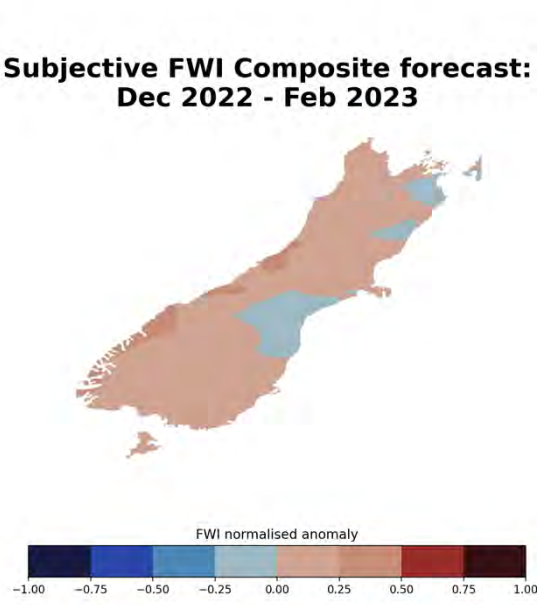
Figure 3: Maps showing the current soil moisture anomaly, as well as temperature and rainfall differences from normal since the start of the month.

Fire season analogues

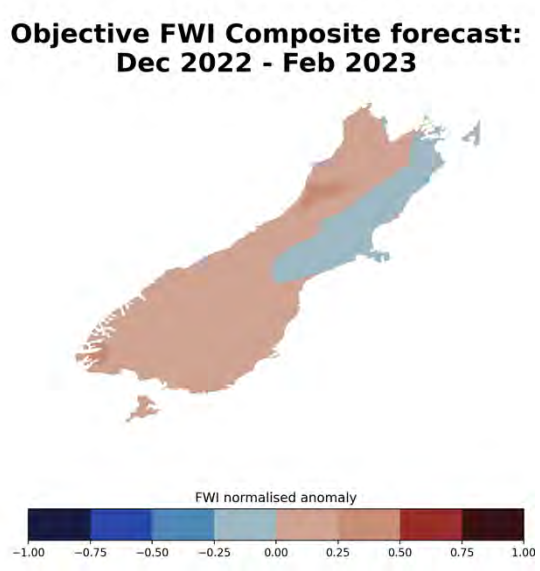
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

This season's analogue years featured historical years that had La Niña-like patterns in the ocean and/or atmosphere (Figure 4). The last two seasons (2020-21 and 2021-22) were both La Niñas. 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 mixed between the expert-selected years and the objective years for summer 2022-23. Much of the western and southern South Island is expected to have a higher fire danger than normal. Overall, this indicates that some regions will need to be prepared for elevated fire weather conditions. The subjective expert-selected guidance agrees more with La Niña-like patterns and is therefore favoured.



Forecaster-selected analogue season - Dec to Feb
2021-22
2016-17
2005-06
2000-01
1999-00
1998-99
1995-96
1988-89



Machine-selected analogue season - Dec to Feb
2020-21
2014-15
2013-14
2011-12
2007-08
2001-02
1996-97
1980-81

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: December 2022

December's air flows are generally expected to be more easterly than normal, continuing the trend of recent months. This may result in normal or slightly above normal rainfall for northeastern areas. However, a strong dry signal is present for western and southern regions. Wind speeds are expected to be below normal for the South Island. Above average temperatures again appear very 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: December 2022 – February 2023

Guidance suggests that summer will exhibit more easterly winds than usual. Temperatures overall look to be warmer than average, especially in western regions (Figure 6). Rainfall looks to be near normal or above normal for the northeast and eastern South Island, although the strong signal for dry conditions remains in the west and south. Somewhat humid conditions look to persist in the east, although relative humidity is forecast to be slightly below normal in western areas. Wind speeds continue to look lower than normal. These climate anomalies continue to be well-aligned with La Niña conditions.

The tropical cyclone season for the Southern Hemisphere runs begins in November. On average, at least one ex-tropical cyclone passes within 550 km of New Zealand each year. This season the risk is considered near normal to elevated.

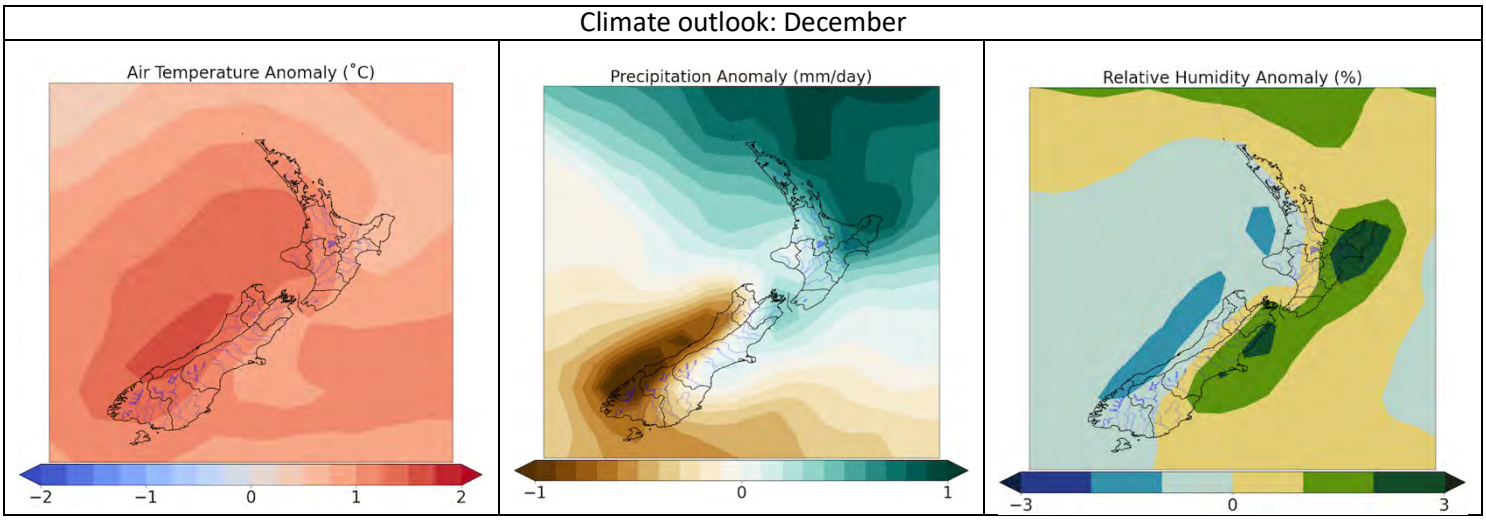


Figure 5: Climate outlook for December showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

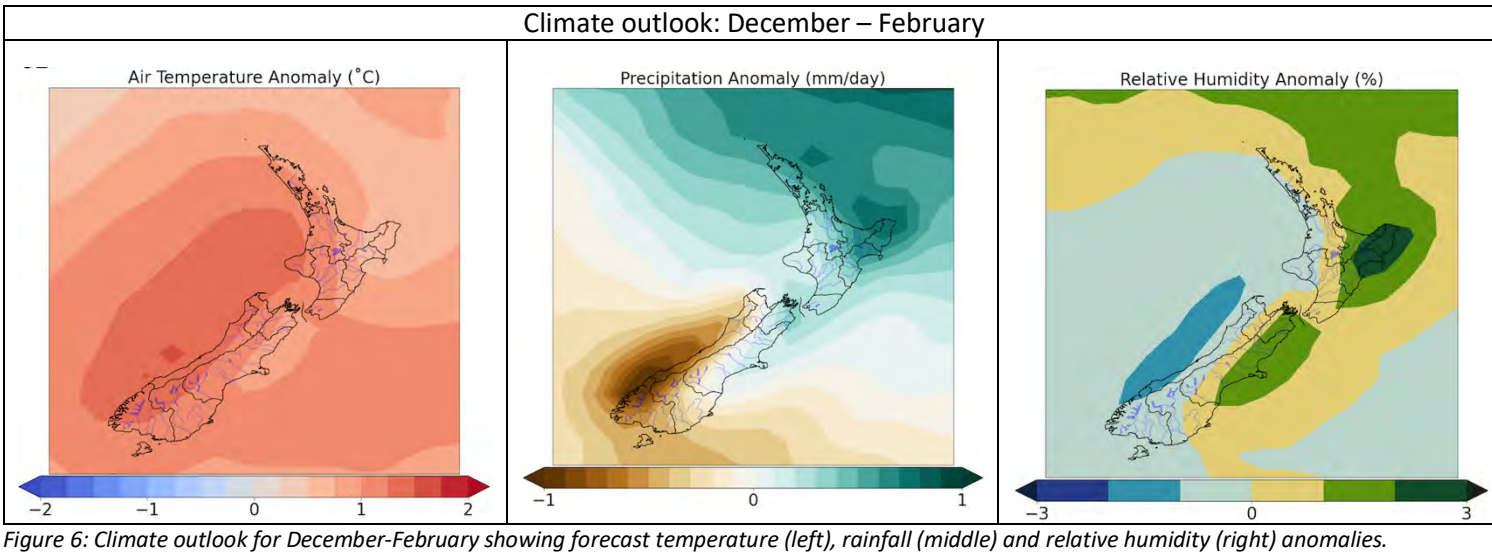


Figure 6: Climate outlook for December-February showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

Expected impact on fuels and fire danger

Fine fuel moisture is critically important to fire behaviour, with lower 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 be increased by warmer temperatures in most parts of the South Island, but this will be offset in the east by normal or above normal humidity and precipitation.

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.

Looking to December and beyond, the changing of the season will see increasing availability of medium, heavy and subsurface fuels as they dry out. The moisture of these fuels has less of an impact on fire spread rates, but as they dry the fuel availability increases resulting in greater fire intensity making suppression more difficult. The drying of these fuels is dependent on temperature, precipitation and to some degree humidity. The outlook above indicates that the medium and heavy fuel availability will likely be slightly below normal in north eastern areas but potentially about or greater than normal in the west and south.

The net effect of the climatic outlook is that western and western parts of the South Island (Westland, Fiordland and Southland) are likely to have normal or slightly higher than normal fire dangers while the eastern parts experiencing increased easterly wind flows (coastal Marlborough/Kaikoura and Northern Canterbury) 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, including in the east. It should also be noted that although eastern parts are not expected to have higher than normal fire danger, their usual summer fire dangers are still relatively high.

Grass growth & curing

Most fires start in fine fuels such as grass, 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 South Island has experienced good growing conditions over the past few months, with a relatively warm winter and abundant spring rainfall. As a result, we can expect increased grass fuel loads in many areas, especially where grazing has not kept up with grass growth. As the summer progresses, these grass fuels will die off and dry out. This seasonal “curing” of grasses has already begun in some areas, although for the most part grass curing is still low, especially in managed pastures.

Curing for most pasture species occurs as a natural process with summer drying and seed set, the timing of which will vary between regions and seasons. As we move through spring, some areas will also have been subject to frost curing which causes a build-up of dead material over winter; this is then replaced by a green spring flush. This frost curing can result in higher than expected curing levels. Similarly, depending on grazing and pasture management, some grass species may also retain a “thatch” layer of dead material from the previous season. Some species, especially tussocks, also have lower moisture levels in their live foliage in order to survive severe winter frosts. This is why we often see tussock fires in the early spring. The temperatures will now be increasing, but the winter frost-cured or thatch material may still be present, elevating curing levels.

If they 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.

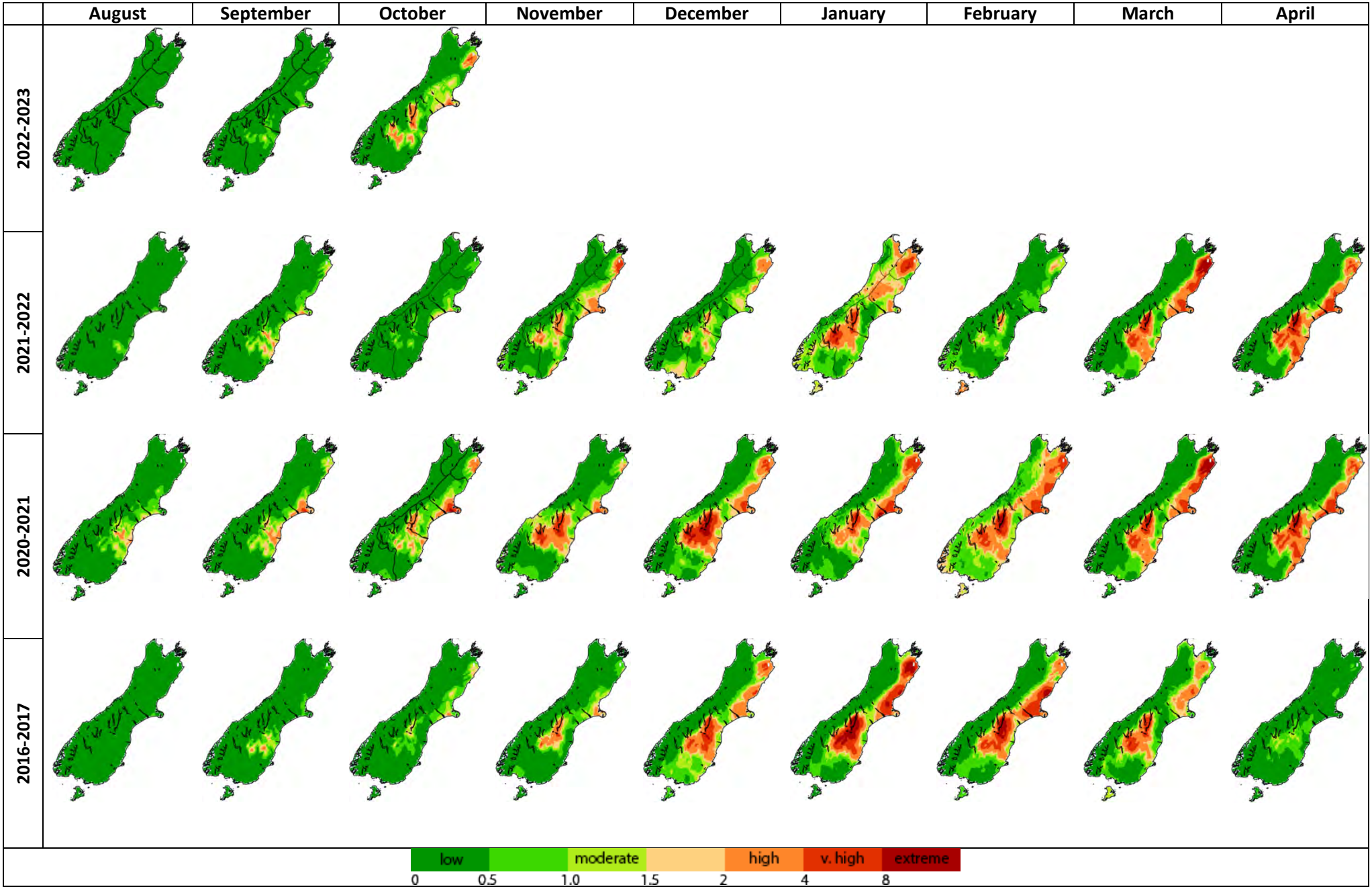


Figure 7: Monthly average severity rating for 2022-2023 up to and including October and the comparative years of 2021/2022, 2020/2021, and 2016/2017. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

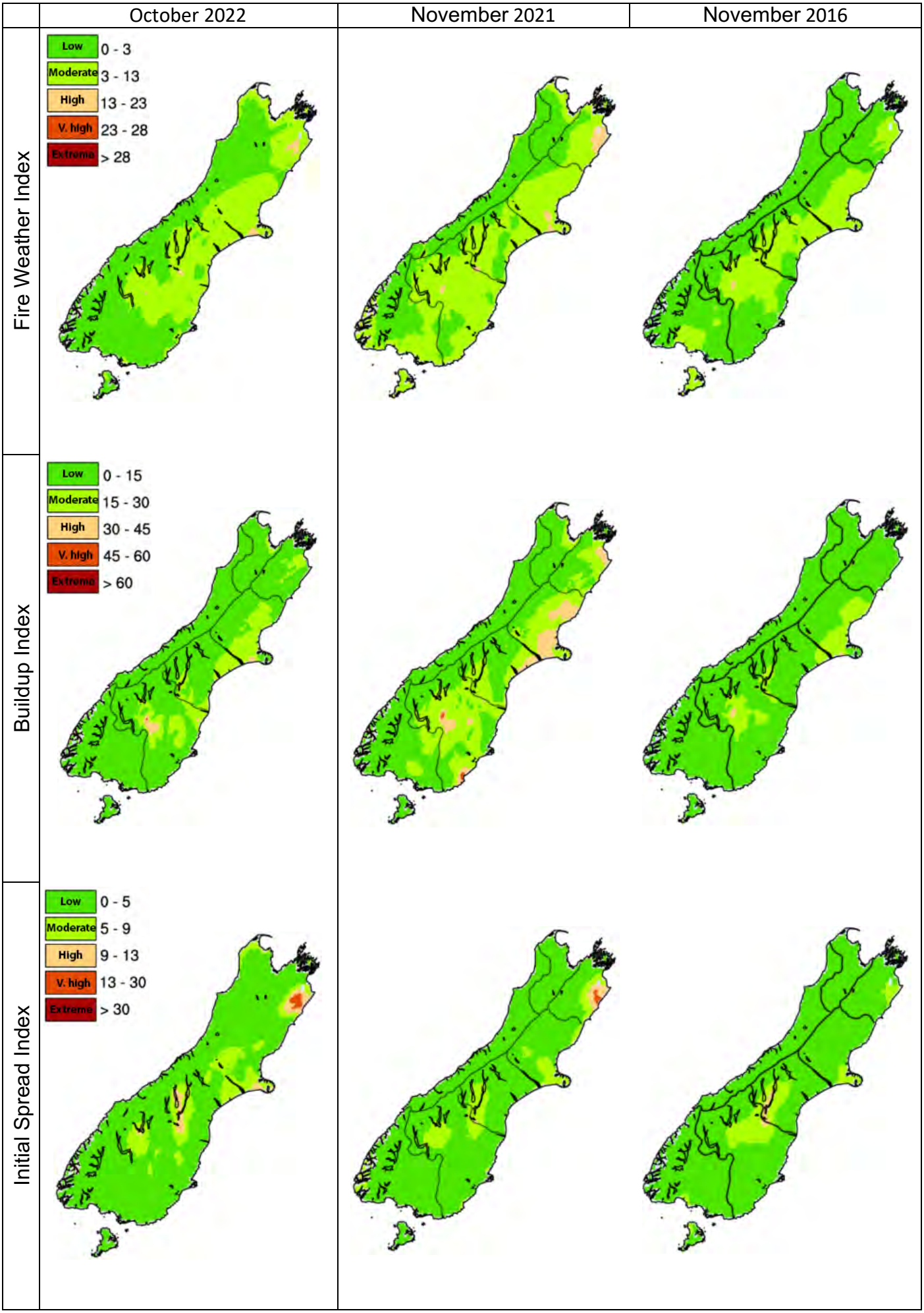


Figure 8: The most recent observed month (left column) and analogue months for November (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

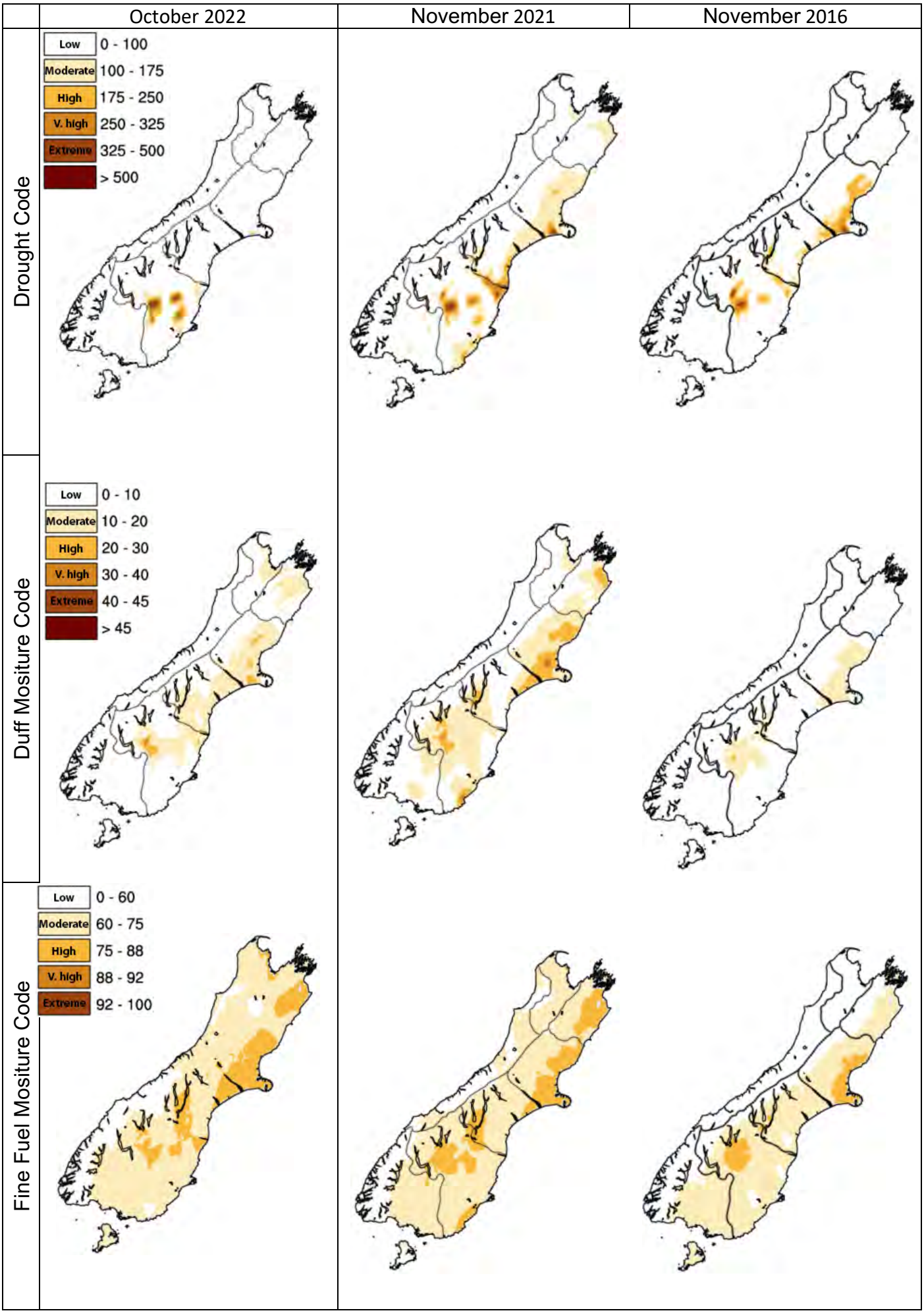


Figure 9: The most recent observed month (left column) and analogue months for November (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

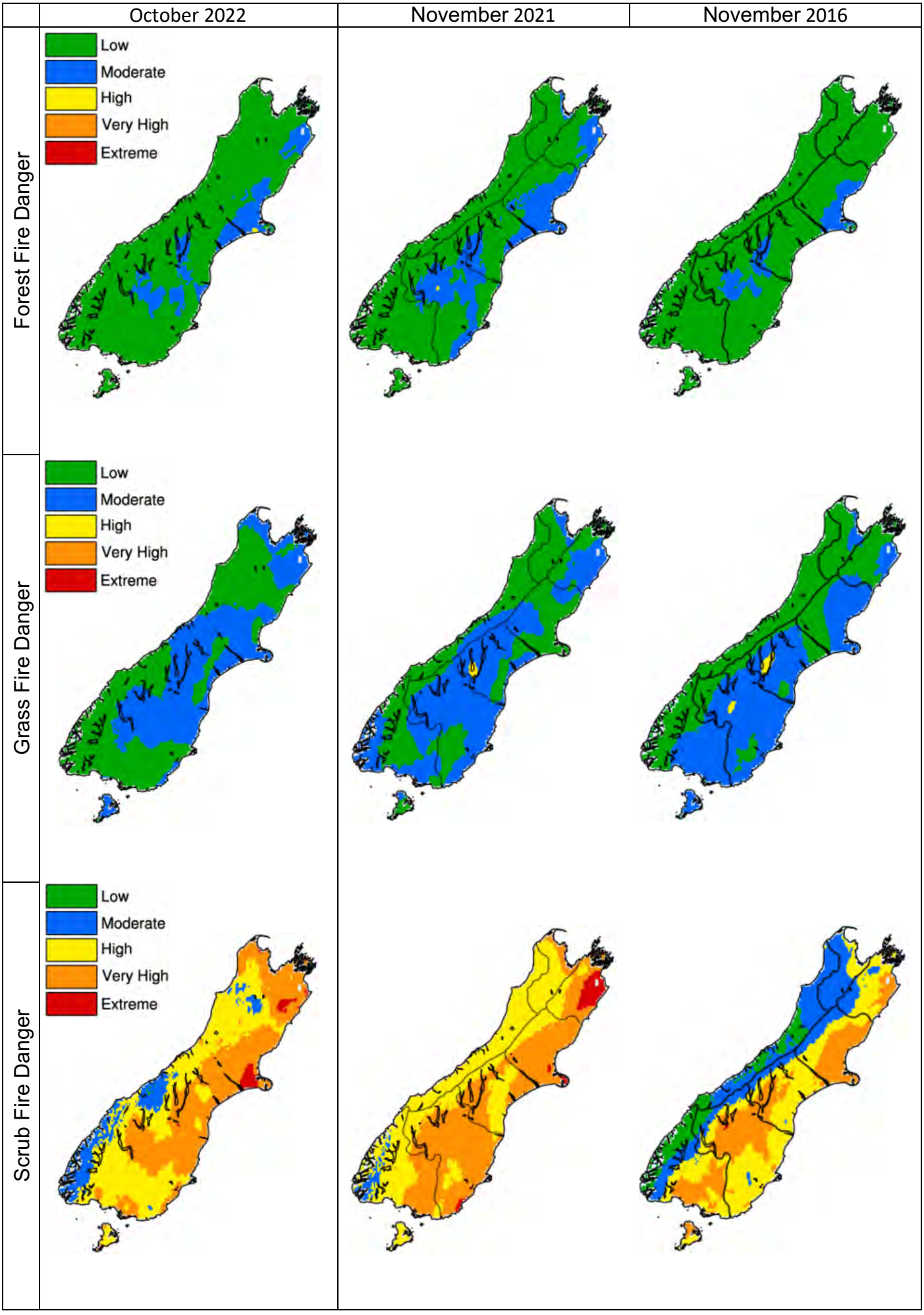


Figure 10: The most recent observed month (left column) and analogue months for November (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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