South Island Monthly Fire Danger Outlook (2021/2022 season)

Issue: December 2021

Current fire danger situation

In general, monthly fire dangers and fire climate severity are low across much of the South Island (Figures 8-11) following recent rainfalls. However, moderate conditions are still located in inland Otago and Southland, as well as parts of Canterbury. With the exception of Southland, this is not uncommon for these areas during the summer season.

Current fuel and soil moisture status

As of 15 December (Figure 4), soil moisture levels are near normal across most of the South Island. However, below normal soil moisture is located in coastal Southland, while above normal soil moisture is located in northern Tasman and Marlborough Sounds. Despite recent widespread rainfall across much of the island, "Dry" conditions remain at least for the moment in coastal Marlborough and northern Canterbury on the New Zealand Drought Index map.

Much of the South Island is currently experiencing low fire danger due to low Fire Weather System Codes and indices (BUI, DC, DMC and FFMC – refer to appendix for definitions) that have resulted from recent rainfall events. The lower DC and DMC values mean moderate, heavy and subsurface fuels will generally not be available to burn. There are however areas shown in Figure 1 around Otago and Southland where BUI values indicate drier conditions and moderate to high fuel availability (although these areas are drier than others, only some are drier than normal for this time of year).

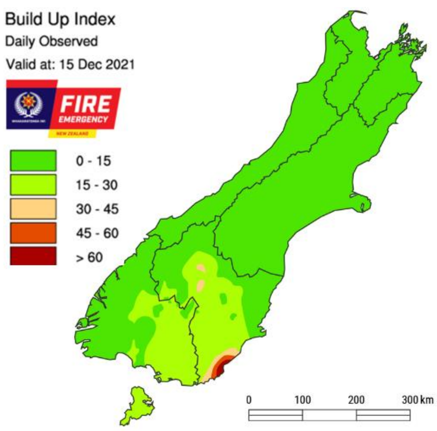


Figure 1: Map of Build-up Index (an indicator of the amount of fuel available to burn in a forest based on their expected moisture content) for the South Island.

Fine fuels may be damp in many areas following recent precipitation, but can and have been drying out quickly with wind and warmer temperatures when rain is not present. Periods with elevated fine fuel dryness can occur between rain events, as shown in the example of fluctuating FFMC (Fine Fuel Moisture Code) over the past month from South Canterbury (Figure 2). Frequent rain may also have resulted in delaying the typical grass curing cycles in some areas, keeping grass curing percentages lower than normal for this time of the year in parts.

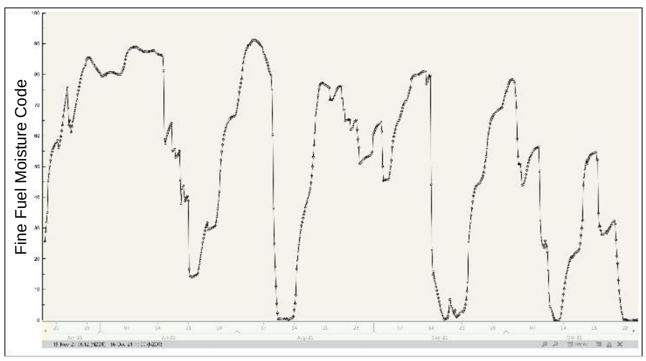


Figure 2: Graph of hourly Fine Fuel Moisture Code values for the past month based on observed weather for the Albury Raws.

Forecast climate and weather

Late December may feature a series of fronts bringing rain to the West Coast and lower South Island, with drier conditions in the east. In January, more easterly wind flows than normal are expected. This may result in near average or above average rainfall in northern areas, with Otago, Southland, and the West Coast potentially drier than normal. Overall, wind speeds are expected to be below normal, with above average or well above average temperatures.

Looking into late summer and early autumn, La Niña conditions are likely to continue, with generally easterly winds and above average temperatures. Drier than normal conditions will continue to be favoured in the south and west. For more information, see pages 3 and 4.

What to watch for

- Areas of Southland, Central Otago and North Canterbury that have received little recent precipitation compared to other parts.
- Southern and Western areas which are likely to receive higher than normal fire dangers in the coming months.
- Areas where abundant spring grass growth has resulted in greater fuel loads heading into summer when they become cured (with increased dead and brown material). Grass curing may be delayed, but will still occur in many areas.
- When eastern parts of the island that are subject to strong NW winds (expected to be less common this season).
- Complacent behaviours resulting from the recent rainfall events and mild early summer fire danger conditions, and some property owners may have delayed burns due to the wet spring.
- Fire can still occur in light fuels such as scrub, especially during warm sunny and/or windy periods.

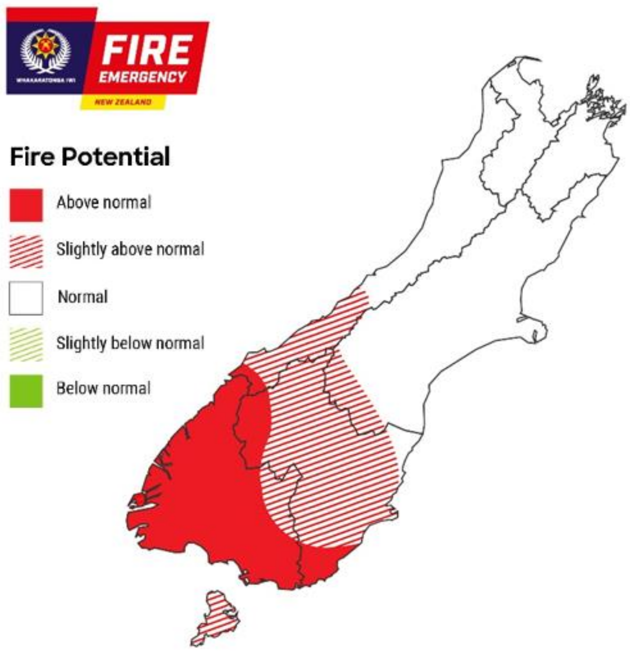


Figure 3: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

Fires such as this in light flashy fuels like scrub vegetation do not require extended dry periods and are not uncommon in spring and early summer.

Current climate

November 2021 was New Zealand's warmest November on record, surpassing November 2019. Temperatures were well above average (>1.2°C above average) across large portions of the upper, western, and lower South Island. Above average temperatures (0.5°C to 1.2°C above average) were observed across much of Canterbury, with small pockets of near average temperatures (±0.5°C of average) in Banks Peninsula and interior Otago. This trend for above average temperatures has continued in the first half of December, especially along the West Coast (Figure 4, right).

November rainfall was above normal (120-149% of normal) or well above normal (>149% of normal) across the northern West Coast, southern Canterbury, interior Otago, and parts of Fiordland. Below normal (50-79% of normal) or well below normal (<50% of normal) rainfall was observed in Nelson, Marlborough, and northern and central Canterbury. For the first part of December (Figure 4, middle), well above average rainfalls (>149%) have occurred in the north and west, but rainfall was below normal in the southwest and well below normal (<20%) in coastal Southland and north Canterbury.

Soil moisture levels are currently near normal across most of the South Island (Figure 4, left). However, below normal soil moisture is located in coastal Southland, while above normal soil moisture is located in northern Tasman and Marlborough Sounds.

Climate drivers

The NINO3.4 Index anomaly (in the central Pacific) during November (through the 28th) was -0.59˚C. The Southern Oscillation Index (SOI) was +1.1 during November, both near the La Niña threshold. The three-month average SOI was +0.9.

During November, upper-oceanic heat content was well below normal in the central and eastern equatorial Pacific as a full-basin La Niña signature matured. Modest cool anomalies persisted in the sub-surface, although the coolest water relative to normal has now surfaced or is surfacing. From an oceanic perspective, La Niña will likely peak over the next month.

Convective forcing was focused over Africa, the eastern Indian Ocean, Maritime Continent, and far western Pacific during November, indicative of the atmospheric response to La Niña.

In addition to the oceanic and atmospheric trends described above, New Zealand's local weather patterns have been consistent with La Niña, with more northeasterly winds than normal. Therefore, NIWA has classified a La Niña event, with an 85% chance of it continuing through the summer season.

La Niña will be the dominant climate driver during the current fire season. La Niña is often associated with more northeasterlies during summer, but each La Niña event comes with unique characteristics.

Marine heatwave conditions have become established in New Zealand's coastal waters during the first half of December. Climate models indicate that unusually warm seas will continue to be a factor this summer, with the potential for marine heatwave conditions through January in particular. This is expected to have a strong upward influence on air temperatures and humidity and may provide more moisture for weather systems to tap into as they approach the country.

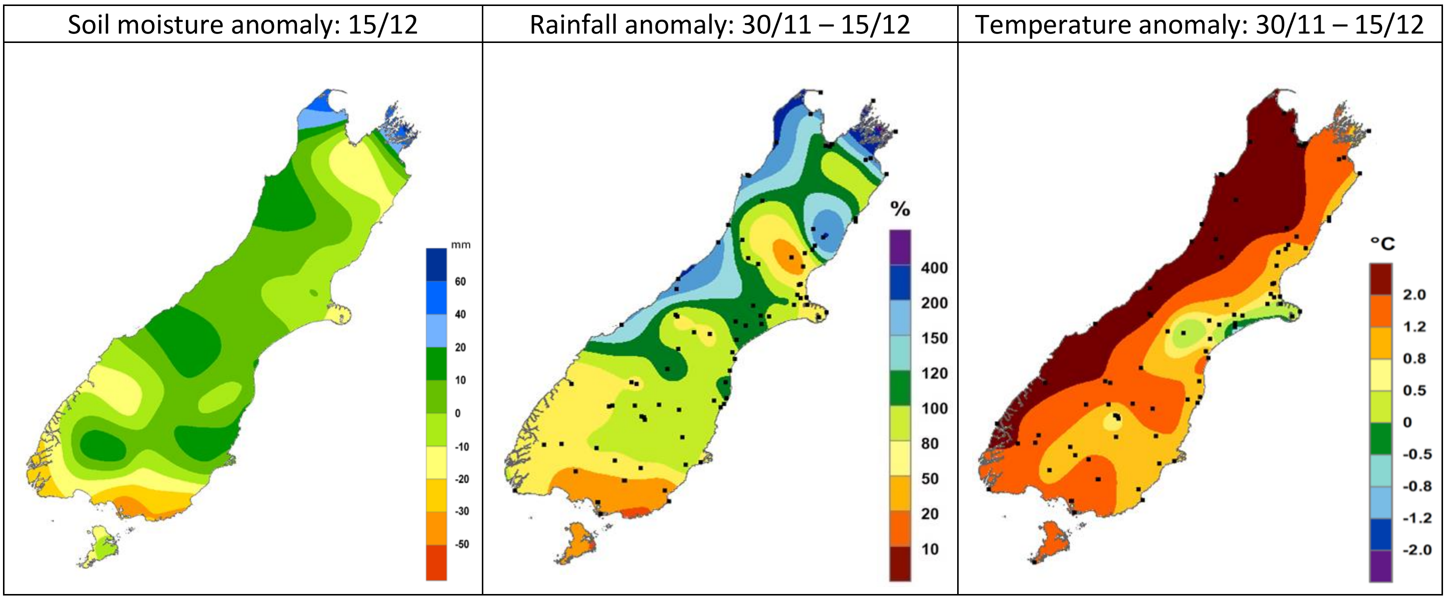


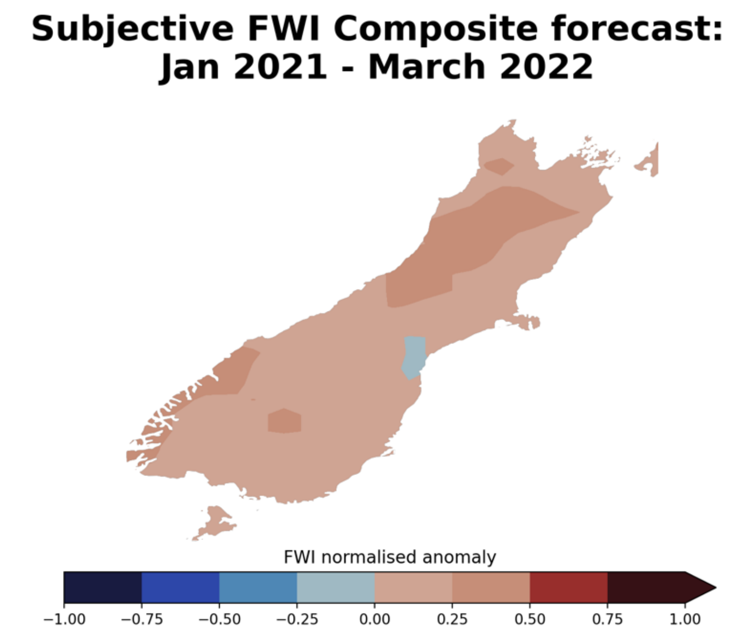
Figure 4: Maps showing the current soil moisture anomaly as well as temperature and rainfall differences from normal since the start of the month.

Fire season analogues

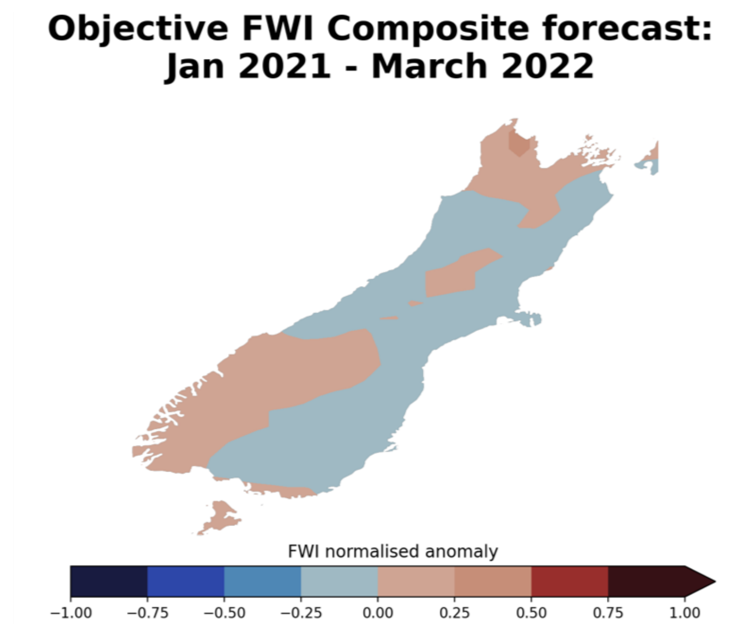
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

This summer's analogue years featured historical years that had La Niña-like patterns in the ocean and/or atmosphere (Figure 3). 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 summer with higher fire weather indices relative to the long-term average across nearly all of the South Island. 2020 is one of the strongest analogues, placing 1st on the forecaster-selected analogue list (top) and 3rd on the computer-selected analogue list (bottom). This season featured drought conditions in parts of the South Island. Overall, it's a sign that many 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 - Dec to Feb
2020
2008
2001
2000
1999
1996
1989
2002



Machine-selected analogue season - Dec to Feb
1968
2007
2020
2012
1965
1956
1997
2014

Figure 5: Analogue fire seasons as selected with expert interpretation from NIWA (top) and automated computer analysis (bottom). The fire weather index is a combination of the initial spread index and build-up 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 fire weather index between 1991-2020 for relevant season.

Climate outlook: January

January's air flows are generally expected to be easterly, which would favour drier than normal conditions across the western and southern South Island, although potentially wetter than normal in the upper South Island. Overall, wind speeds are expected to be below normal in January, with above average temperatures very likely (especially in the west and south). Relative humidity is forecast to be higher than normal in northeastern areas, but below normal in the south and west.

Climate outlook: January - March

Mid-summer to early autumn is expected to have more easterly winds than normal. Above average temperatures are likely, particularly in the western South Island. Rainfall looks to be below normal in the south and west, but perhaps near to above normal in the upper South Island. Hot conditions will be common, with relative humidity forecast to be below normal in western and southern areas. Wind speeds continue to look lighter than normal. These climate anomalies are well-aligned with La Niña conditions.

The tropical cyclone season for the Southern Hemisphere runs from November 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.

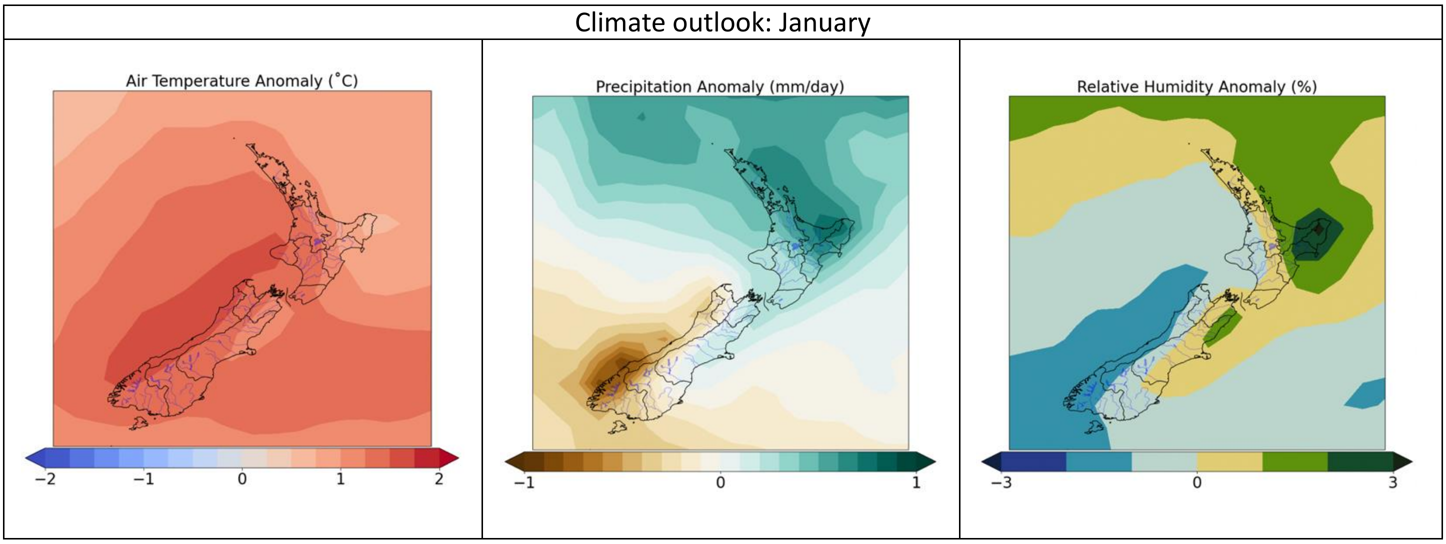


Figure 6: Climate outlook for January showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

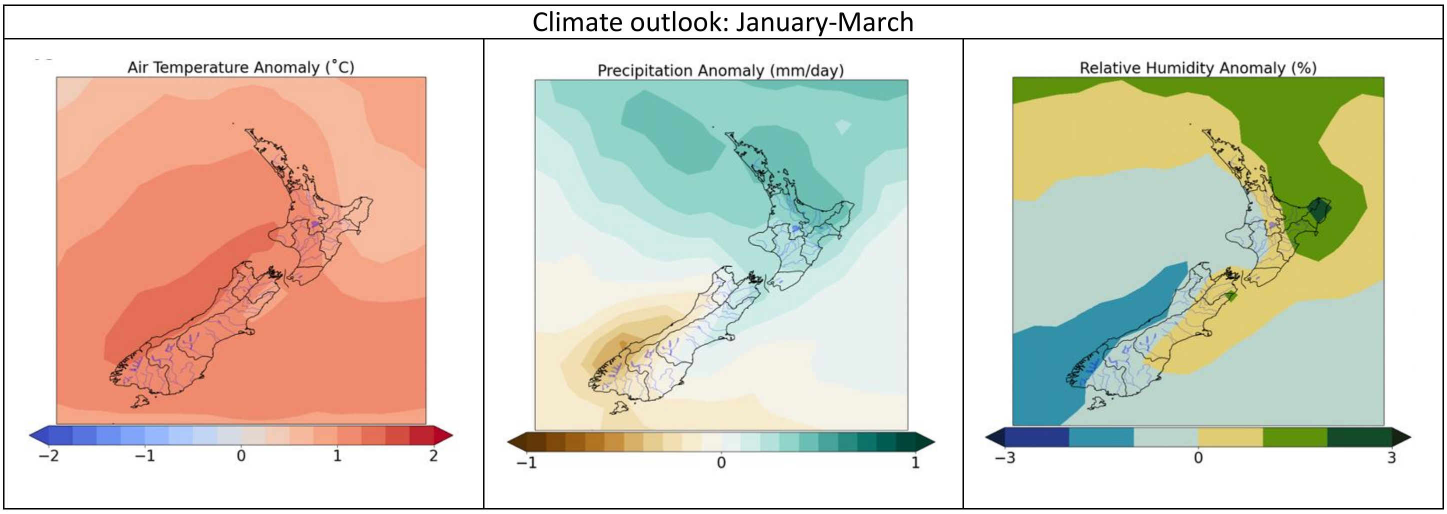


Figure 7: Climate outlook for January-March showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

Expected impact on fuels and fire danger

Fine fuel moisture is critically important to fire behavior 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 is expected to be offset in the northeastern parts of the island by normal or above normal and humidity.

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 higher than normal FFMC values in the west and south as described above. It is also anticipated that the strong, hot, dry NW foehn winds that affect eastern areas of the South Island will be less frequent this season.

Looking to January 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 about or below normal in the north and east but are likely to be about normal or slightly above normal in the south and west, and for inland areas of central Otago and Southland.

The net effect of the climatic outlook is that southwestern and inland areas of the South Island are likely to have normal or above normal fire danger. Conversely, northern and eastern areas of the South Island are expected to receive more humidity and precipitation with the easterly wind flows and have about normal or below normal fire danger. There will however still be periods when the westerly flows return and, if these are strong and not accompanied by precipitation, they are likely to result in periods of elevated fire danger. It should also be noted that although eastern parts are not expected to have higher than normal fire danger, their normal fire danger is relatively high.

While fire dangers for grass and forest fuels are typically low, scrub fuels respond very quickly and can produce extreme fire behaviour within relatively short periods since recent rain. Vigilance therefore needs to be maintained around communities and high value sites where the prevailing surrounding fuel is scrub.

Grass growth & curing

Most of the North Island has experienced good growing conditions. A warm winter/spring with average or above average rainfall has made for good growing conditions, from which we can expect many areas will have increased fuel loads, especially where grazing has not kept up with the grass growth.

Grass fuels will generally only burn in exceptional conditions (low humidity and high winds) if they are less than 50% cured, i.e. less than 50% brown or dead material present. Subject to weather and topography influences, grass fire ease of ignition, intensity and spread rates increase steadily as the curing percentage increases. A fire in <50% cured grass produces very slow-moving fires and small flames, whereas >90% cured grass is able to produce extreme flame lengths and fire intensities.

Curing for most pasture species occurs as a natural process with seed set and summer drying, the timing of this will vary between regions, seasons and grass types. Some areas will also be subject to frost curing where there is a build-up of dead material over winter which is then replaced by a green spring flush. The temperatures will now be increasing but the winter frost cured material may still be present.

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 be monitored closely as a critical factor in assessing fire danger.

Example of an escaped burns in relatively mild conditions that could have been avoided with careful supervision and basic tools to control the spread of fire.

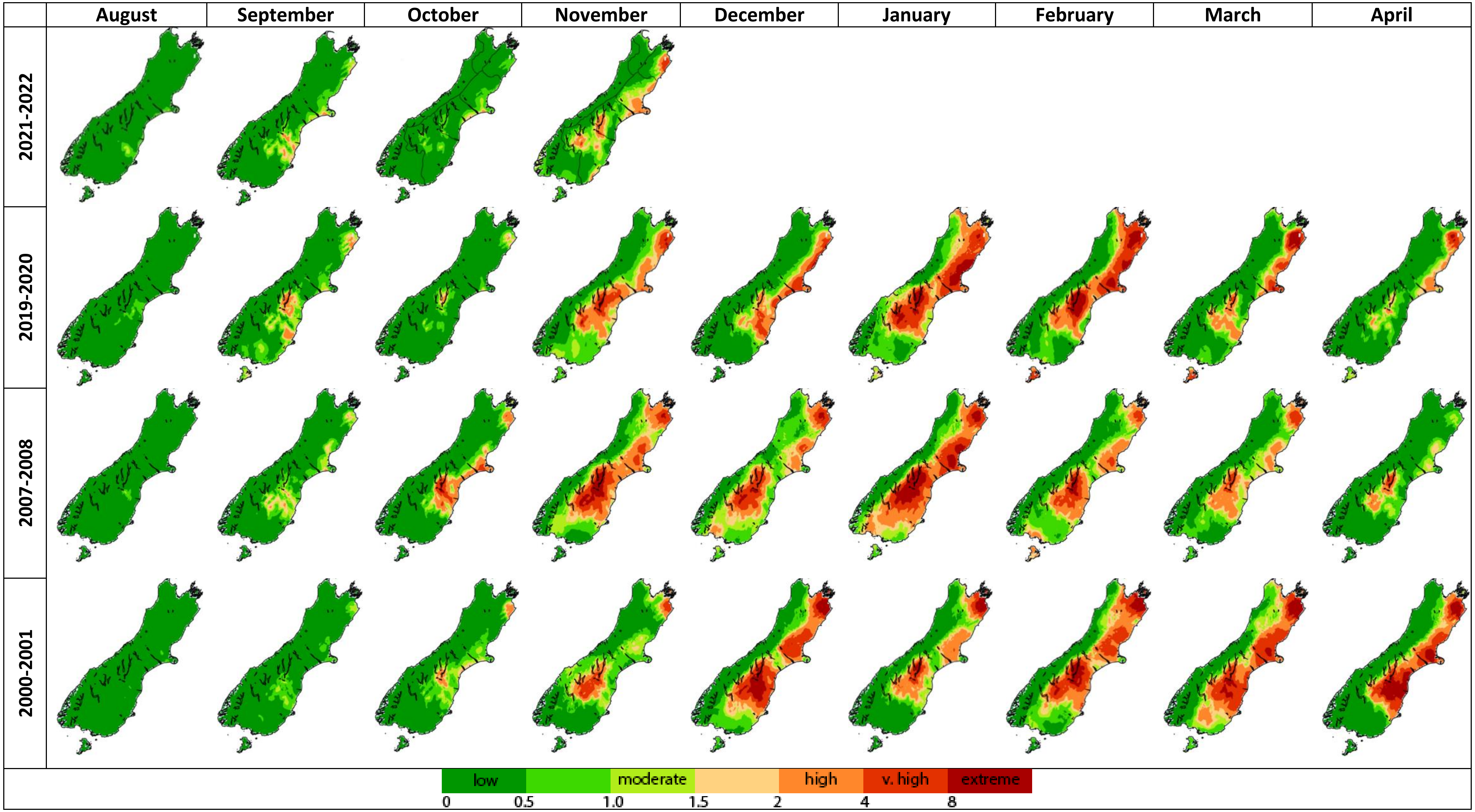


Figure 8: Monthly average severity rating for 2021-2022 up to and including November and the comparative years of 2019/2020, 2007/2008 and 2000/2001. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

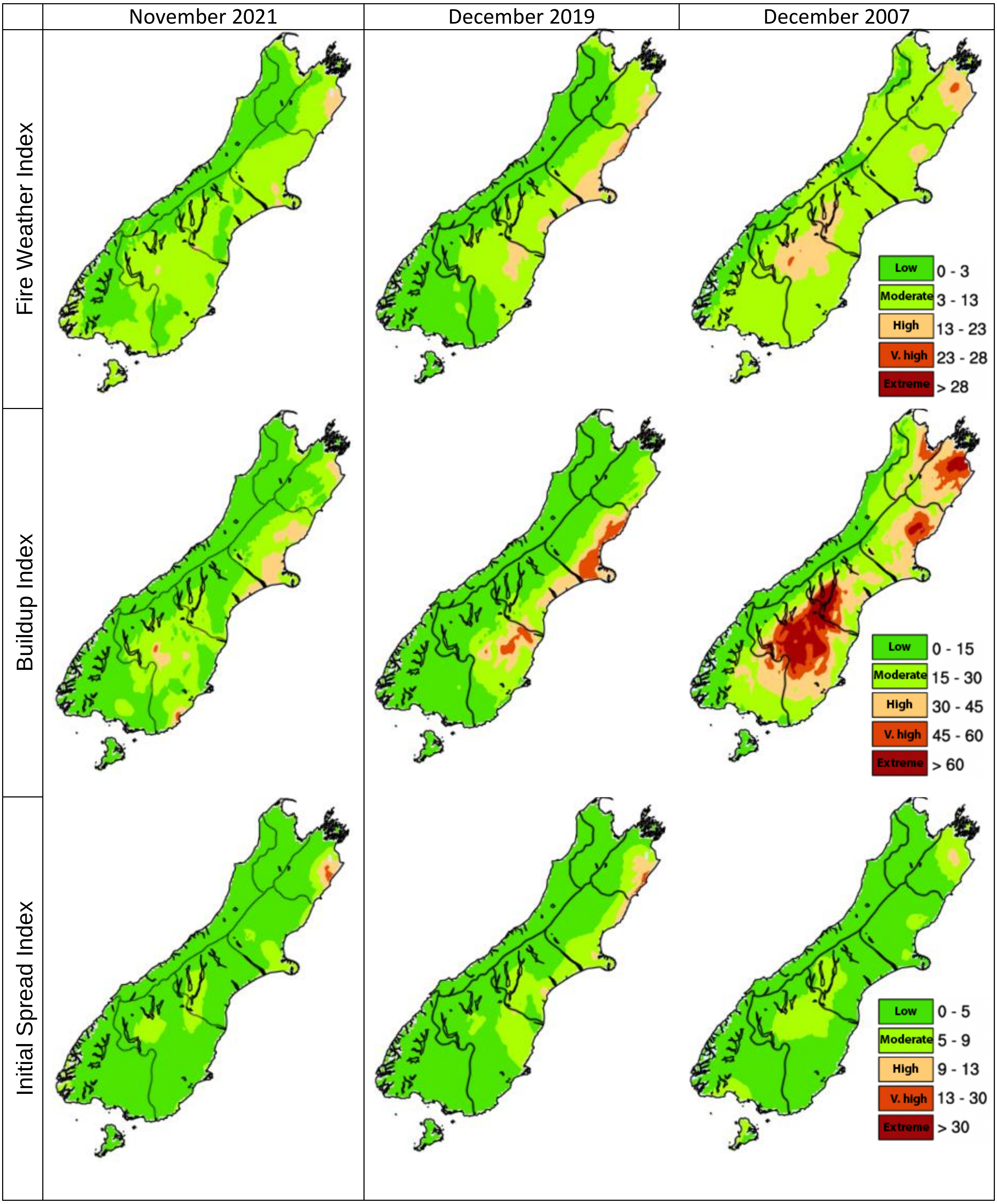


Figure 9: The most recent observed month (left column) and analogue months for December (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

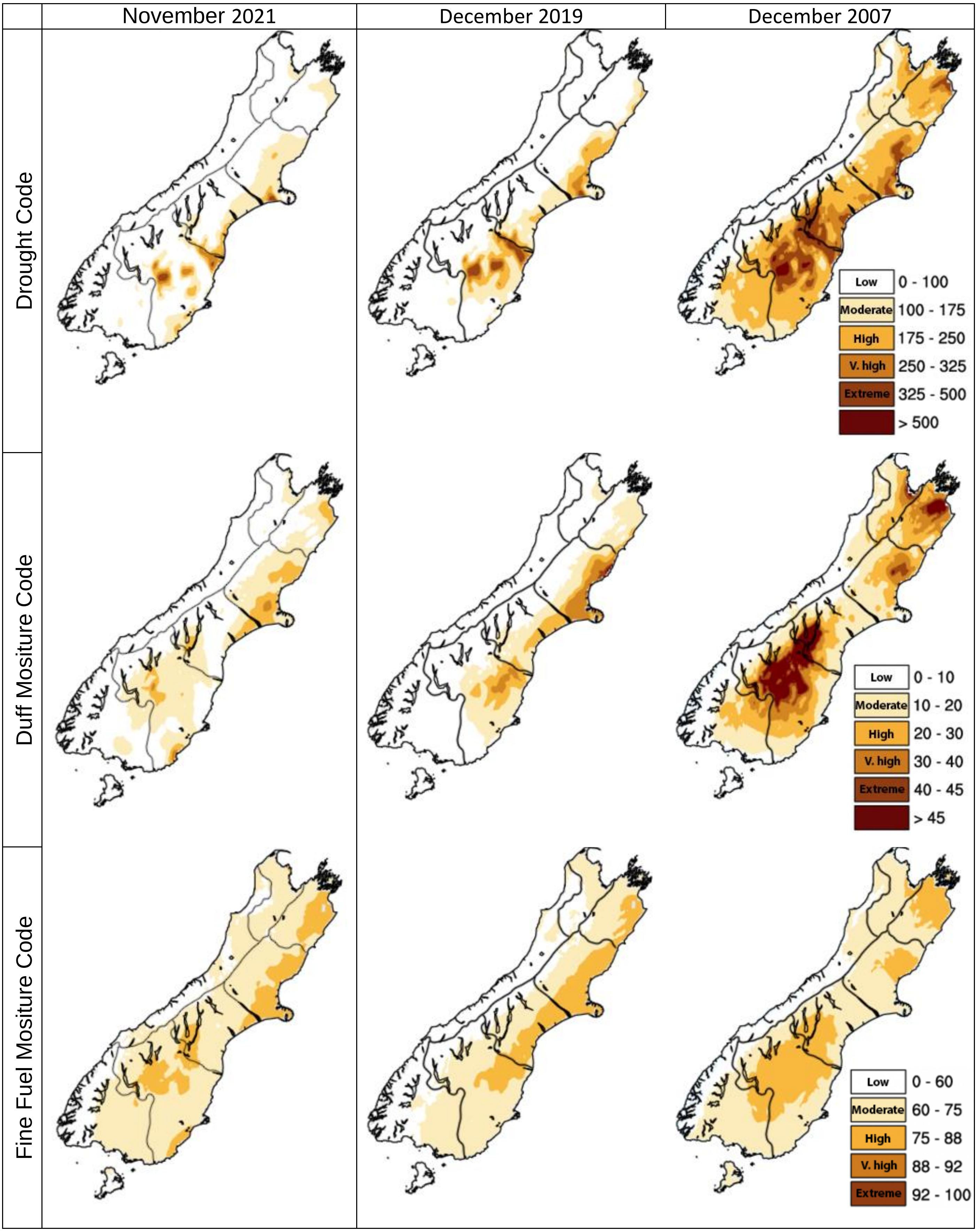


Figure 10: The most recent observed month (left column) and analogue months for December (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

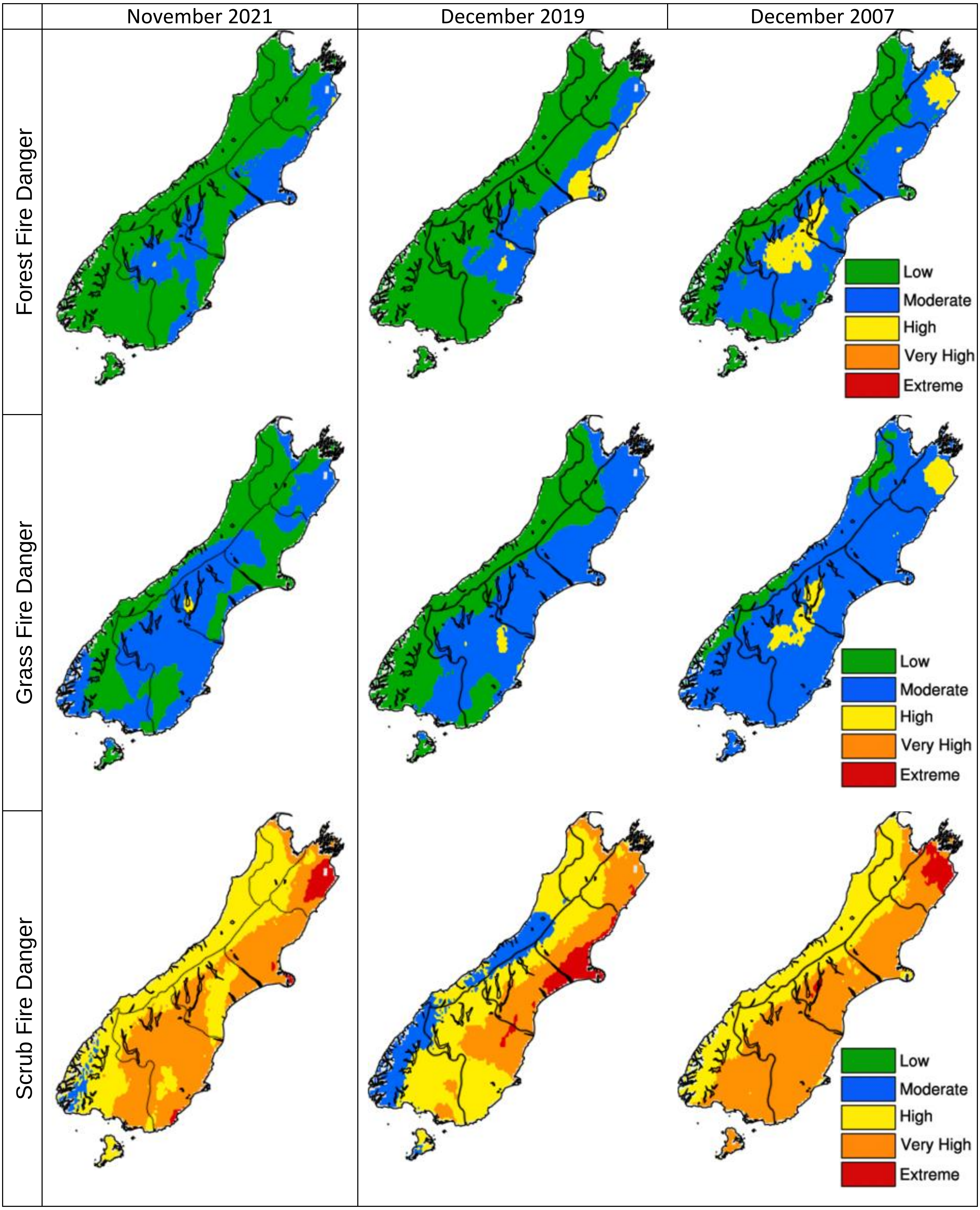


Figure 11: The most recent observed month (left column) and analogue months for December (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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

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 mopup needs
11-20	Moderate
21-30	Difficult
31-40	Difficult & extended
41+	Extreme & extensive

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 mopup needs
101-175	Moderate
176-250	Difficult
251-300	Difficult & extended
301+	Extreme & extensive

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

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

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

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.

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