

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

## Issue: September 2021

### Current fire danger situation

In general, monthly fire dangers and fire climate severity are low across much of the South Island (Figures 6-9). The exceptions being Canterbury and Otago where moderate conditions exist. With the occasional elevated spike day occurring during the recent wind event

### Fuel and soil moisture status

Figure 2 shows that as of 19 September, soil moisture levels for the time of year are near normal for the majority of the South Island. Exceptions include eastern parts of the island from about Christchurch to near Blenheim as well as from Dunedin through to Central Otago where soil moisture higher than normal for the time of year. A small area of drier than normal soils, for the time of year, is evident over the Waitaki District.

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 appendix for definitions) that result from winter precipitation, and lower temperatures (slower drying rates). The Lower DC and DMC means moderate, heavy or subsurface fuels will generally not be available to burn. There are however a number of areas between Canterbury and Otago where the DMC and DC indicate drier conditions and moderate to high fuel availability. These fuels are likely to continue to dry through coming months, resulting in potential for deep seated burning and higher intensity fires due to greater fuel availability.

### Forecast climate and weather

Late September is expected to bring periods of unsettled weather to the South Island, with heavy rain possible for the west of the South Island. High pressure is likely during the last few days of the month, continuing into early October. The frequency of fronts and windiness during October may be reduced compared to September, but there will still be disturbed weather at times. Looking later into the spring season, a La Niña event has a 50-60% chance for development. La Niña tends to bring more

northeasterly winds to New Zealand with wetter conditions in the north and east and drier conditions in the south and west. However, last summer's La Niña was an exception. For more information, see page 3&4.

### What to watch for

Parts of Northern Otago and Southern Canterbury where drying is a head of normal, elevated forest fire dangers are likely. Areas where winter grass growth has resulted in greater fuel loads heading into summer when they become cured (with increased dead and brown material). When the Island is subject to strong NW winds. Likely to be common late Sept early October but will occasionally return through the early summer months.

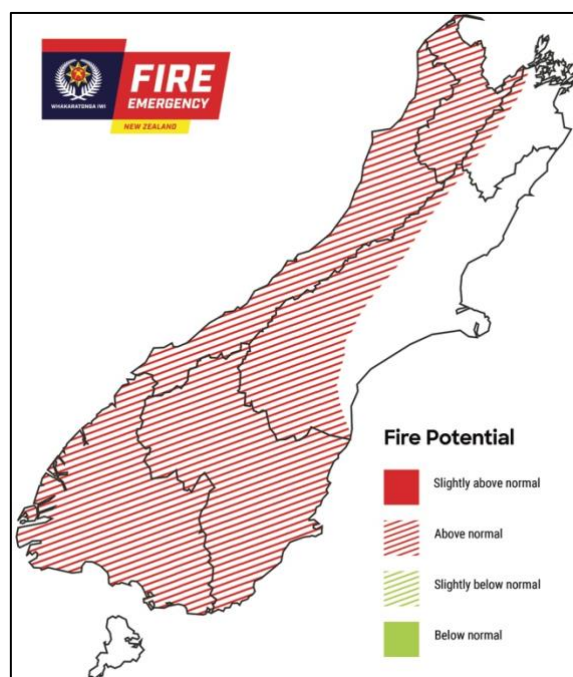


Figure 1: Locations identified as areas of interest that may develop an elevated risk of high to extreme fire danger over the next three months.

## Current climate

Winter 2021 was New Zealand's warmest winter on record. Average or below average temperatures have occurred so far in September for the northern half of the South Island, with average or above average temperatures for the southern half of the island.

August was dry month for coastal Canterbury and (south of Christchurch) and northern Otago where below normal (50-79%) or well below normal (<50%) rainfall occurred. However, above normal (120-149%) or well above normal (>149%) August rainfall was observed in southern and western Southland, inland Otago, coastal North Canterbury, Marlborough, Nelson and Tasman regions.

Soil moisture levels for the time of year are near normal for the majority of the South Island. Exceptions include eastern parts of the island from about Christchurch to near Blenheim as well as from Dunedin through to Central Otago where soil moisture higher than normal for the time of year. A small area of drier than normal soils, for the time of year, is evident over the Waitaki District.

## Climate drivers

A mix of climate drivers have affected the weather during September. Westerly and northeasterly winds have brought numerous fronts and low-pressure systems to the country, which are expected to continue into late September before giving way to high pressure before the end of the month. A trend toward more high pressure is likely during October as fronts become less frequent, however there will still be unsettled conditions at times.

During August, upper-oceanic heat content decreased across the equatorial Pacific for the third consecutive month. The distribution of anomalies is currently closest to a central Pacific type of La Niña, similar to that of this time last year. A negative Indian Ocean Dipole, referring to well above average sea surface temperatures in the tropical eastern Indian Ocean, continued during September. An Atlantic Niño, characterised by warmer than average ocean temperatures in the central and eastern equatorial Atlantic, also persisted.

These teleconnections, or climate patterns related to one another across long distances, support an ocean-atmosphere system that is likely to continue to trend in a La Niña-like direction. La Niña or El Niño Southern Oscillation "cool" neutral conditions are about equally likely (45-50% chance each) during spring before the chance for La Niña peaks at 50-60% during summer.

If La Niña develops, it will become a dominant climate driver during the upcoming fire season. La Niña is often associated with more westerlies over New Zealand during spring and north-easterlies during summer, but each La Niña event comes with unique characteristics.

La Niña events tend to bring warmer temperatures and more moisture/humidity to the northern and eastern parts of both islands, although last summer was an exception.

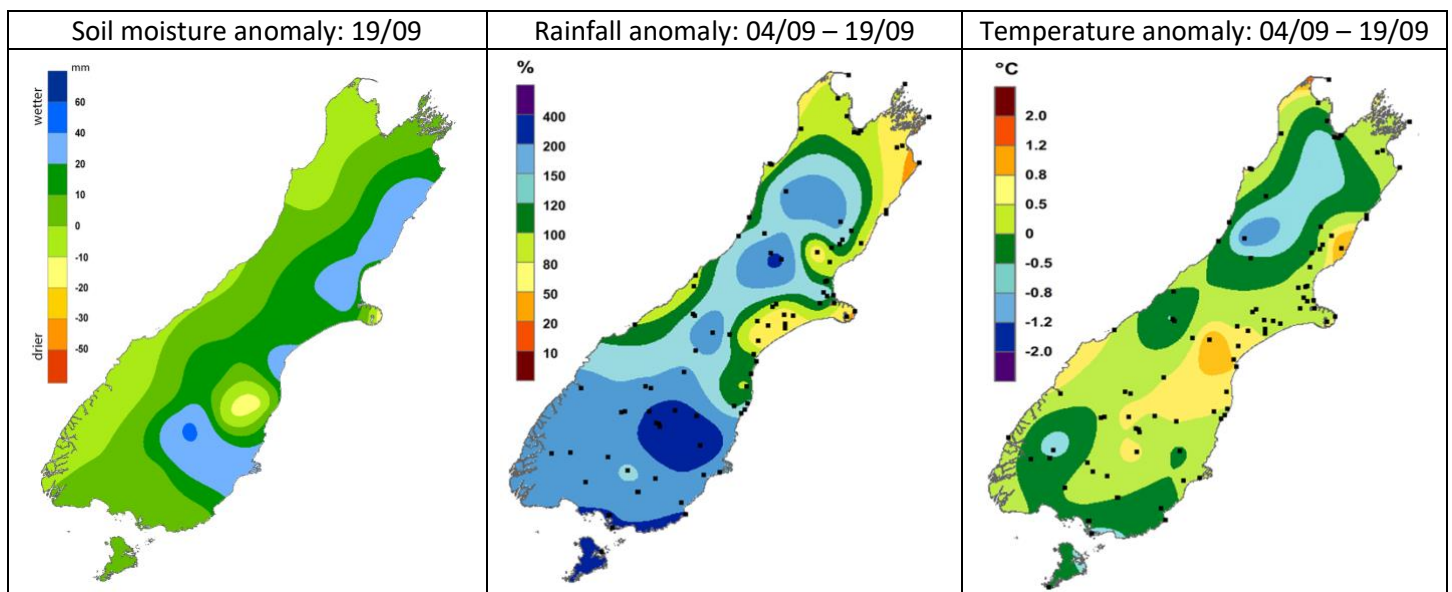


Figure 2: Maps showing the current soil moisture anomaly as well as temperature and rainfall as a difference from normal over the last 15 days.

## 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. The analog seasons on the left are selected with expert interpretation from NIWA. The analog seasons on right are automatically selected via a computer analysis. Where the two methods agree, confidence tends to be higher.

The early signal is for a summer with higher fire weather indices relative to the long-term average, for much of the South Island, in particular, western and southern areas of the island. Summer 2020-21 is one of the strongest analogues, placing 1<sup>st</sup> on the forecaster-selected analog list (left) and 4<sup>th</sup> on the computer-selected analog list (right). Also, high up the analog ranking is 2012-13 and 2007-08. Overall, it's an early sign that many regions across the island will need to be prepared for longer dry periods that can enhance fire weather conditions.

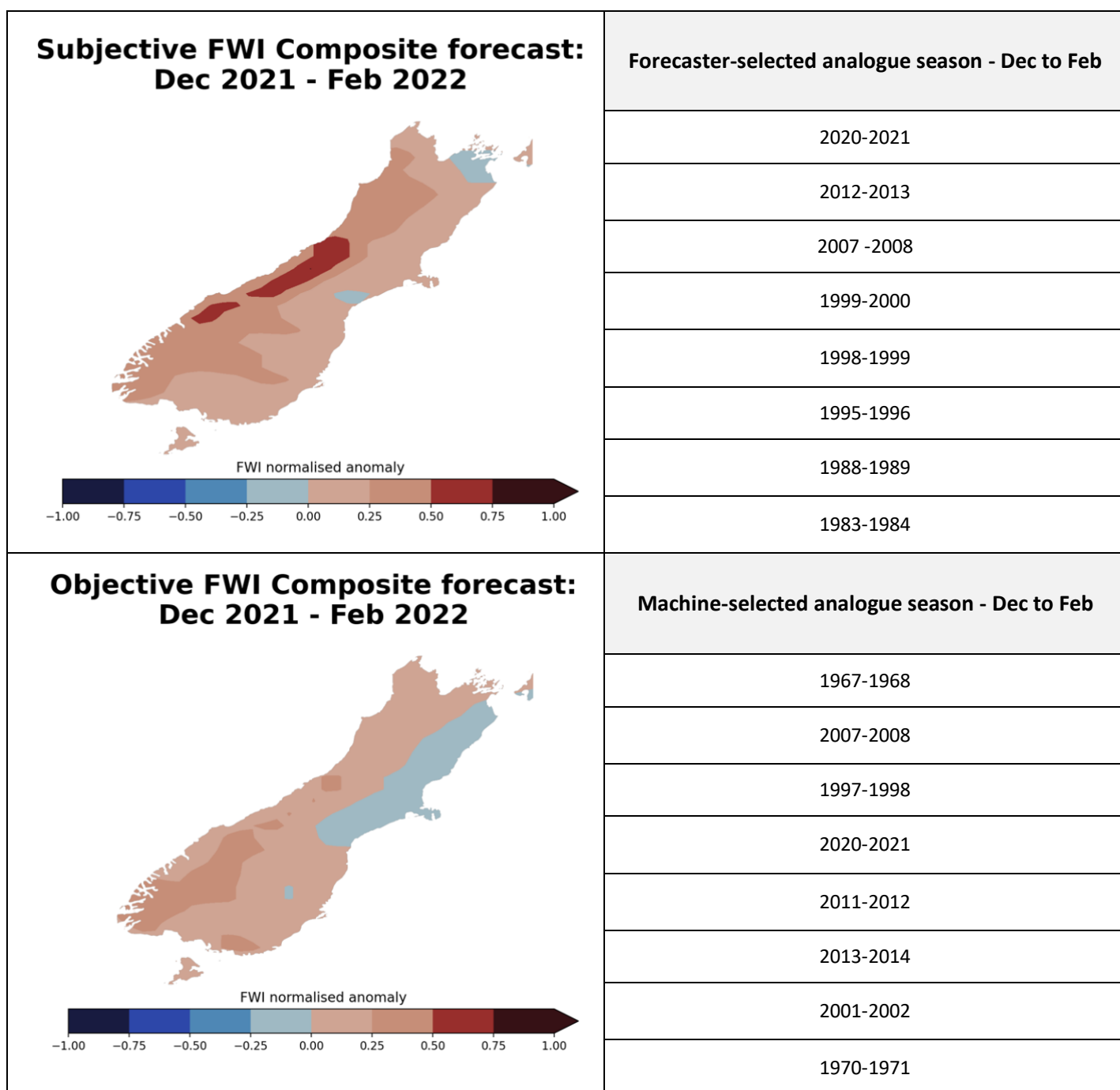


Figure 3: Analogue fire seasons as selected with expert interpretation from NIWA (top) and automated computer analysis (bottom). The fire weather index is a combination of the initial spread index and build-up index, and is a numerical rating of the potential frontal fire intensity. In effect, it indicates 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: October

October's prevailing air flows are expected to begin to favour northeasterly, a change from September's westerlies. Rainfall patterns are expected to be mixed, with large parts of the South Island leaning near normal while Southland and Otago lean toward reduced monthly rainfall. For the west of the South Island, there is a signal for rainfall to be near normal or above normal. Wind speeds are expected to be slightly reduced from normal, another change from September. Relative humidity levels are expected to be near normal range for much of the island, though there are indications of a gradient from southwest (somewhat reduced) to northeast (somewhat elevated).

## Climate outlook: October - December

Late 2021 may have more easterly quarter winds than normal with patterns of high pressure near and south-east of NZ. Temperatures are likely above average for the South Island. Rainfall looks to be near or below normal in many regions, driest relative to normal in the south and west. Sub-tropical lows may bring a chance for periodic downpours. Wind speeds may be slightly lower than normal. Relative humidity levels are expected to be near normal range for much of the island, though there are indications of a gradient from southwest (somewhat reduced) to northeast (somewhat elevated).

The tropical cyclone season for the Southern Hemisphere runs from November to April, with the odd one occurring outside this period. On average, about 10 tropical cyclones form in the South Pacific between November and April. The Tropical Cyclone Outlook for the upcoming season ahead will be published in October.

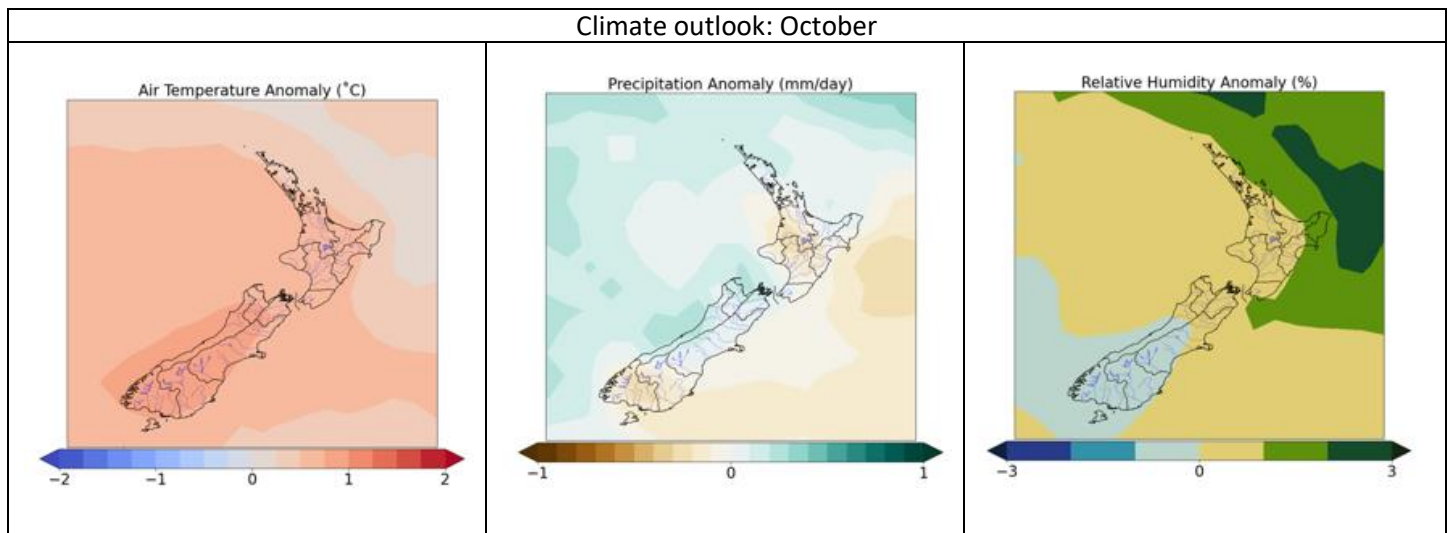


Figure 4: Climate outlook for October showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

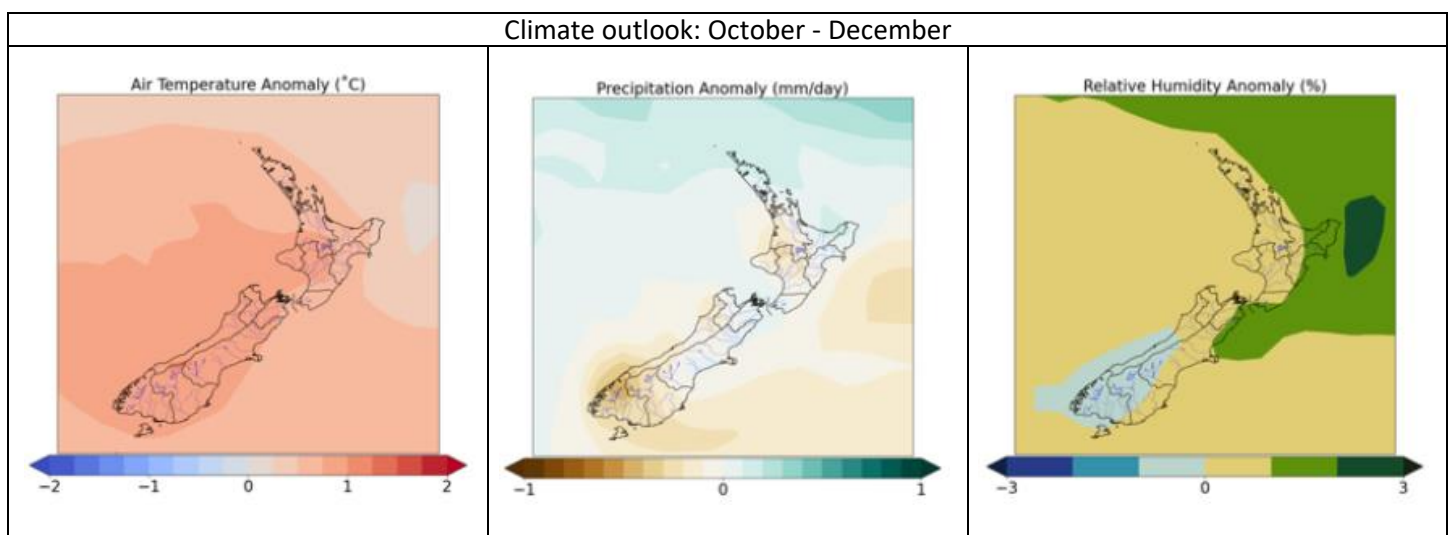


Figure 5: Climate outlook for October-December showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

## Expected impact on fuels and fire danger

Eastern parts of the South Island have recently received periods of strong warm relatively dry NW spring winds which rapidly dry out the fine fuels which can result in fast moving wind driven fires even where much of the medium and heavy fuels may have too much moisture to be available to burn. Previous years has seen these the winds drive fires through the fine fuels at high rates of spread during mid-early spring in eastern parts of the South Island. The potential for fast moving fires driven by the NW winds will remain common through to early October.

Beyond October is likely to see increased availability of medium, heavy and subsurface fuels as they dry out to normal or slightly dryer than normal conditions for most areas other than northeastern parts of the South Island which are expected to be close to normal. Winds are likely to be generally lower than normal reducing the likely spread rates of fires, however there will be some days when the strong NW winds return and potential for higher fire spread rates increase.

## Grass growth & curing

Winter/spring average or above soil moisture for much of the South Island makes 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 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. Subject to weather and topography influences, grass fire ease of ignition, intensity and spread rates increase steadily as the curing percentage increases. At 50% cured grass produces slow moving fires and small flames, with 100% cured grass able to produce extreme flame lengths and intensities.

Curing for most pasture species occurs as a natural process with summer drying and seed set, the timing of this will vary between regions and seasons. Some areas will also be subject to frost curing where there is a build-up of dead material over winter. This is then replaced by a green spring flush but also some species, especially tussocks, have lower moisture levels in their live materials in order to survive severe winter frosts. This is why we often see tussock fires in the early spring.

Many 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



Wind driven Fire in light flashy scrub fuel – because it is almost all fine fuels this is something that could occur in windy spring conditions within extended dry periods.



Fire in young second rotation pine plantations have a dangerous mix of fine fuels from new growth and weeds such as gorse plus considerable dead heavy fuels from the logging harvest waste. Credit: Air Attack Magazine

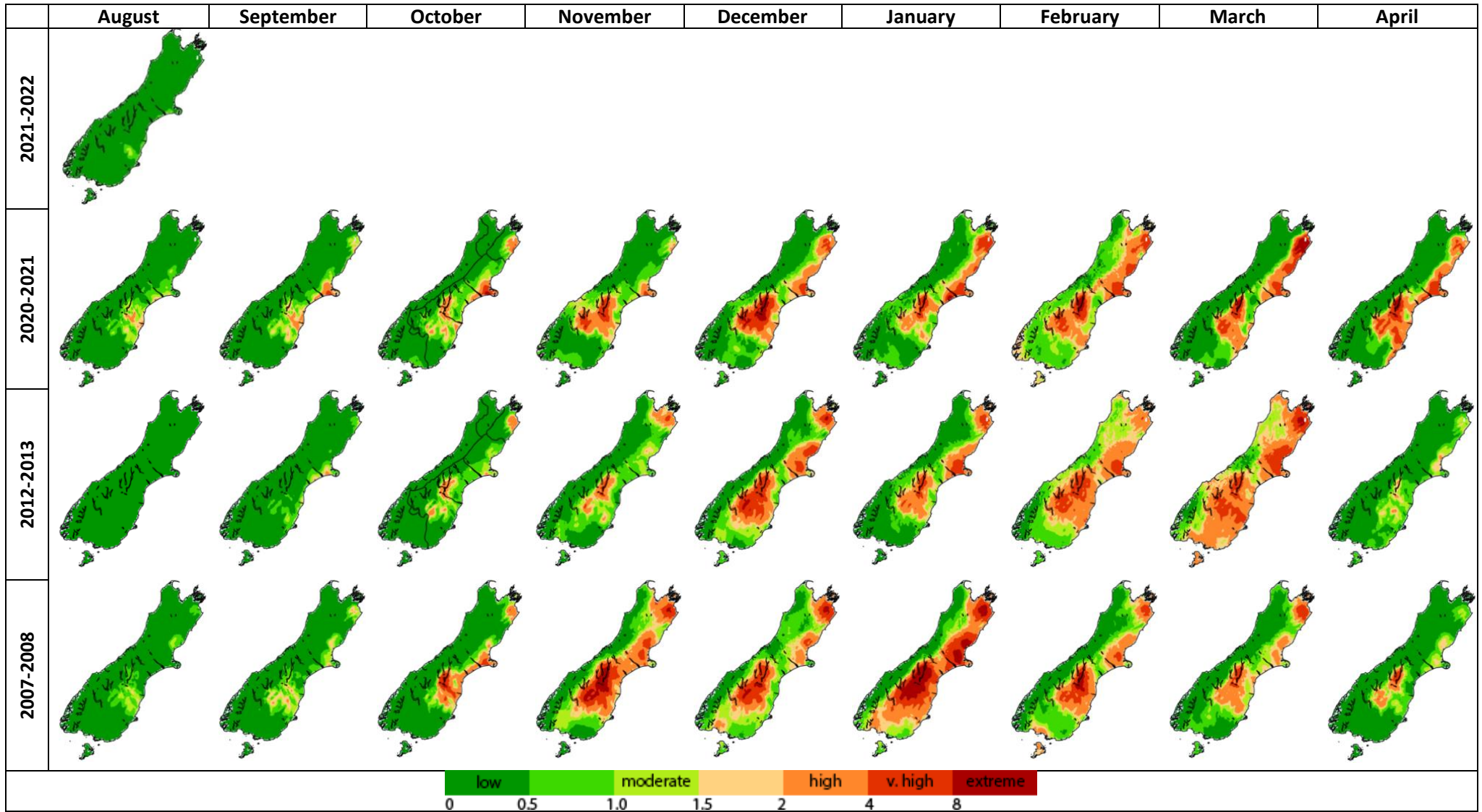


Figure 6: Monthly average severity rating for August 2021 and the years 2020/21, 2012/13 and 2007/08. These are analogue years for the current season and give us an insight what the upcoming fire season may be like.

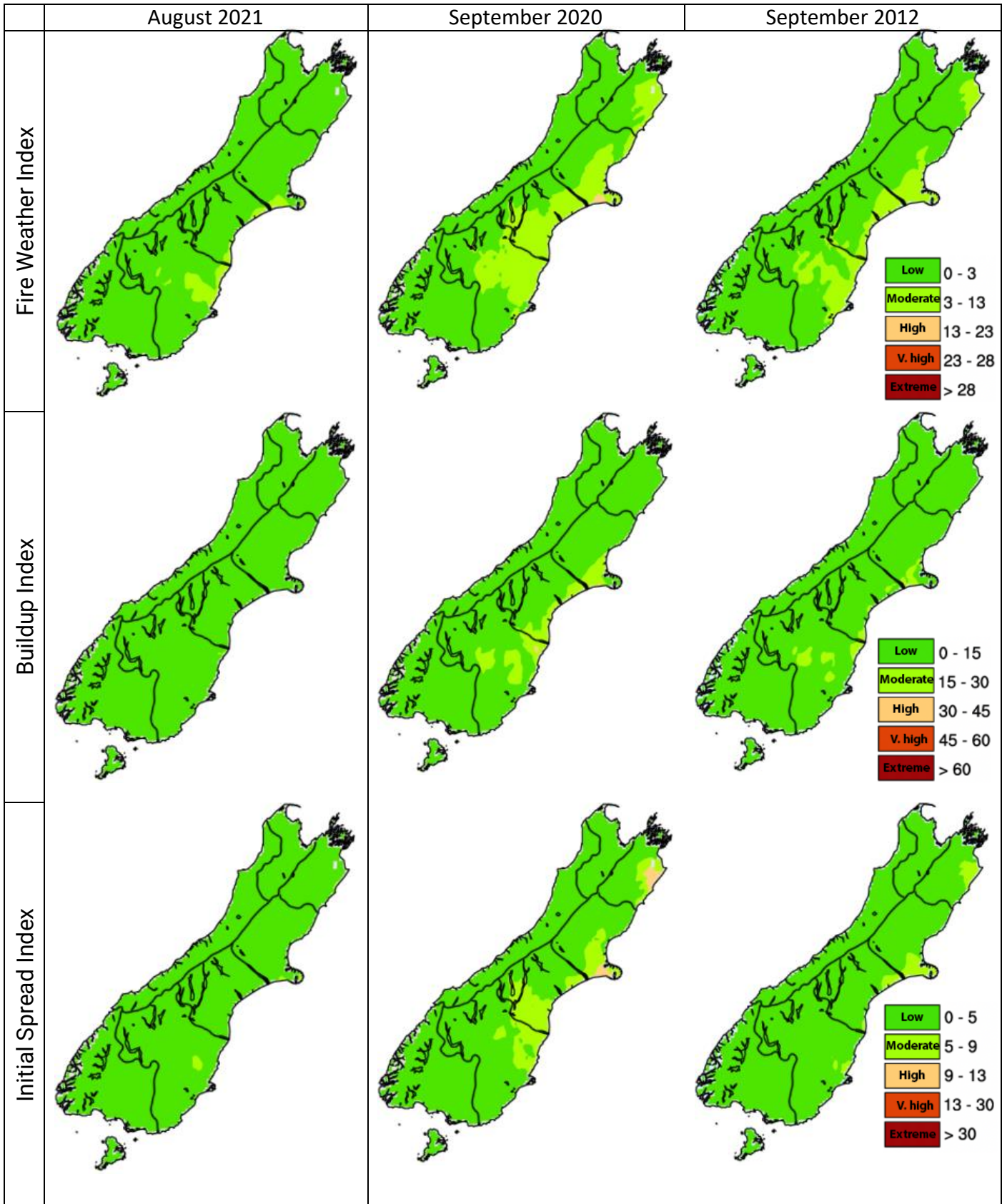


Figure 7: Previous (left row) and expected (middle and right rows) monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

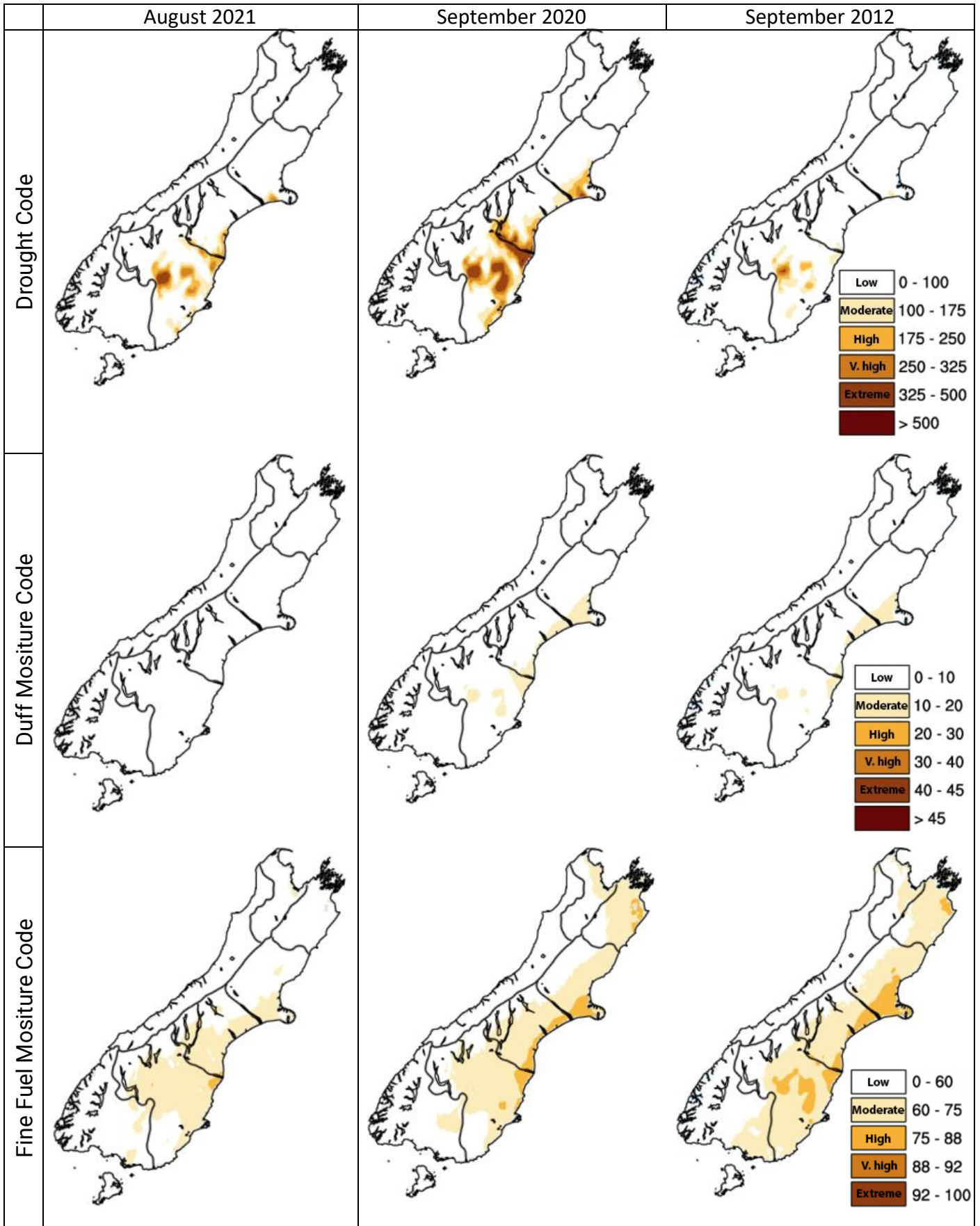


Figure 8: Previous (left row) and expected (middle and right rows) monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).



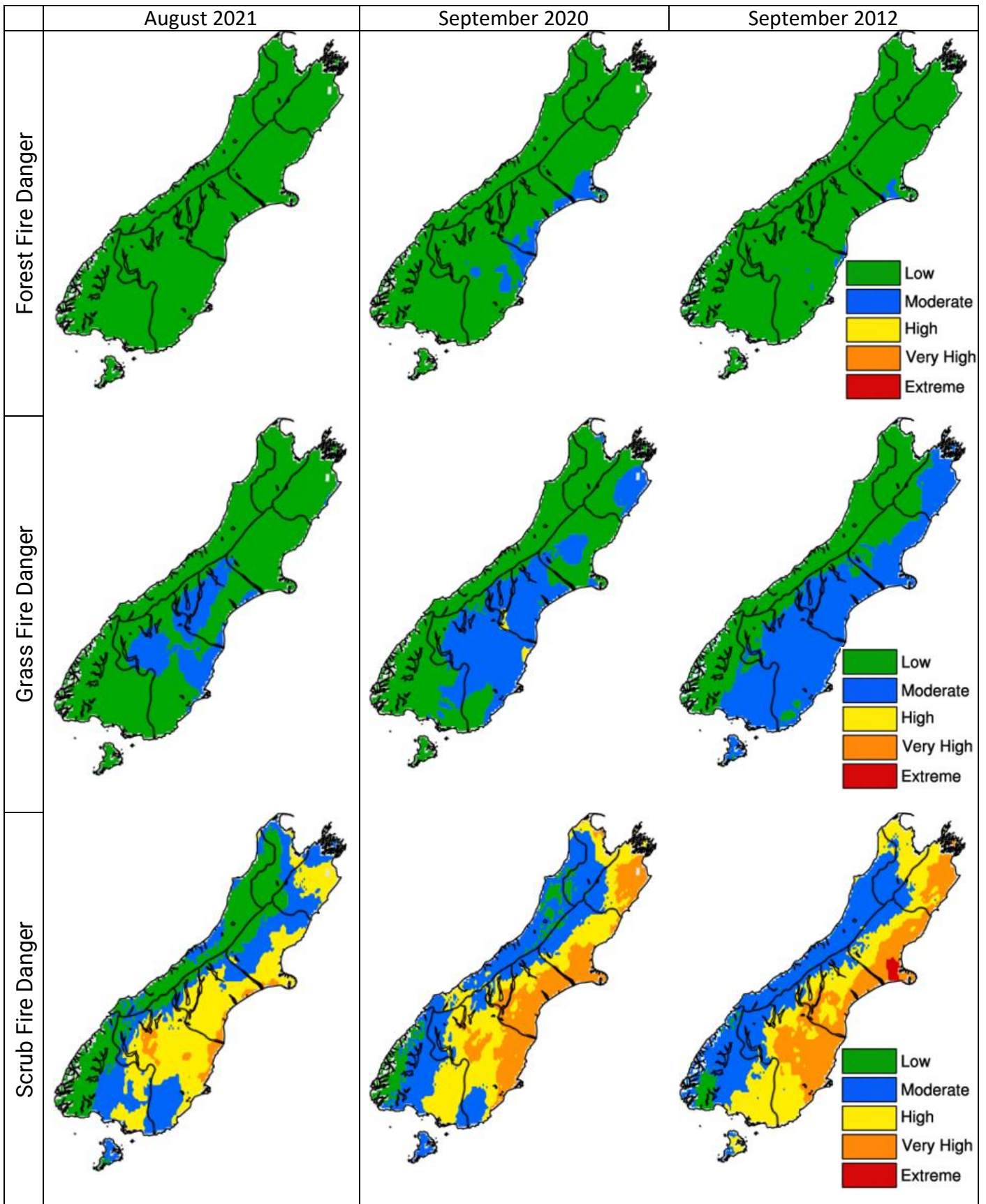


Figure 9: Previous (left row) and expected (middle and right rows) monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

## 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

|         |                      |
|---------|----------------------|
| 0-100   | Little mopup needs   |
| 101-175 | Moderate             |
| 176-250 | Difficult            |
| 251-300 | Difficult & extended |
| 301+    | Extreme & extensive  |

seasonal drought effects on forest fuels and amount of smouldering in deep duff layers and large logs.

**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 FENZ

