North Island Monthly Fire Danger Outlook (2021/2022 season)
Issue: November 2021

Current fire danger situation

In general, monthly fire dangers and fire climate severity are low across much of the North Island (Figures 6-9). The exception is an area around Hastings where moderate condition exists, but about normal for that area and Wairarapa which has higher than normal fire conditions.

Current fuel and soil moisture status

As of 17 November (Figure 2), soil moisture levels are above normal for a majority of the eastern and northern North Island. However, soil moisture levels are below normal for the time of year in Wairarapa. Elsewhere, soil moisture is near normal. No "dry" shading is currently observed on the New Zealand Drought Index map.

Most of the North 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 generous winter/spring precipitation. The Lower BUI means minimal burning of moderate, heavy or subsurface fuels is less likely. However, the BUI is increasing in areas around Hastings (about normal) and Wairarapa (significantly above normal in some places) as shown below in figure 1.

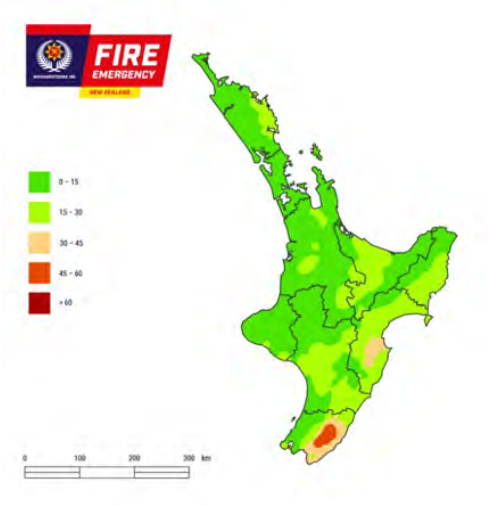


Figure 1: Map of Build-up index (an indicator of the amount of fuel available to burn in a forest based on their expected moisture content) for the North Island.

Fine fuels will generally be damp from frequent precipitation over the past month, but can and have been drying quickly with the wind and warmer temperatures of late spring when rain is not present as is shown with the example of the fluctuating FFMC (fine fuel moisture code) from the Central North Island.

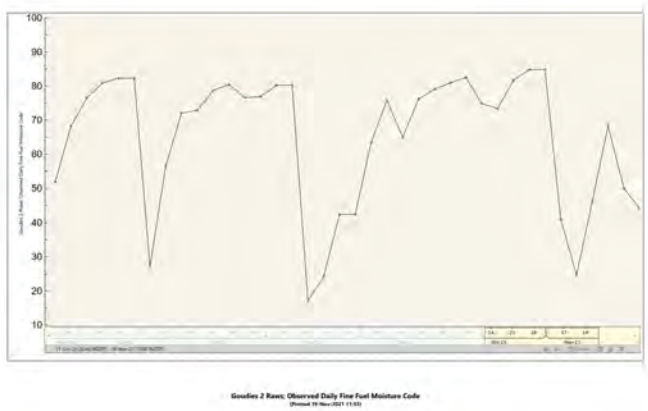


Figure 2: Graph of Goudies predicted grass fire spread rate for the past month based on observed weather conditions.

Forecast climate and weather

Late November will likely feature a mix of high pressure with tranquil weather, and low pressure bringing rainfall. In December, easterly wind flows are expected to prevail, which would favour wetter conditions in the northern and eastern North Island, but perhaps drier in the west. Overall wind speeds are expected to be below normal in December, with above average temperatures. Looking later into the summer, La Niña conditions are likely to continue, with generally easterly winds and above

average temperatures. Wetter conditions are favoured in the north and east, but perhaps drier in the west. For more information, see pages 3 and 4.

What to watch for

- Western and southern areas are expected to experience normal or slightly above normal fire danger over the coming months as depicted in figure 3, especially Wairarapa where drying is already ahead of normal and ahead of other parts of the country.
- Areas where grass fuel loads are high due to vigorous grass growth during good spring growing conditions.
- Complacent behaviors with mild spring fire danger and or increased burning in December because people have delayed their burns in a wet spring.
- Fire in light fuels such as scrub especially during warm sunny and or windy periods.

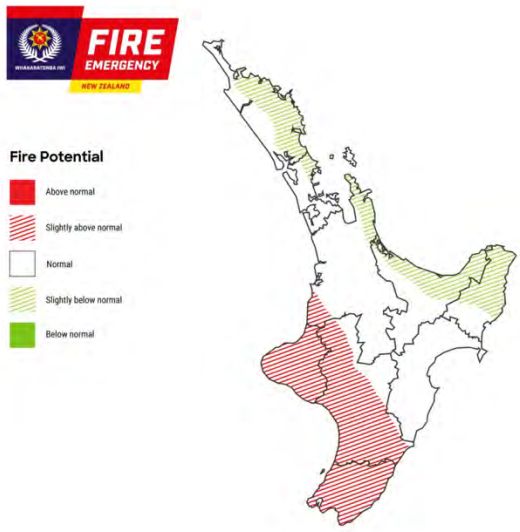


Figure 3: Locations identified as areas of interest that may develop an increased risk of high to extreme fire danger over the next three months.

Fire such as this in light flash fuels like the scrub fire example do not require extended dry periods and are not uncommon in spring and early summer.

Current climate

October 2021 was New Zealand's 5th-warmest October on record. Temperatures were above average (0.51°C to 1.20°C above average) to well above average (>1.20°C above average) across the entire North Island.

October rainfall was well above normal (>149% of normal) in large parts of Northland and Auckland. Rainfall was above normal (120-149% of normal) in the Coromandel, coastal Bay of Plenty, and coastal Taranaki. Conversely, below normal (50-79% of normal) and well below normal (<50% of normal) rainfall was observed in Manawatū-Whanganui, Wellington, and most of the east coast of the North Island.

Soil moisture levels are currently above normal for a majority of the eastern and northern North Island. However, soil moisture levels are below normal for the time of year in Wairarapa. Elsewhere, soil moisture levels are near normal.

Climate drivers

In October, the NINO3.4 Index anomaly (in the central Pacific) during October (through the 24th) was -0.54˚C. The Southern Oscillation Index (SOI) was +0.8 during October, on the La Niña side of neutral. The three-month average SOI was +0.7, also on the La Niña side of neutral.

During October, upper-oceanic heat content decreased substantially across the equatorial Pacific. Sub-surface ocean conditions during October were 3˚C to 4˚C colder than average around 100 m depth in the east-central Pacific, a marked trend from September.

This was driven by an upwelling Kelvin wave and stronger than normal trade winds across the equatorial Pacific Ocean, focused over the Niño 3.4 region. Stronger than normal trade winds are expected to continue during November, which will result in continued cooling of the sea surface in the equatorial Pacific.

NIWA has moved to "La Niña Alert". There is an 80% chance for the development of a formal La Niña event between November-January, based on international guidance.

La Niña will become a dominant climate driver during the upcoming fire season. La Niña is often associated with more 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.

Soil moisture anomaly: 17/11	Rainfall anomaly: 01/11 – 17/11	Temperature anomaly: 01/11 – 17/11

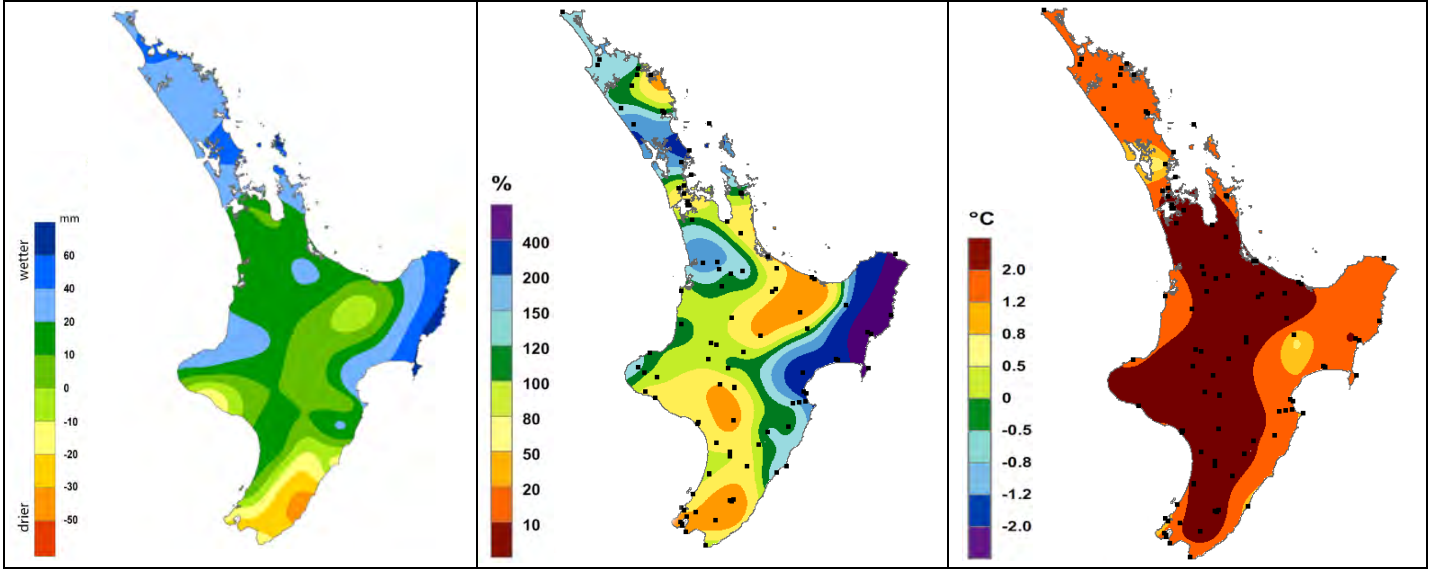


Figure 2: Maps showing the current soil moisture anomaly as well as temperature and rainfall as a difference from normal since the start of the month

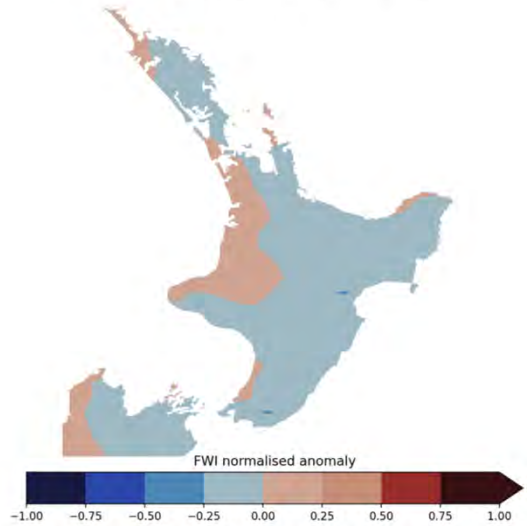
Fire season analogues

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 the western North Island, but perhaps slightly lower than the long-term average in northern and eastern areas. Summer 2020-21 is one of the strongest analogues, placing 1st on the forecaster-selected analogue list (top) and 4th on the computer-selected analogue list (bottom). This season featured drought conditions in parts of the North Island. Overall, it's a sign that some regions (especially in the west) will need to be prepared for longer dry periods that can elevate fire weather conditions.

Forecaster-selected analogue season - Dec to Feb
2020-2021
1999-2000
2017-2018
2008-2009
2000-2001
1998-1999
1995-1996
1988-1989



Machine-selected analogue season - Dec to Feb
1967-1968
2007-2008
1996-1997
2020-2021
2011-2012
2013-2014
1970-1971
2001-2002

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 the relevant season.

Climate outlook: December

December's air flows are generally expected to be easterly, which would favour wetter conditions in the northern and eastern North Island, but perhaps drier in the west. Overall, wind speeds are expected to be below normal in December, with above average temperatures. Relative humidity is forecast to be higher than normal across the North Island, especially in the north and east.

Climate outlook: December - February

Summer is expected to have more easterly quarter winds than normal. Above average temperatures are likely, particularly in the west of the North Island. Rainfall may be near normal to above normal in the north and east, driven by occasional sub-tropical depressions, but perhaps below normal in the western North Island. Hot and humid conditions will be common, although relative humidity is forecast to be slightly below normal in western areas. Wind speeds continue to look lighter than normal except in the northern North Island. 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 TC 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.

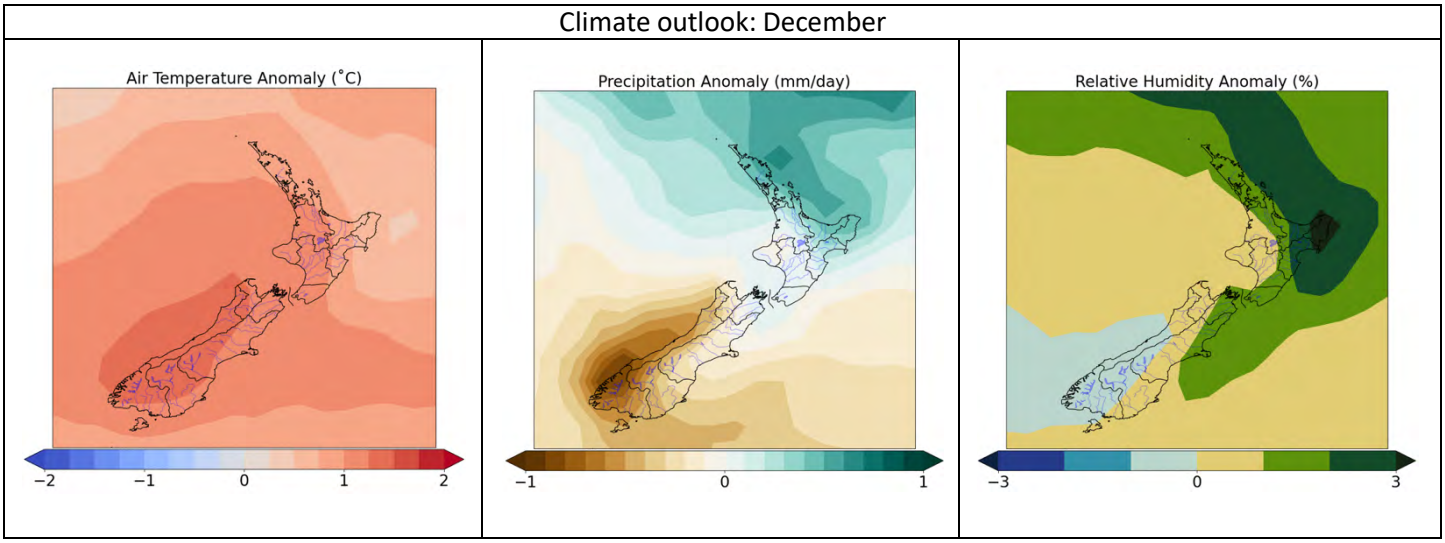


Figure 4: Climate outlook for December showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

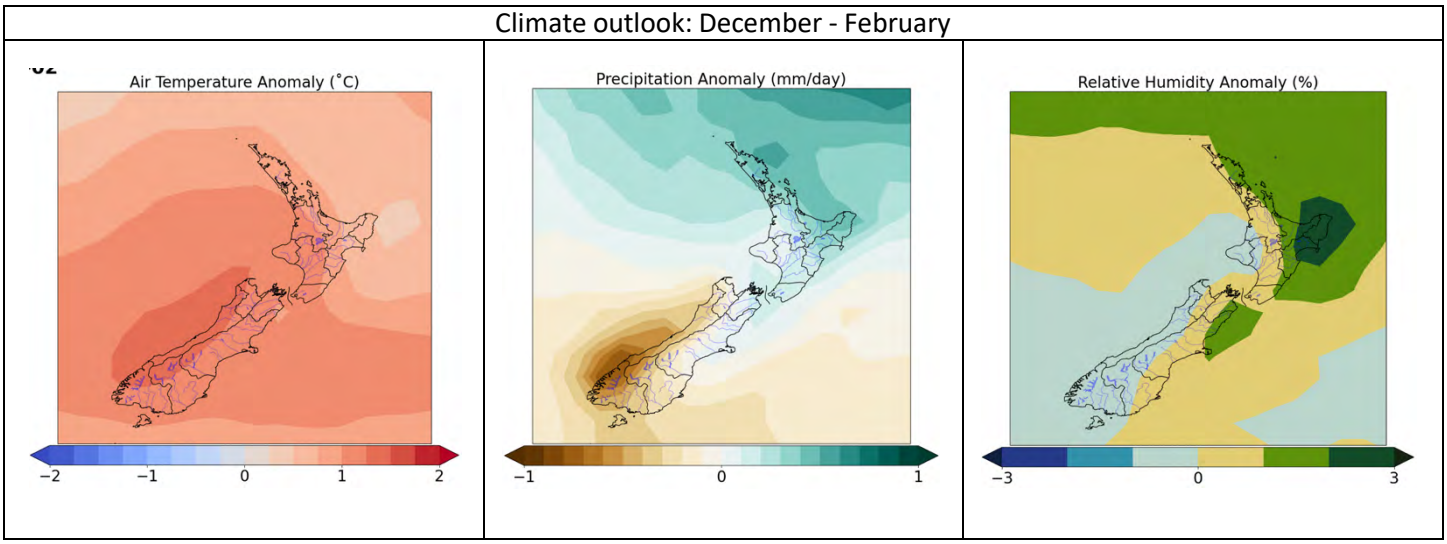


Figure 5: Climate outlook for December-February showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

Expected impact on fuels and fire danger

Fine fuel moisture is critically important to fire 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 North Island, but this will be offset in the east and North by normal or above normal humidity and precipitation.

Anticipated generally lower wind speeds are likely to see less frequent wind driven fires and generally reduced spread rates, although the reduction may be offset by lower than normal fine fuel moistures in the west and south 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 about normal in the north and east but are likely to be about normal or greater than normal in the south and west.

The net effect of the climatic outlook is that western parts of the North Island are likely to have normal or slightly higher than normal Fire Danger while the eastern parts of the North Island with the easterly wind flows are expected to receive more humidity and precipitation and have about normal or below normal fire danger. There will however 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. 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.

Grass growth & curing

Most of the North Island has experienced good growing conditions. A warm winter/spring with average or above rainfall 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 very slow-moving fires and small flames, with >90% 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, seasons and grass types. 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. The temperatures will now be increasing but the winter frost cured material may still be present.

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.

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

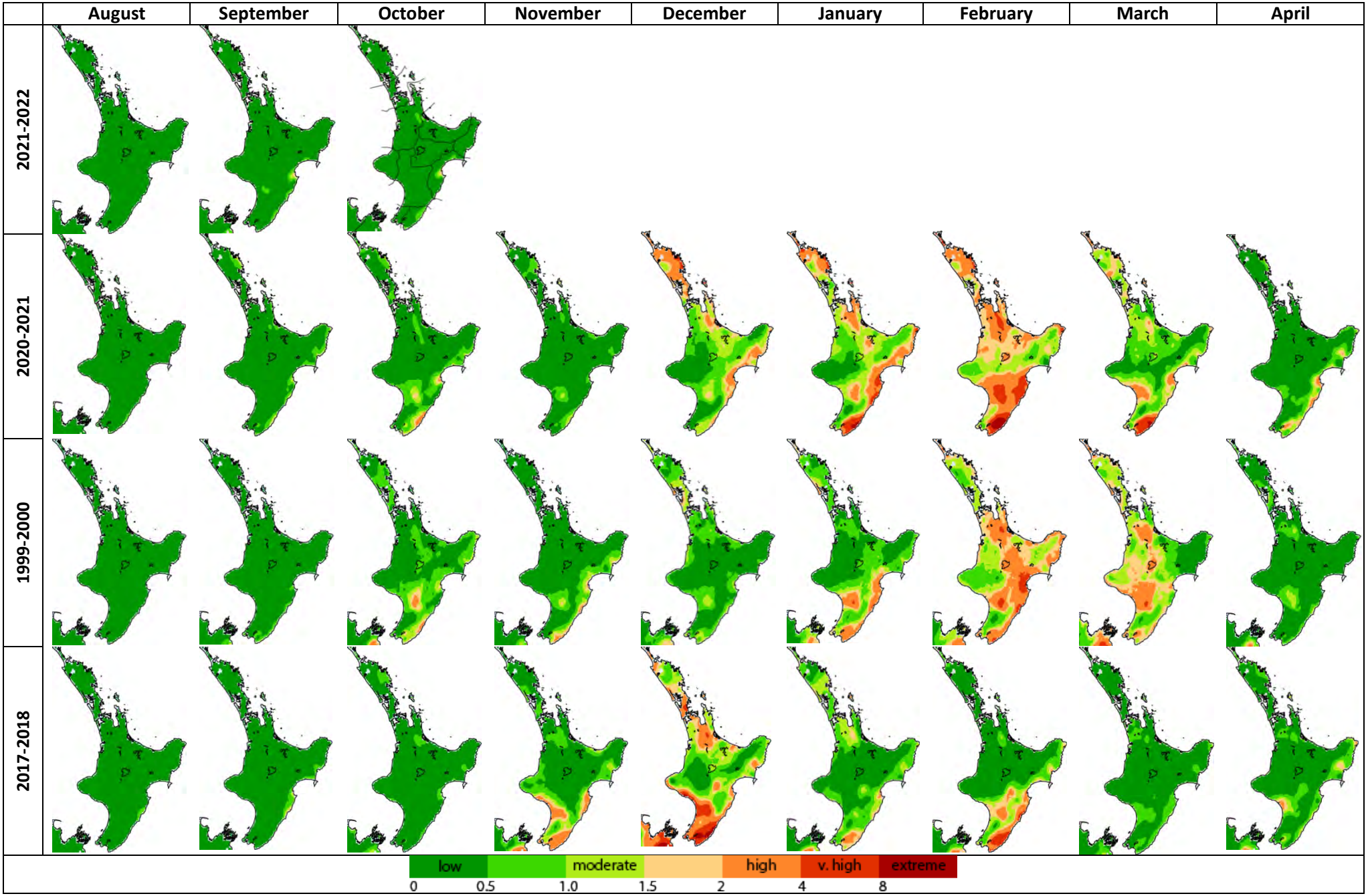


Figure 6: Monthly average severity rating for October and the years 2020/21, 1999/2000 and 2017/18. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

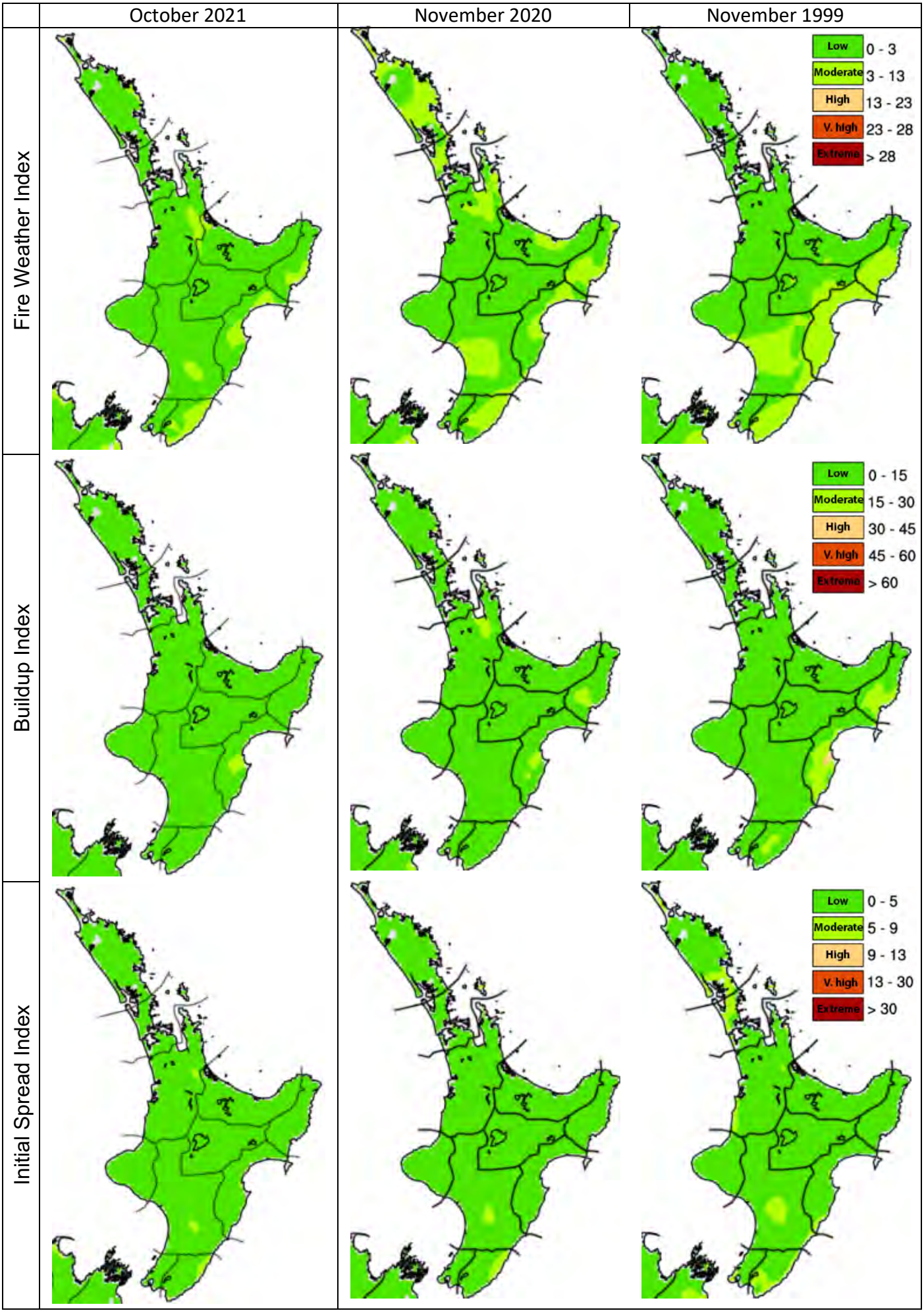


Figure 7: The most recent observed month (left column) and analogue months for November (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

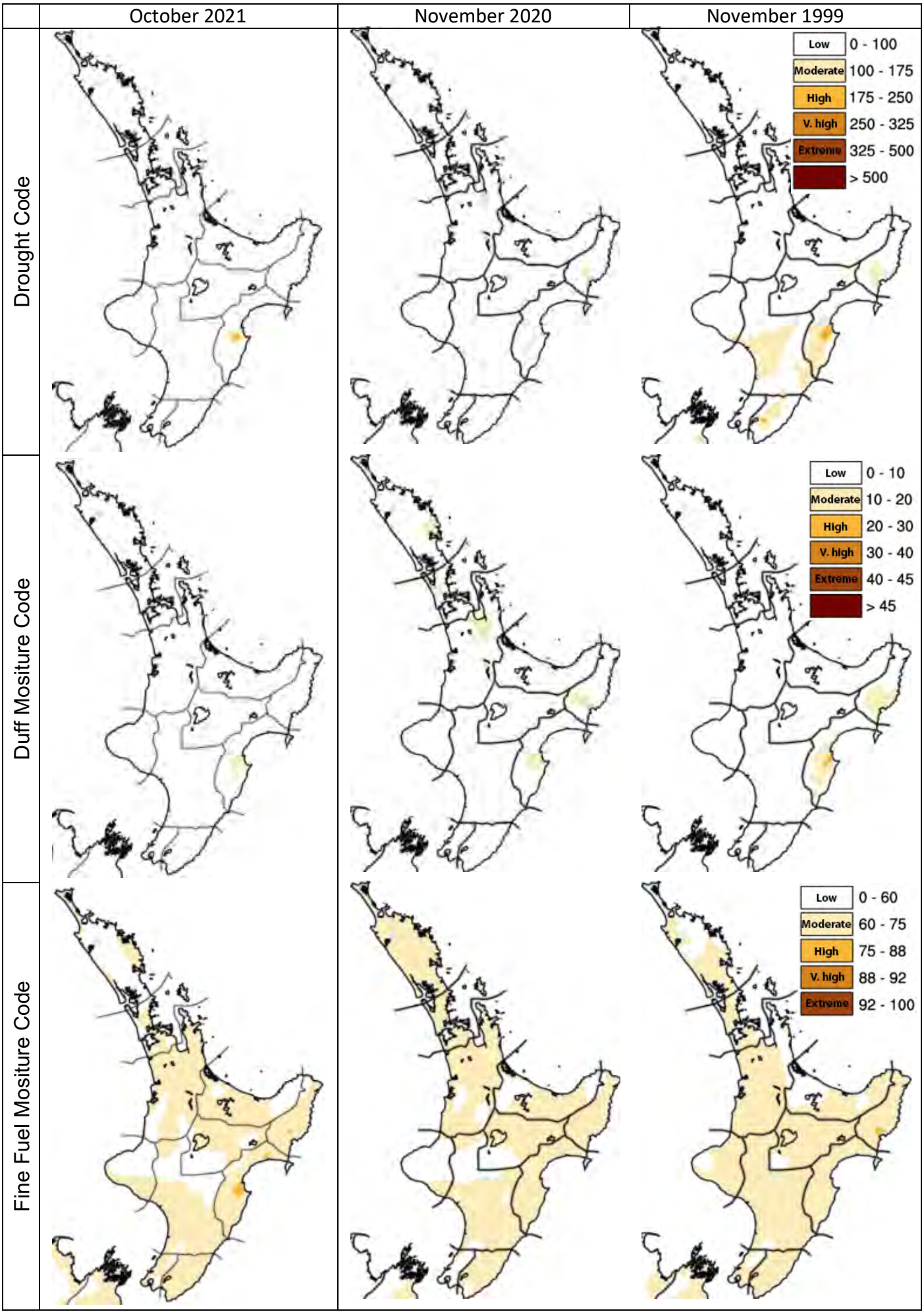


Figure 8: The most recent observed month (left column) and analogue months for November (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

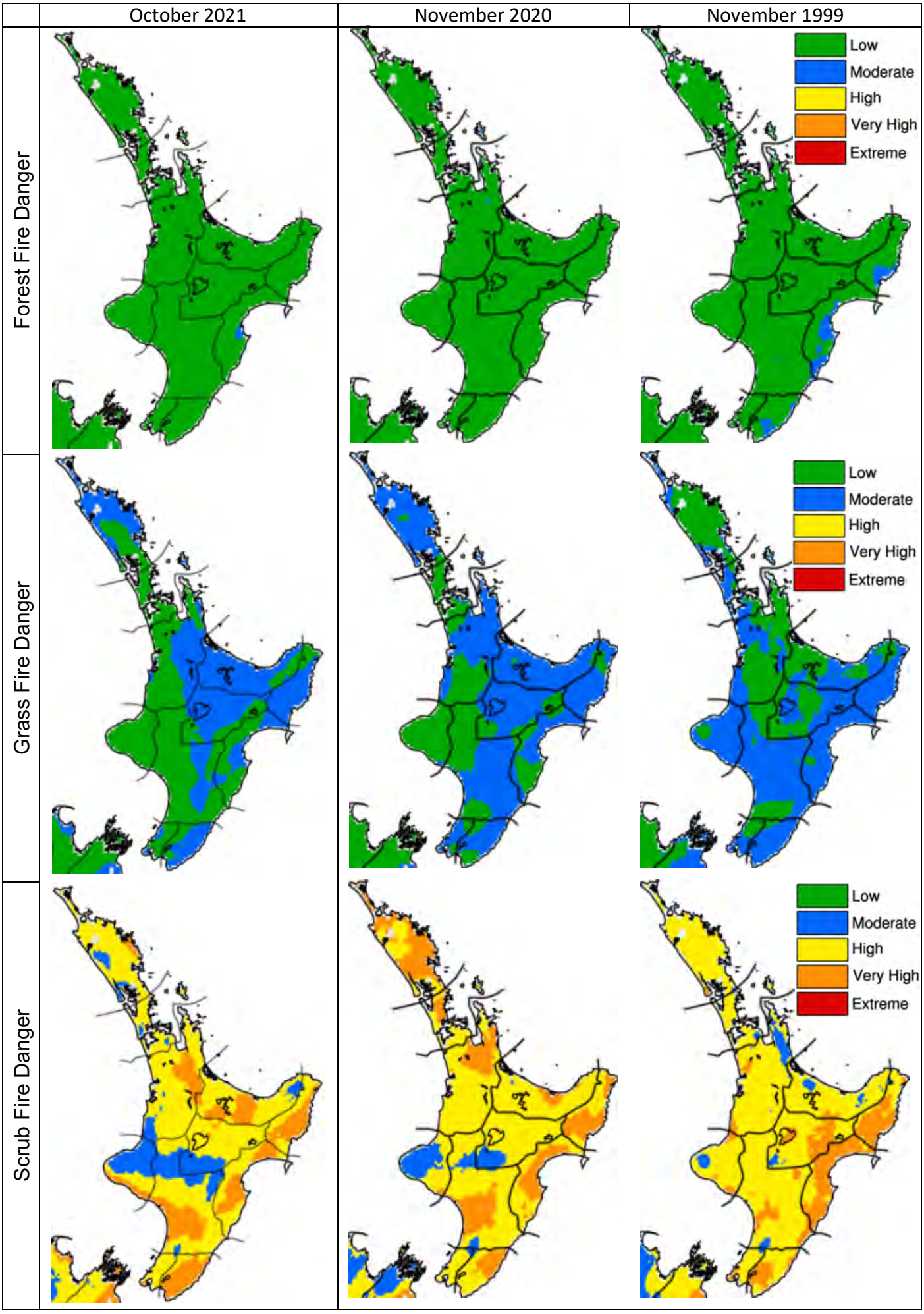


Figure 9: The most recent observed month (left column) and analogue months for November (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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 mopup 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 mopup 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