North Island Monthly Fire Danger Outlook (2022/2023 season)
Issue: January 2023

Current fire danger situation

December's various fire indices were all low to moderate (with the exception of scrub fire danger that was high to very high in parts of the North Island), generally lower than normal for this time of year. See Figures 7-10 for more detail.

Current fuel and soil moisture status

As of 19 January (Figure 3, left), soil moisture levels are above normal or well above normal across a majority of the North Island. Near normal to slightly below normal soil moisture is located in western Northland, southern Manawatū-Whanganui, and western Wellington. The New Zealand Drought Index is currently showing no dryness or drought in the North Island.

Current fire dangers across the North Island are almost all low to moderate as a result of substantial rain in the first few weeks of the year. The one North Island exception being a small area around Palmerston North.

Current lower BUI values (Figure 1) and contributing DCs (Drought Codes) and DMCs (Duff Moisture Codes) mean minimal burning of moderate, heavy or subsurface fuels is likely across most of the North Island except the areas around Palmerston North where values indicate a higher level of fuel availability in Forest fuels. 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. In summary, in current conditions we are unlikely to see significant fires in mature forest but there are some periods where the summer heat make it possible to get significant fires in fine fuels such as scrub.

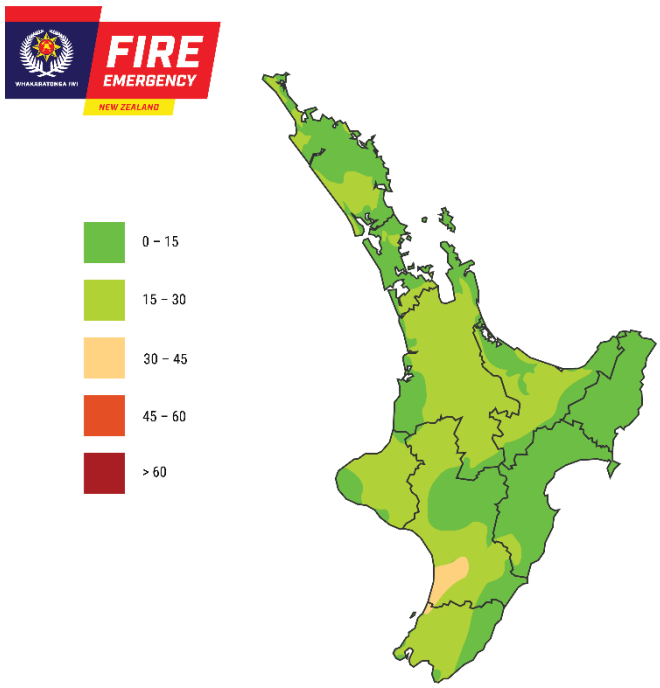


Figure 1: Map of Buildup Index (an indicator of the amount of fuel available to burn in a forest based on their expected moisture content) for the North Island as at 20th January.

Forecast climate and weather

Late January looks to be somewhat drier than normal as high pressure is generally favoured in the New Zealand region. Although soils are generally quite wet across the island, this could result in rapid drying through the end of January. For February 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 much of the North Island, with many locations (especially in the west) seeing warmer than average temperatures.

February-April will exhibit more easterly winds than usual, although La Niña is expected to transition to ENSO-neutral later in the period, which may increase variability in air flows. There may be an increased chance for tropical cyclone activity from late February into 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

- Rain over the past months mean there are likely to be many burn piles that have not been burnt yet, plus in some areas there will be waste from storm damage to be burnt. This means we may have increased burns in the coming months and, although the conditions are not especially high risk, some people will no doubt not take reasonable caution – especially when the earlier rain leads some people to be complacent.
- Areas where grass fuel loads are higher than normal due to good growing conditions. Together with periods of elevated FFMCs and warm, dry windy conditions, these can contribute to easy ignition and spread of grassfires.
- Spontaneous combustion due to warm damp conditions. This could be in either fresh hay that has been bailed and stacked before being fully dried, or it could be from skid sites (large piles of logging waste). Especially large forestry skid piles can have lots of bark and smaller material including dirt that prevent air flow through the pile, and can also have pieces of metal or oily rags in the piles that aid heat build-up and ignition.

Fire of 19th January 2023 near Coronet Peak

Many areas in the North Island currently have Fire potential well below normal, but most are expected to trend toward fire potential closer to normal over the coming months. In indicating areas to watch, Figure 2 shows expected fire potential for a couple of months' time rather than the current conditions.

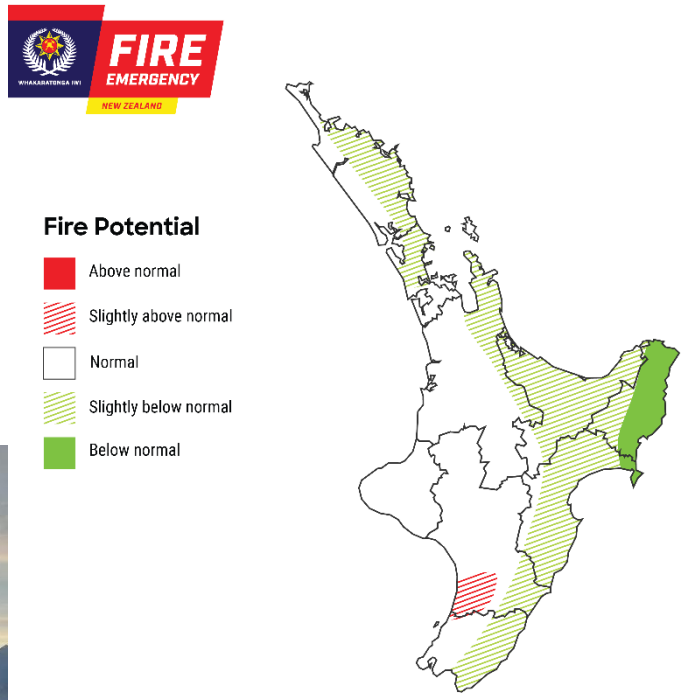


Figure 2: Locations identified as areas of interest that may develop an increased risk of above normal fire potential over the next three months.

Current climate

December temperatures were above average (0.51°C to 1.20°C above average) to well above average (>1.20°C above average) across a majority of the North Island, although near average (±0.50°C of average) temperatures were observed in coastal Gisborne and Hawke's Bay. So far in January, temperatures have been above average in the western North Island, but below average along the east coast (Figure 3, right).

December rainfall was above normal (120-149% of normal) or well above normal (>149% of normal) in eastern Northland, the Coromandel, Bay of Plenty, and much of the east coast. Below normal (50-79% of normal) or well below normal (<50% of normal) rainfall was observed in the Far North and southern Auckland, with near normal (80-119% of normal) rainfall observed elsewhere. So far in January, rainfall has been above normal to well above normal in most areas, but near normal to below normal in parts of the Central Plateau and Kapiti Coast (Figure 3, middle).

Soil moisture levels are above normal or well above normal across a majority of the North Island. Near normal to slightly below normal soil moisture is located in western Northland, southern Manawatū-Whanganui, and western Wellington (Figure 3, left).

Climate drivers

The NINO3.4 Index anomaly (in the central equatorial Pacific) during December was -0.83˚C (climatology: 1991-2020), While this was within the La Niña range, it marked a warming trend as compared to November, indicating that the event is past its peak.

The December monthly Southern Oscillation Index (SOI) was +1.7 and +1.3 from October-December (climatology: 1991-2020), both in the La Niña range.

Trade winds across the equatorial Pacific were stronger than normal during December. Thus, La Niña continued, despite the slight weakening.

In the subsurface central equatorial Pacific, substantial changes took place between November and December as warmth associated with the West Pacific Warm Pool shifted eastward. Cooler than average waters contracted toward the central part of the basin while warmer than average waters at depth pushed from the central to the eastern equatorial Pacific. The setup was reflective of a decaying La Niña.

A sea surface temperature seesaw in the Indian Ocean called the Indian Ocean Dipole (IOD) eased during December, evidenced by an increase in the outgoing longwave radiation (a proxy for decreasing cloud) compared to November. During October-December, convective forcing was dominated by the low frequency signal of the negative Indian Ocean Dipole and La Niña, superimposed with pulses of the Madden-Julian Oscillation (MJO).

Tropical forcing favours the Indian Ocean and Maritime Continent during February, roughly corresponding to phases 2-5. This is historically associated with above average temperatures and mixed rainfall patterns. Phase 5 tends to be much wetter than normal during February.

New Zealand's coastal water temperatures became more unusually warm in all regions except the north of the North Island during December. Marine heatwave conditions were widespread, with local anomalies of more than 4˚C off the West Coast and greater than 3˚C near Waikato.

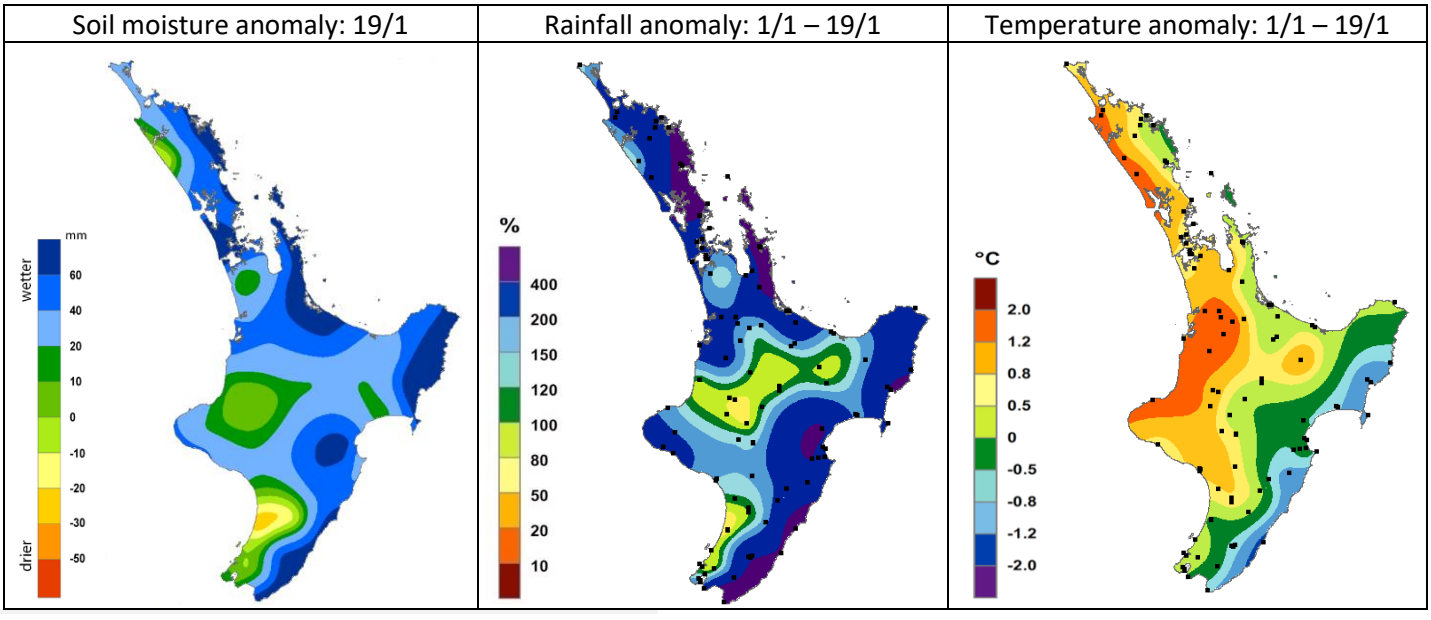


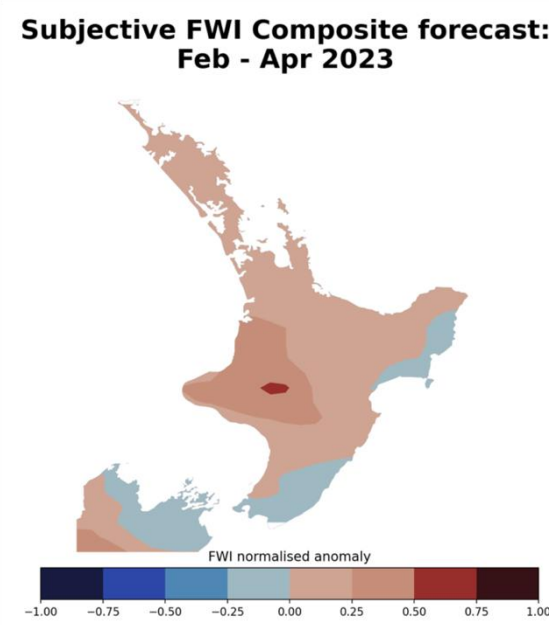
Figure 3: Maps showing the current soil moisture anomaly, as well as temperature and rainfall differences from normal since the start of the month.

Fire season analogues

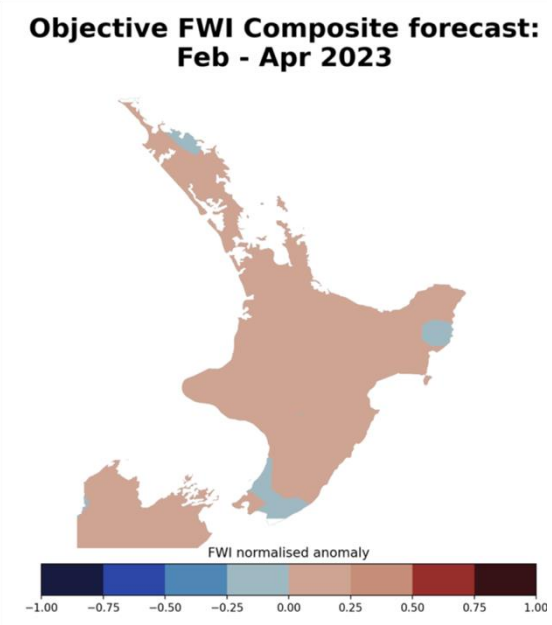
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

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 late summer and early autumn 2023. Northern and western areas are expected to have slightly higher fire danger than normal as the season progresses. The subjective expert-selected guidance agrees more with La Niña-like patterns and is therefore favoured.



Forecaster-selected analogue season - Feb to Apr
2022
2011
2008
1994
1989
2013
2000
1996



Machine-selected analogue season - Feb to Apr
2007
1989
2000
2014
2001
2019
2004
2006

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: February 2023

February's air flows are generally expected to be more easterly than normal, continuing the trend of recent months. The signal is for a wetter than normal lean for the North Island, although the risk for ex-tropical cyclones looks reduced until at least late February. Wind speeds are expected to be below normal for most of the North Island. Above average temperatures appear 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: February – April 2023

Guidance suggests that Feb-Apr will exhibit more easterly winds than usual, although La Niña is expected to transition to ENSO-neutral later in the period, which may increase variability in air flows. Temperatures overall look to be warmer than average, especially in western regions (Figure 6). Rainfall looks to be near normal or above normal for most of the North Island. Above normal relative humidity is expected in the east, although relative humidity is forecast to be slightly below normal in western areas. Wind speeds continue to look lower than normal for most of the North Island.

The tropical cyclone season for the Southern Hemisphere runs through April. This season the risk is considered near normal to elevated. Tropical cyclone activity may increase from late February into March.

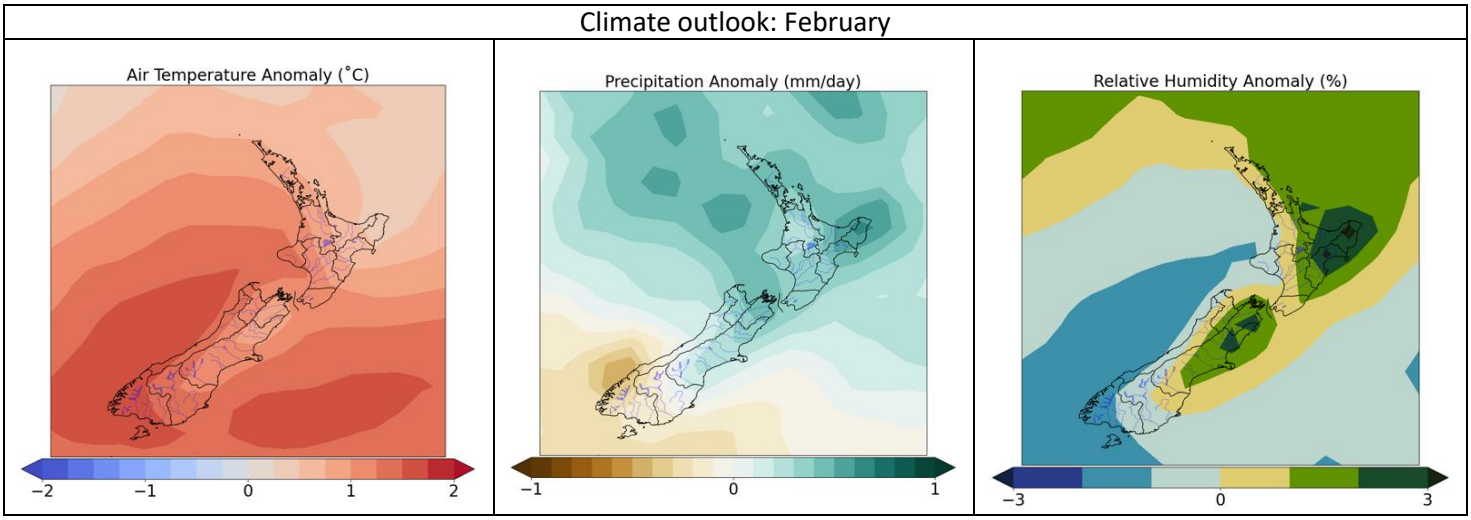


Figure 5: Climate outlook for February showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

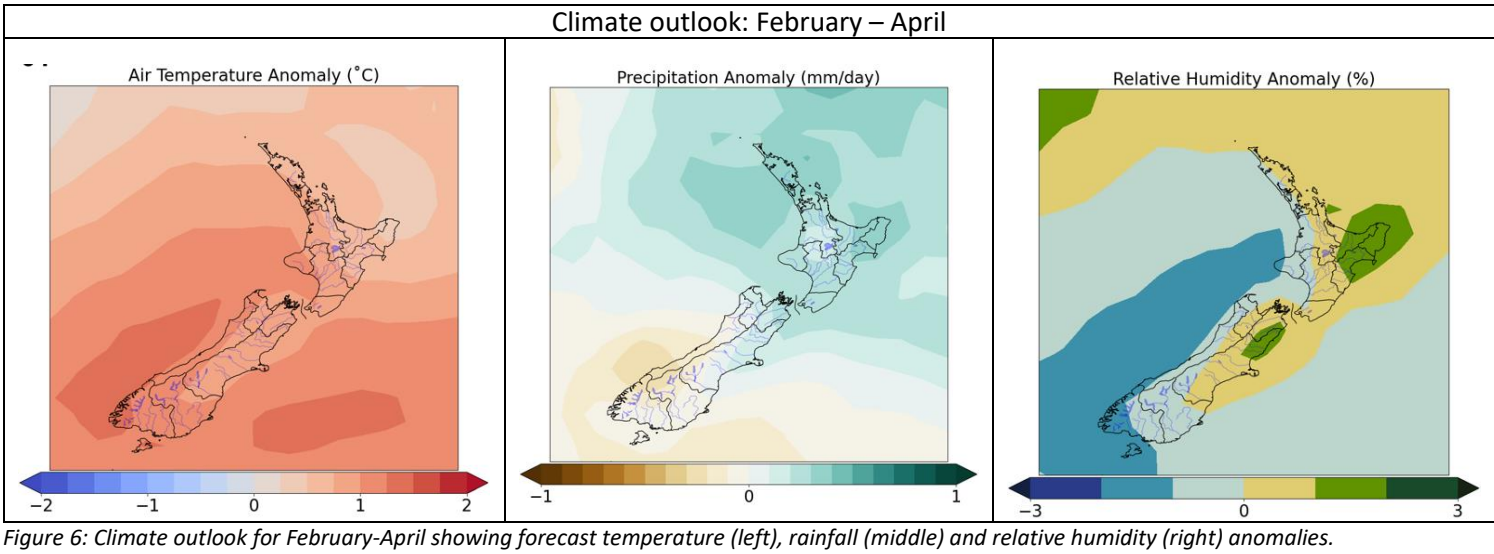


Figure 6: Climate outlook for February-April showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

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 North Island, but this will be offset in the east by normal or above normal humidity and precipitation in eastern areas.

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 north as described above.

Looking to February, the current very high fuel moistures for medium and heavy fuels (see Figure 1) in most areas mean relatively low forest fuel availability. These medium and heavy fuel moistures are expected to reduce as these fuels dry, thus increasing forest fuel availability. But given current moisture levels and continued higher than normal precipitation and humidity in most North Island areas, these medium and heavy fuels are not expected to have lower than normal fuel moistures, especially eastern parts. The exception being around Palmerston North, which may have lower fuel moistures and higher fuel availability.

The net effect of the climatic outlook is that the Far North and Western parts of the North Island are likely to have normal fire potential while the eastern parts experiencing increased easterly wind flows are expected to receive more humidity and precipitation and have slightly below normal fire potential. Tairawhiti with its vulnerability to heavy rain from tropical depressions is likely to have lower than normal fire potential (see Figure 2).

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 in the South East of the North Island.

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 North Island has experienced good growing conditions over the past few months, with a relatively warm winter and abundant spring and early summer 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 may 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.

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.

FENZ staff accurately measuring grass curing in tussock to validate assessments from Satellite imagery

Grass curing is so important to fire danger and fire behaviour. FENZ currently has a project that will trial the use of satellite imagery to assess grass curing. If successful, not only will grass curing be updated automatically in the Fire Weather System but it will show the variation in curing across the landscape and research shows that it can be more accurate than current visual assessments in many situations.

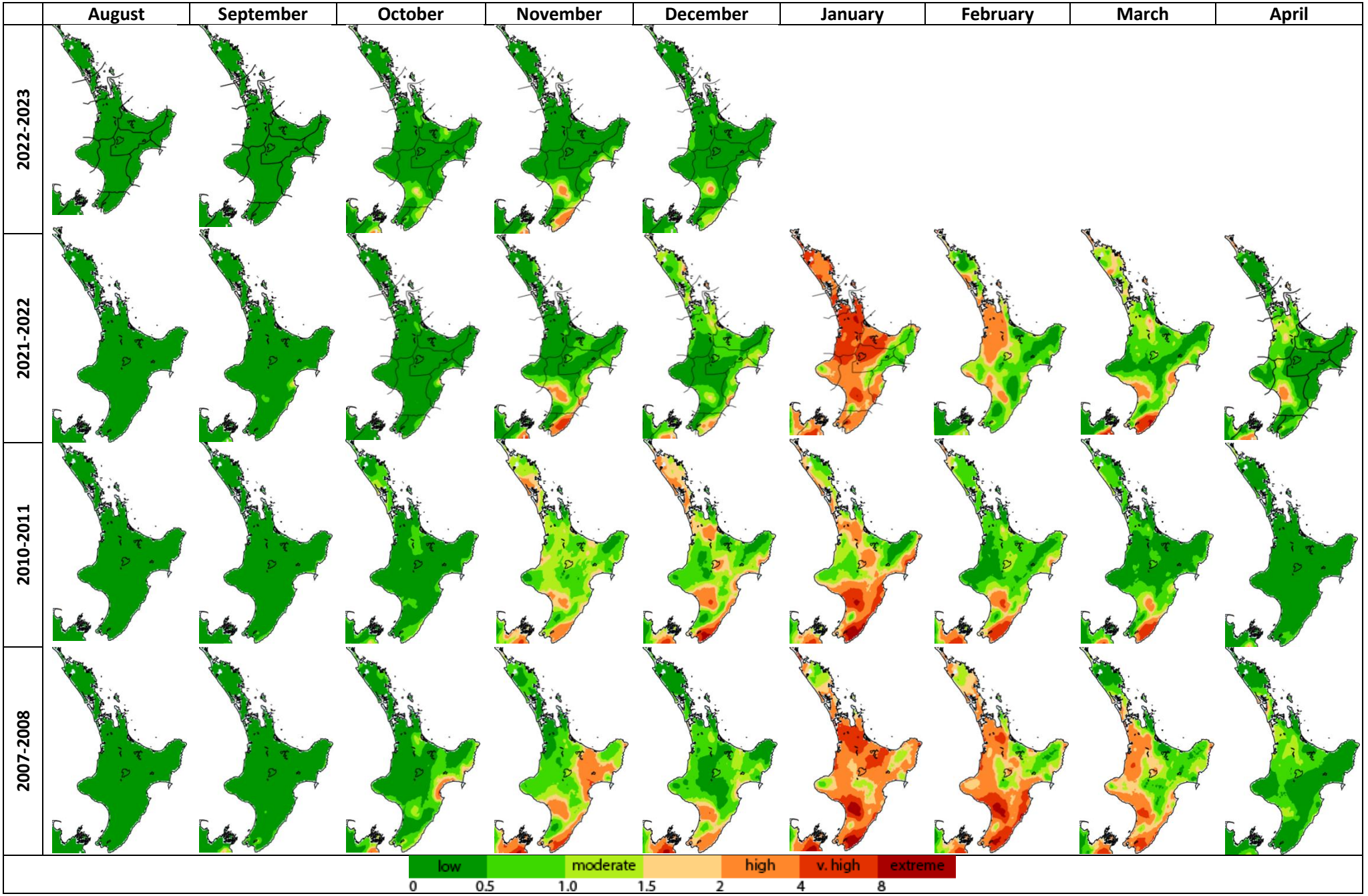


Figure 7: Monthly average severity rating for 2022-2023 up to and including December and the comparative years of 2021/2022, 2010/2011, and 2007/2008. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

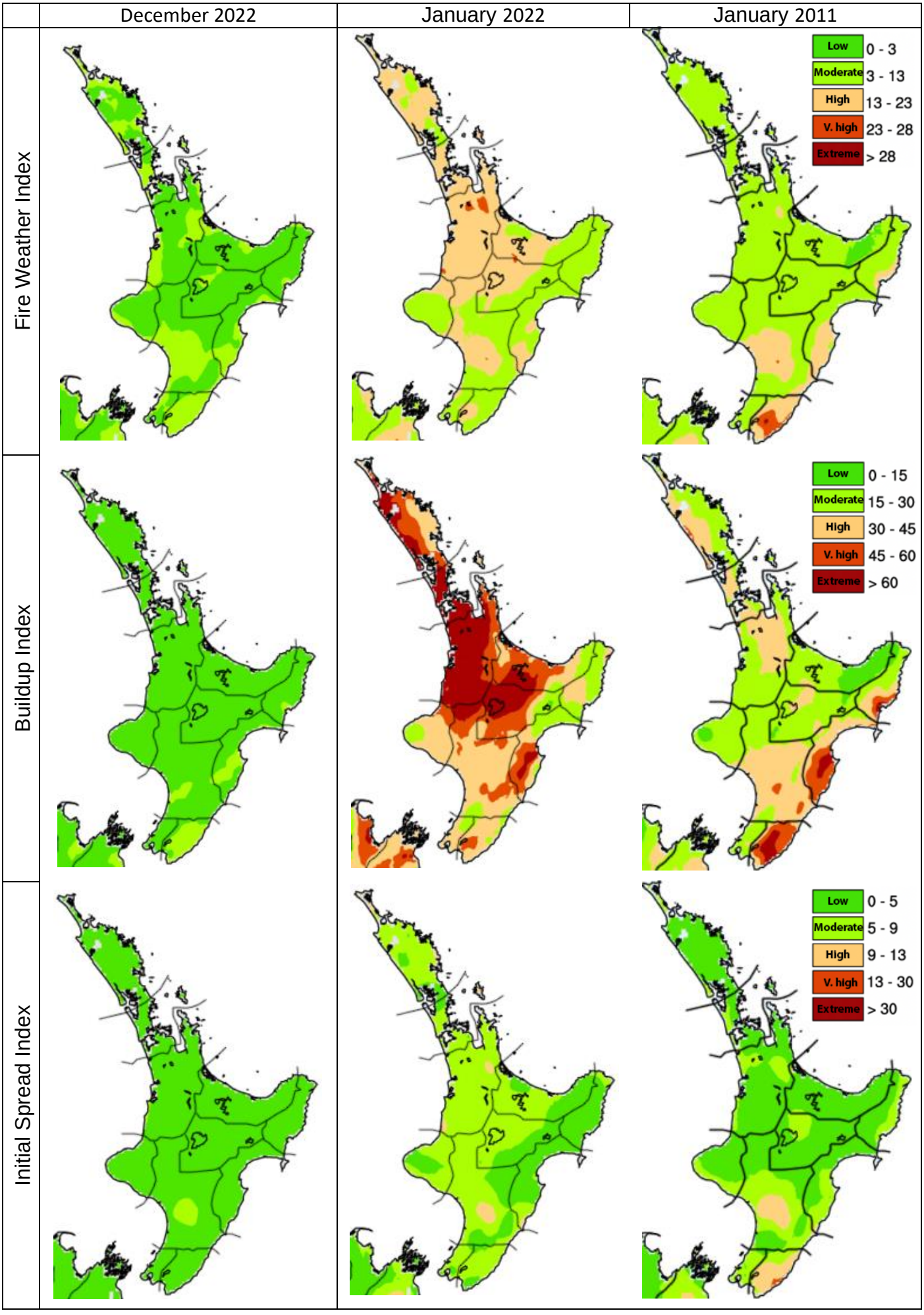


Figure 8: The most recent observed month (left column) and analogue months for January (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

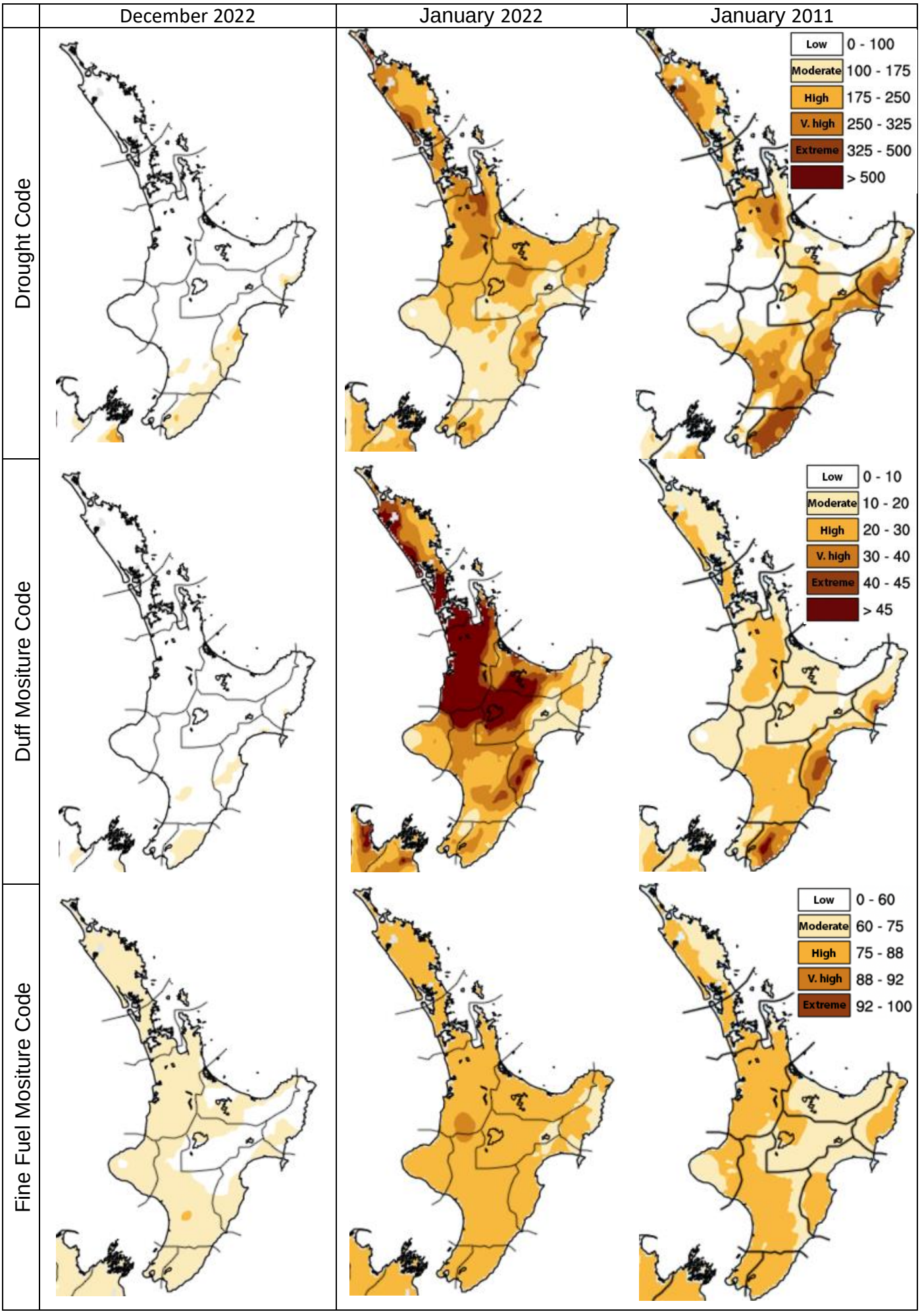


Figure 9: The most recent observed month (left column) and analogue months for January (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

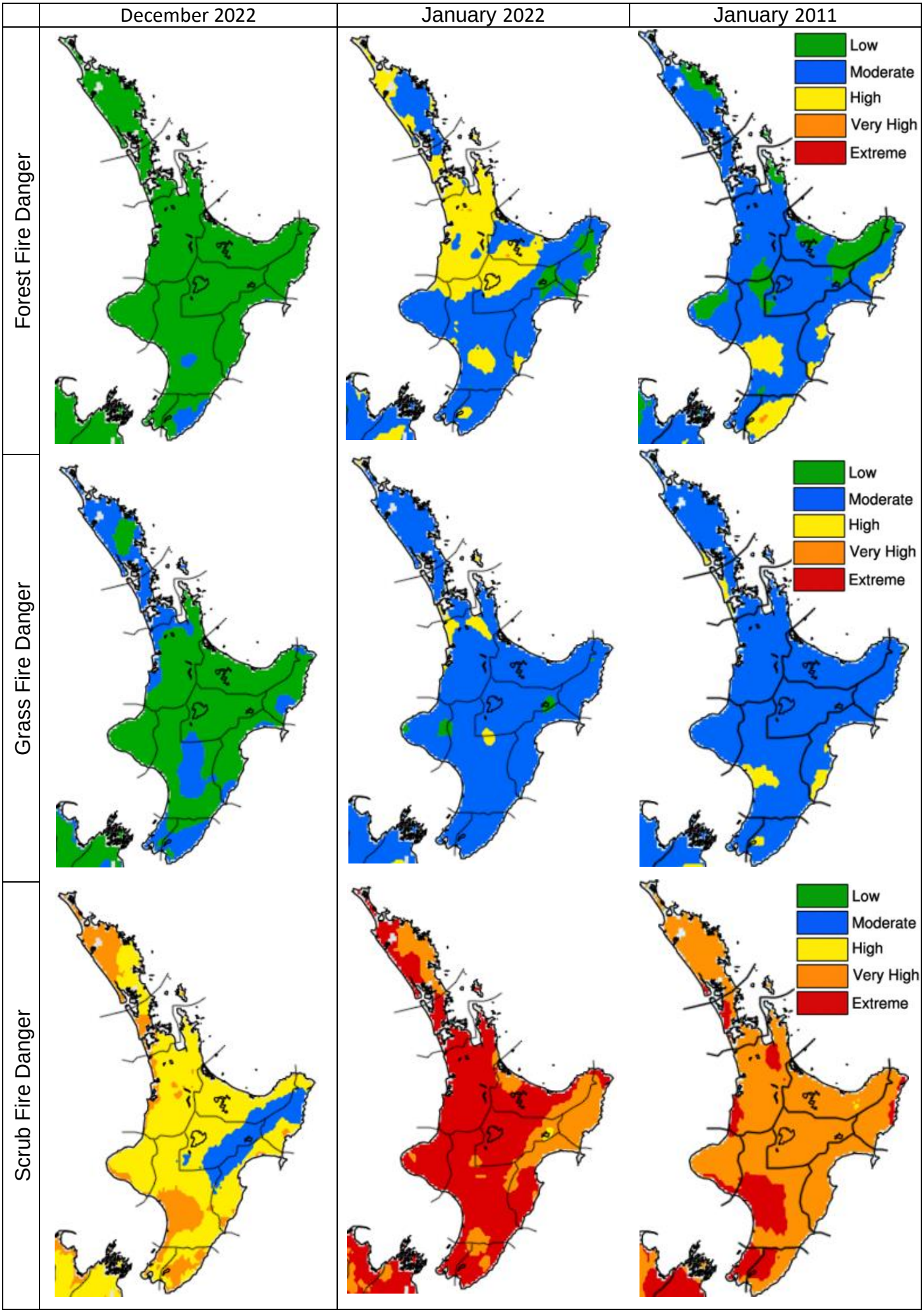


Figure 10: The most recent observed month (left column) and analogue months for January (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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