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

Current fire danger situation

February's various fire indices were generally all low (with the exception of scrub fire danger that was high to very high in parts of the North Island), lower than normal for this time of year. See Figures 9-12 for more detail.

Current fuel and soil moisture status

As of 15 March (Figure 4, left), soil moisture levels are above normal across much of the North Island, although near normal soil moisture is located in Northland and Taranaki, with slightly below normal soil moisture in Horowhenua. The New Zealand Drought Index is currently showing no dryness or drought in the North Island (Figure 1).

After the significant rainfall events of the first few months of 2023, conditions in parts of the North Island are slowly starting to dry out, especially in Northland and northern Waikato. Parts of Horowhenua and southern Taranaki are also starting to experience some dryness, as expressed in slowly rising Drought Code (DC) values. However, overall DC values are still well below the recognised threshold of 250 which represents difficult and extended mop-up and are generally still below normal for this time of year.

Grass curing was largely a non-event across the North Island this summer, which has contributed to less than normal risk of fire ignition in grasslands. Elevated fine material in scrub fuels still have the ability to dry out quickly in warm, dry windy conditions, and as such scrub can remain a concern for fire under such conditions at any time of the year. The chance of fires spreading to surrounding forest and grasslands is limited though, although there may be local circumstances where there remains potential. However, with shortening day lengths, the onset of heavy dews and typically good overnight temperature and humidity recovery, the possibility of there being a significant fire which challenges initial attack capability in the North Island over the coming months is relatively low. The likelihood will continue to lessen as we progress towards the colder winter months.

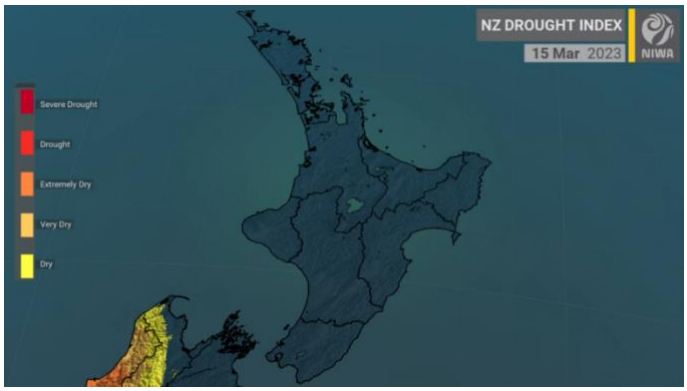


Figure 1: The New Zealand Drought Index (NZDI)[1] as of 15 March 2023, showing no dryness in the North Island.

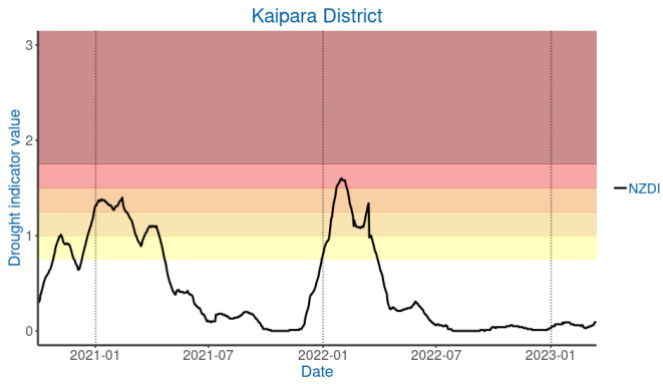


Figure 2: NZDI for Kaipara District, showing the distinct lack of drying experienced during the 2022/23 summer season compared to the previous two years, a pattern typical across all North Island districts.

[1] *NZDI is a climate data-based indicator of drought based on four commonly-used climatological drought indicators, these being the Standardised Precipitation Index, the Soil Moisture Deficit, the Soil Moisture Deficit Anomaly, and the Potential Evapotranspiration Deficit.*

Forecast climate and weather

The remainder of March looks to have variable air flows, with more westerlies than have been seen in recent months. For April as a whole, the transition away from La Niña is expected to be associated with variable air flows, temperatures and rainfall patterns. However, there is the possibility for La Niña-like easterlies and tropical or sub-tropical moisture to return for a time during the first half of April, although with low confidence.

April-June may exhibit a trend toward somewhat drier conditions, consistent with the easing of La Niña. Variable air flows are expected, but there may still be a preference for easterly-quarter winds at times.

For more information, see pages 3 and 4.

What to watch for

- As Easter approaches, it could reasonably be anticipated that holiday-home owners will be looking to put in a last effort around their properties to tidy up ahead of the winter months, including dealing with storm debris. As part of this there may be an increase in people wanting to burn vegetation waste over the long holiday weekend, with little regard to prevailing conditions in favour of just getting the job done.

- The threat of spontaneous combustion in debris piles created with vegetation following all the recent flooding has raised some concerns regarding the potential for ignition. Many of the piles that are being created as part of the clean-up will be above the historically recognised limits of 3 m in height, which is also a recommendation of the recent Scion publication in terms of preventing spontaneous combustion of slash at skid sites. However, the general lack of compaction of the piles, the fact that most of the fines will have been stripped off by the fast-flowing flood waters, and the presence of space within the piles for air flow all contribute to reducing the risk of spontaneous combustion. It is still something to be mindful of, however.

- With all the work currently being undertaken to clear debris from properties across Hawke's Bay and Tairawhiti, one of the most practical solutions likely to be considered for disposal is burning. Given the size and nature of both the debris piles and the material within them, these have the potential to burn for considerable lengths of time and generate extremely high fire intensities. As such, they could pose concerns during dry or windy periods for quite some time and careful consideration needs to be given to the management and monitoring of such fires, as well as the nature of the surrounding vegetation and exposures.

- The significant use of heavy machinery during the post-Gabrielle and Auckland flooding event clean-ups could result in a spike in machinery fires due to a build-up of dust, caked mud and general debris on the equipment. While this may not result in fire spreading to vegetation, it is just something to be aware of, especially when operations involving the machinery are long and protracted, with limited opportunities for thorough cleaning and potentially maintenance.

Most areas across the North Island have fire potential below normal for the time of year, with only northern areas and parts of Horowhenua experiencing normal conditions. Figure 3 shows current fire potential based on the prevailing conditions. Based on the time of year and forecast conditions, it is unlikely that we will see any significant elevation of fire potential in any areas over coming months, despite the forecast drying trend associated with the easing of La Niña.

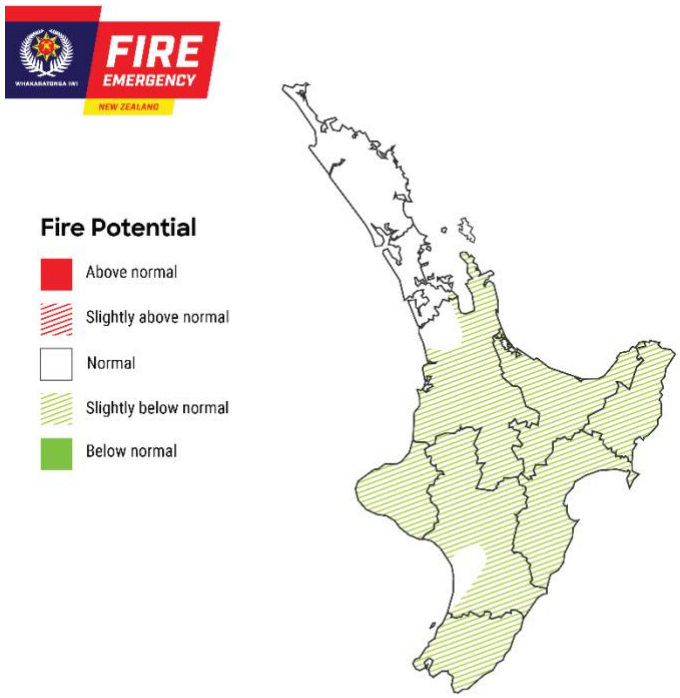


Figure 3: Relative fire potential across the North Island based on prevailing weather and fuel conditions.

Current climate

February temperatures were above average (0.51-1.20°C above average) or well above average (>1.20°C above average) across the western and lower North Island. Across the northern and eastern North Island, temperatures were generally near average (±0.50°C of average). So far in March, temperatures have generally been near average, although the lower North Island has been warmer than average (Figure 4, right).

February rainfall was exceptional in the North Island. Above normal (120-149% of normal) or well above normal (>149% of normal) rainfall was observed across most of the North Island. Parts of southern Northland, Auckland, Gisborne, Hawke's Bay, and coastal Wairarapa received at least 400% of the normal February rainfall. However, so far in March, rainfall has been below normal or well below normal in many areas (Figure 4, middle).

Soil moisture levels are above normal across much of the North Island, although near normal soil moisture is located in Northland and Taranaki, with slightly below normal soil moisture in Horowhenua (Figure 4, left).

Climate drivers

The NINO3.4 Index anomaly (in the west-central equatorial Pacific) through 27 February was -0.46˚C (climatology: 1991-2020), in neutral territory for the first time since July-August 2022. The remnant central Pacific "cool pool" is now flanked by warmer than average seas.

The February monthly Southern Oscillation Index (SOI) was +1.0 and +1.2 from December-February (climatology: 1991-2020), both in the La Niña range.

Trade winds were stronger than normal in the equatorial Pacific. However, significantly reduced trade winds and a possible westerly wind burst are predicted for March. This is linked to a pulse of the Madden-Julian Oscillation (MJO) crossing the Pacific. This radical change in equatorial circulation represents the first real sign that the ocean-atmosphere system has a chance of moving toward El Niño during 2023.

In the subsurface central equatorial Pacific, La Niña's decay continued during February. Sub-surface water temperatures were above average across the entire basin, with waters in the upper 100 m of the eastern equatorial Pacific becoming more anomalously warm as compared to January. Closer to the surface, warmer than average waters spread toward the central Pacific, leading to a contraction of La Niña's remnant cool pool of water.

NIWA's analysis indicates that La Niña will transition to ENSO-neutral during autumn (95% chance), most likely during March. The chance for El Niño conditions then increases to over 60% during winter, continuing through spring. That chance is supported by the trends in sub-surface ocean conditions and trade winds.

During March, Madden-Julian Oscillation (MJO) phase 8 is expected to be associated with below normal air pressure and temperatures and a strong south-to-southwest air flow anomaly around New Zealand. The MJO may move toward phase 1 during mid-to-late March, which is associated with stronger westerly winds during the autumn season. From late March into early April, a convective pulse associated with the MJO may move over the Indian Ocean, Maritime Continent, and West Pacific once more, bringing La Niña-like patterns and briefly increasing the risk for tropical cyclones in the Southwest Pacific.

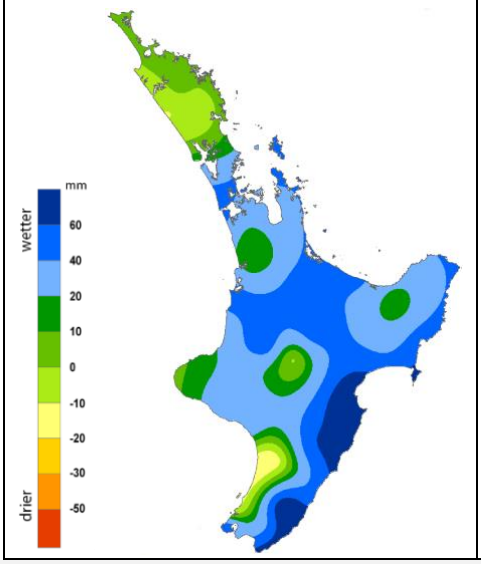
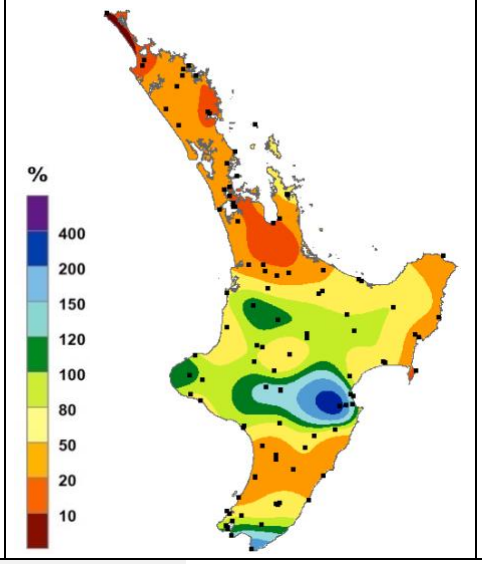
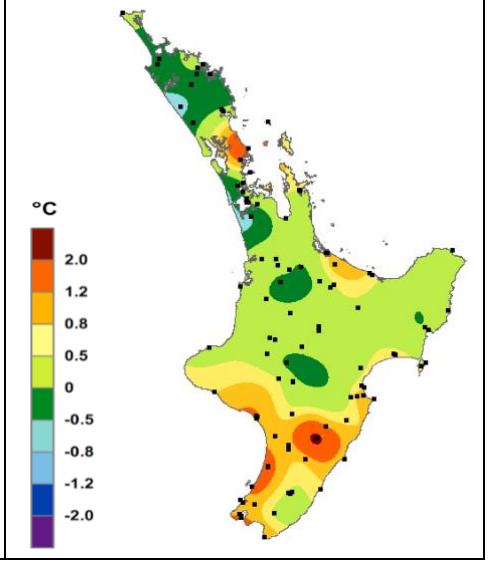
Soil moisture anomaly: 15/3	Rainfall anomaly: 1/3 – 15/3	Temperature anomaly: 1/3 – 15/3
		

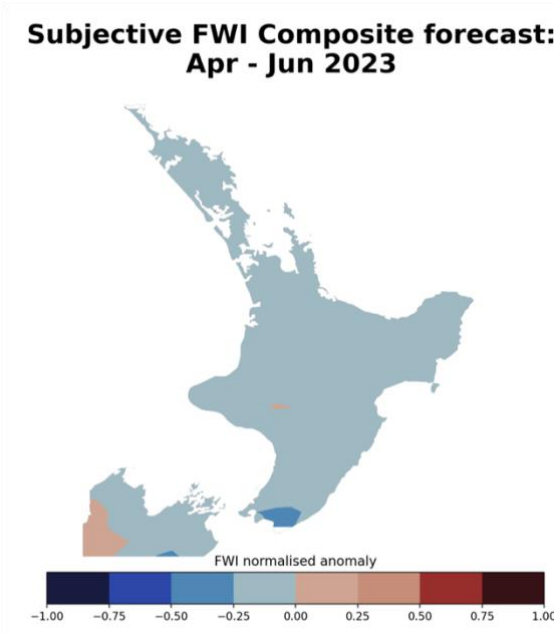
Figure 4: Maps showing the current soil moisture anomaly, as well as temperature and rainfall differences from normal since the start of the month.

Fire season analogues

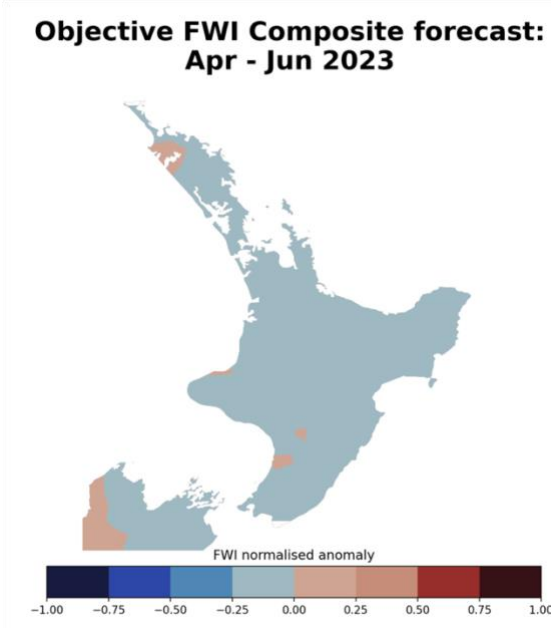
To help understand what fire weather conditions may be like this summer, we can look at analogues. Analogues are historical years with similar climatic conditions to the current year.

This season's analogue years features historical years that had La Niña transitioning to ENSO-neutral conditions, with the possibility of El Niño conditions developing by the middle of the year (Figure 5). 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.

Both sets of analogue years are showing a similar outcome for April-June, with nearly the entire North Island expected to have lower fire danger than normal during the season.



Forecaster-selected analogue season – Apr to Jun
1997
2006
2003
1993
1986
1982
2020
2018



Machine-selected analogue season - Apr to Jun
2004
2001
2011
2000
1981
2013
1990
1999

Figure 5: 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: April 2023

April's air flows are expected to be variable, but still tending easterly at times. Rainfall patterns may also be variable, although the upper North Island may start to trend in a drier direction. Wind speeds are expected to be below normal across the North Island in April. Above average temperatures are favoured overall, but periodic cold snaps will be possible. Relative humidity is forecast to be slightly higher than normal in eastern areas and near normal or below normal in western areas (Figure 6).

Climate outlook: April – June 2023

With ENSO-neutral conditions most likely during April-June, mixed air flows are expected, although there may be a tendency toward easterly-quarter winds. Temperatures overall look to be warmer than average, but notable cold snaps could occur during southerly wind flows (Figure 7). Rainfall could tend a bit drier, especially in the upper North Island. Above normal relative humidity is favoured in the east, although relative humidity could 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.

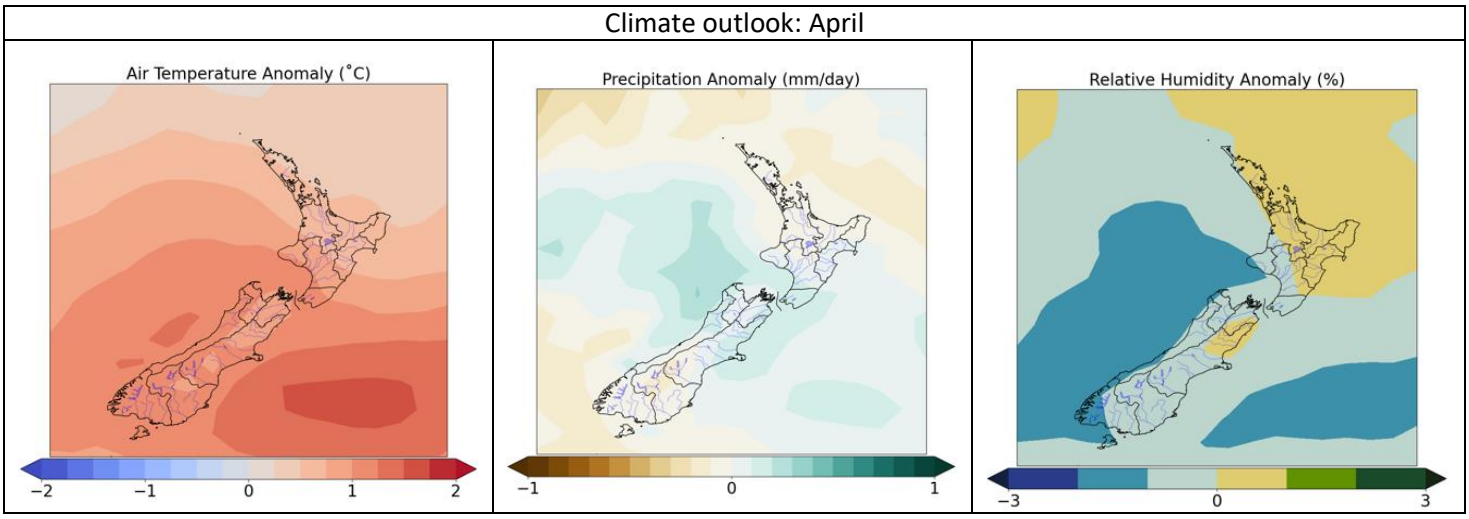


Figure 6: Climate outlook for April showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

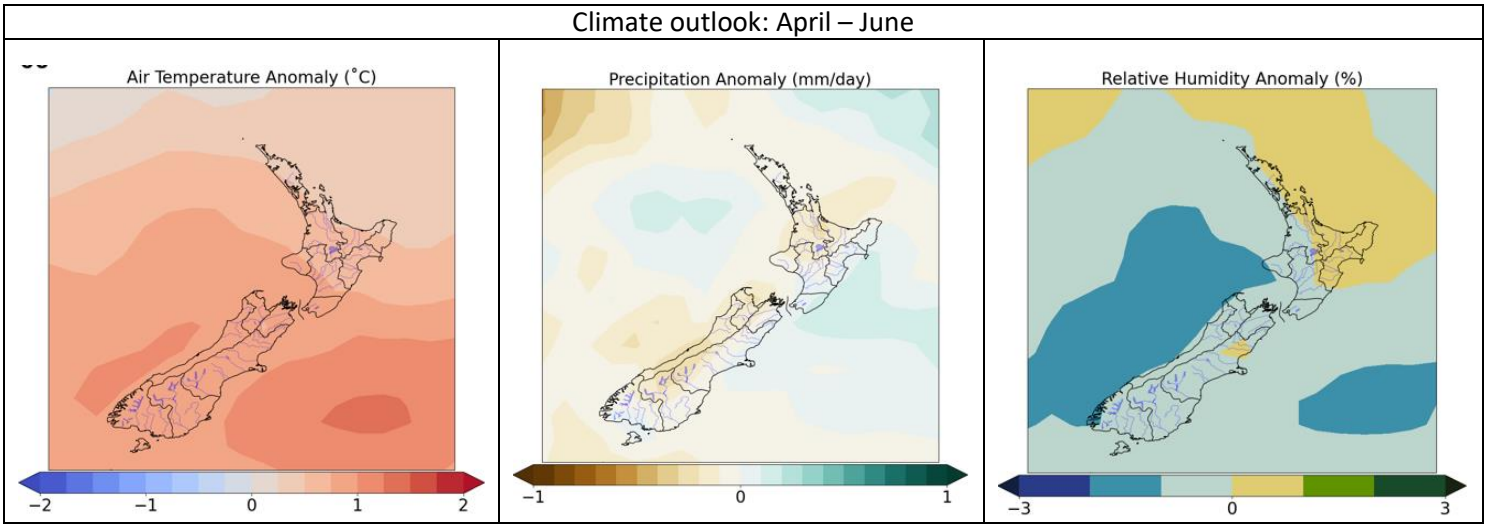


Figure 7: Climate outlook for April-June showing forecast temperature (left), rainfall (middle) and relative humidity (right) anomalies.

Expected impact on fuels and fire danger

While the autumn season typically retains considerable fire danger due to the presence of highly cured grasses, dry soils and dry fuels across all of the main fuel sizes (fine, medium and coarse), this is not the case currently across the North Island. There will be sporadic pockets where seasonal curing in local grasses has occurred, with seed heads now dead and available to dry out if prevailing conditions are conducive. If fires do occur, they are likely to be limited by the amount of green material in the grass sward and are unlikely to spread with much intensity, therefore limiting the potential to involve heavier fuels.

Scrub fuels remain a high risk at any time of the year, with the elevated nature of the fine fuels making them highly receptive to even subtle changes in the drying trend of the weather. They only need windspeeds of 20 km/h with Fine Fuel Moisture Code (FFMC) values of 60 to exhibit very high to extreme fire behaviour, which will challenge and exceed initial response capabilities.

With the potential for a continuing drying trend in the upper North Island, it is possible that these areas will see an increased fuel availability. However, with autumn conditions prevailing, daily increases in the Drought Code (DC) and Duff Moisture Code (DMC) will at best be 7 points and 4 points respectively, further reducing as the days get shorter and cooler as we transition to winter. These in turn influence the Build Up Index (BUI), which is an indicator of the total available fuel for combustion. BUI values are typically below 30 across the entire North Island, with very few exceptions, which means that fires are unlikely to pose any difficulties for control.

As recently observed in Hastings (see Figure 8), thunderstorms have the potential to create fires. While they only represent a very small proportion of total incidents in Aotearoa (typically recognised to be less than 2% of all ignitions), they can have spectacular results. As we progress into the cooler months, thunderstorm risk can increase due to the presence of relatively warmer temperatures at ground level compared to colder air aloft, increasing atmospheric instability. However, most thunderstorms will be associated with rain, and as such things are typically too wet for fire to spread following lightning.

Figure 8: Lightning fire in a palm tree, Hastings (Friday 10th March 2023).

Spontaneous combustion[2]

Accumulations of vegetation debris generate heat as they start to decompose in the presence of low levels of oxygen. This occurs as microbes within the debris turn sugars into water and carbon dioxide, with heat being generated in the process. As the biological activity associated with decomposition increases within the accumulated material, the heat produced can quickly raise the internal temperature to ignition point and over time can result in spontaneous combustion.

Spontaneous combustion fires can occur within large compost or woodchip/sawdust piles, forestry skid sites, or where hay is baled when the plant material is either too green or has excess moisture (as a result of rain, dew etc).

Depending on the size of the debris pile, such fires can be extremely difficult to extinguish, taking considerable time and the use of heavy machinery. Where these fires occur in remote locations, the potential for the fires to become large and potentially spread to surrounding vegetation is elevated even further due to delays in both detection and response, such as with remote forestry skid-sites. This is similar for areas where access is cut off or limited, as may be the case in parts of the motu impacted by recent flooding events.

[2] Report-182-Factors-contributing-to-spontaneous-combustion-of-slash-at-skid-sites.pdf (fireandemergency.nz)

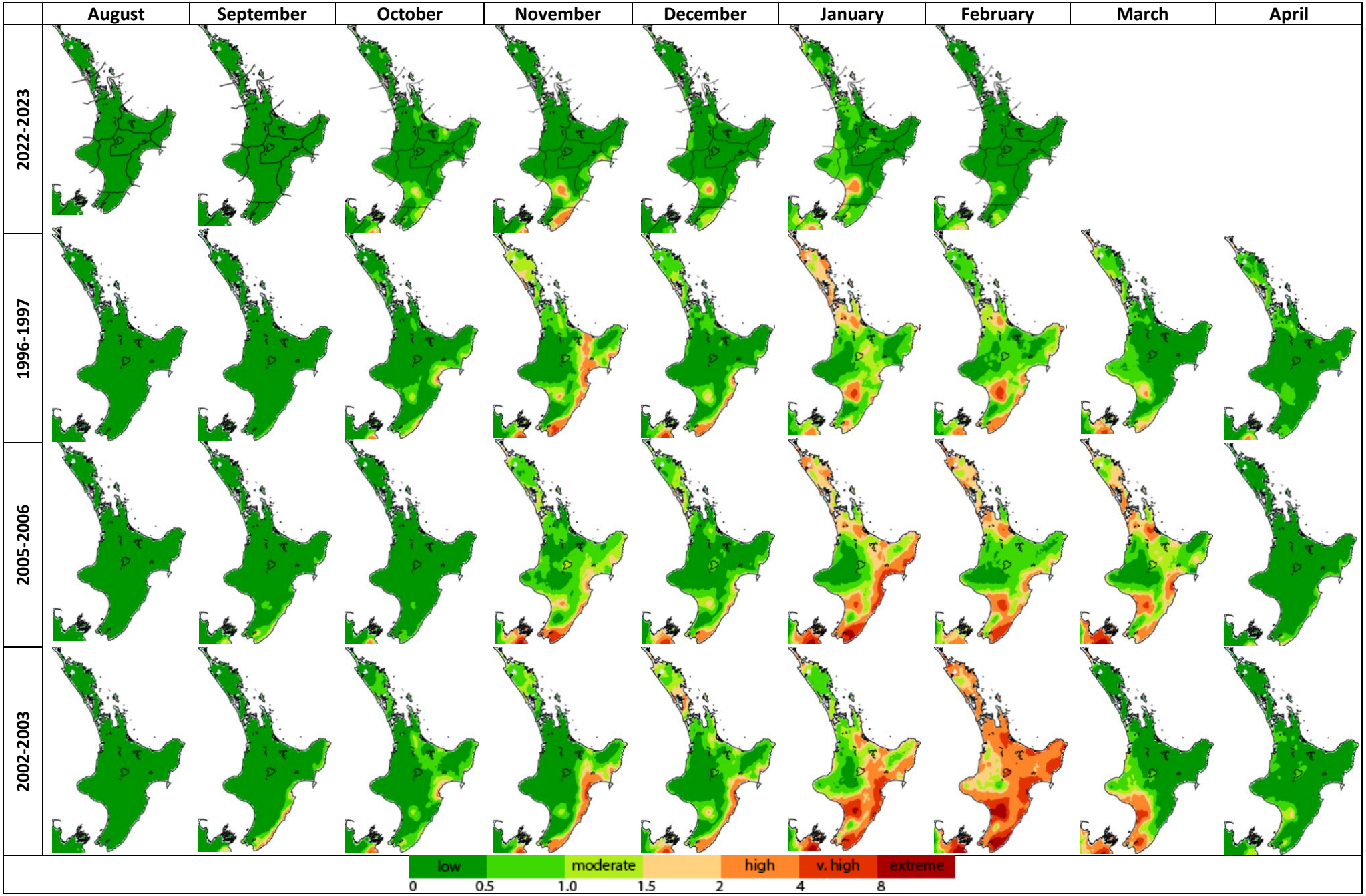


Figure 9: Monthly average severity rating for 2022-2023 up to and including February and the comparative years of 1996/1997, 2005/2006, and 2002/2003. These are analogue years for the current season and give us an insight into what the upcoming season may be like.

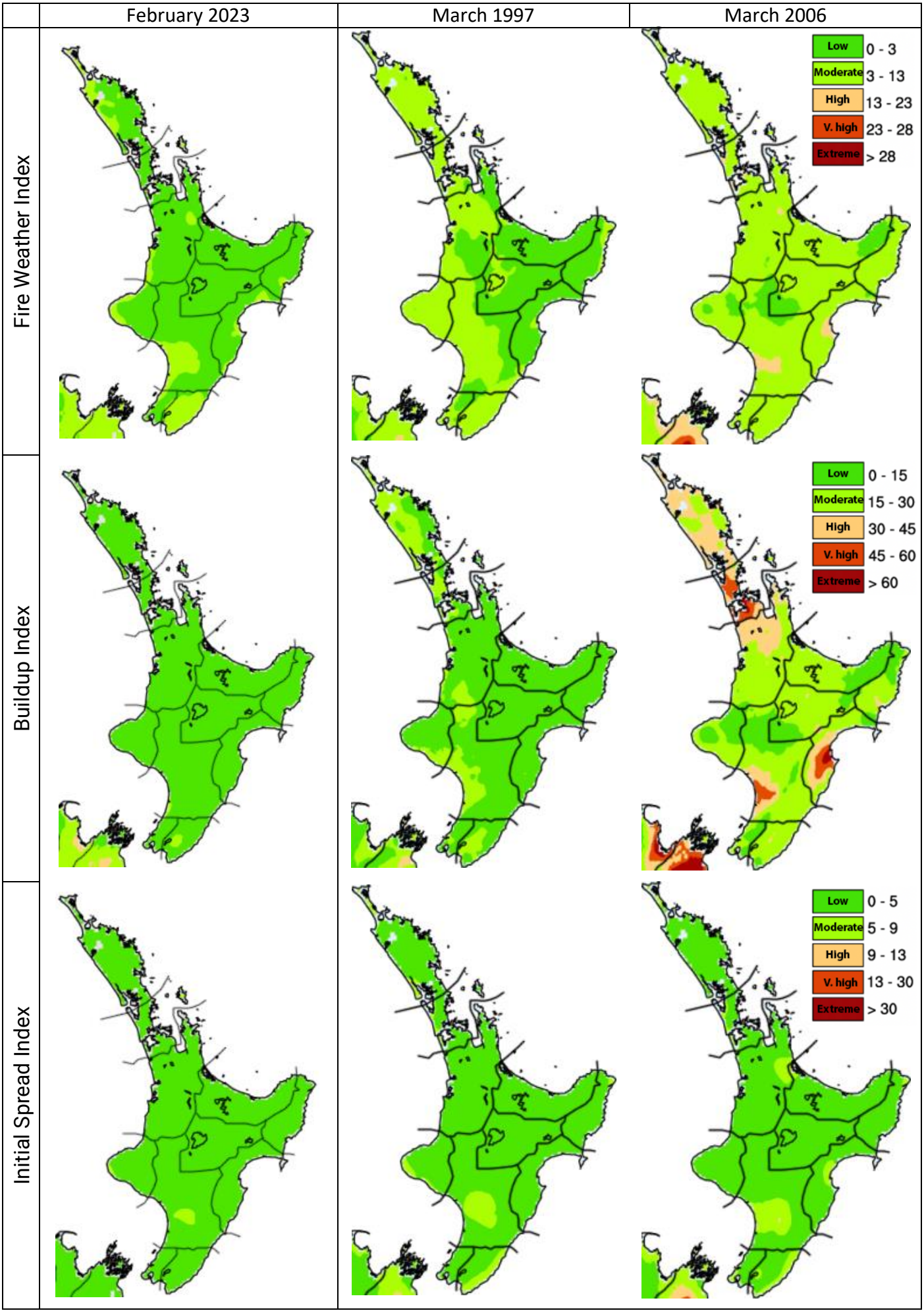


Figure 10: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (bottom).

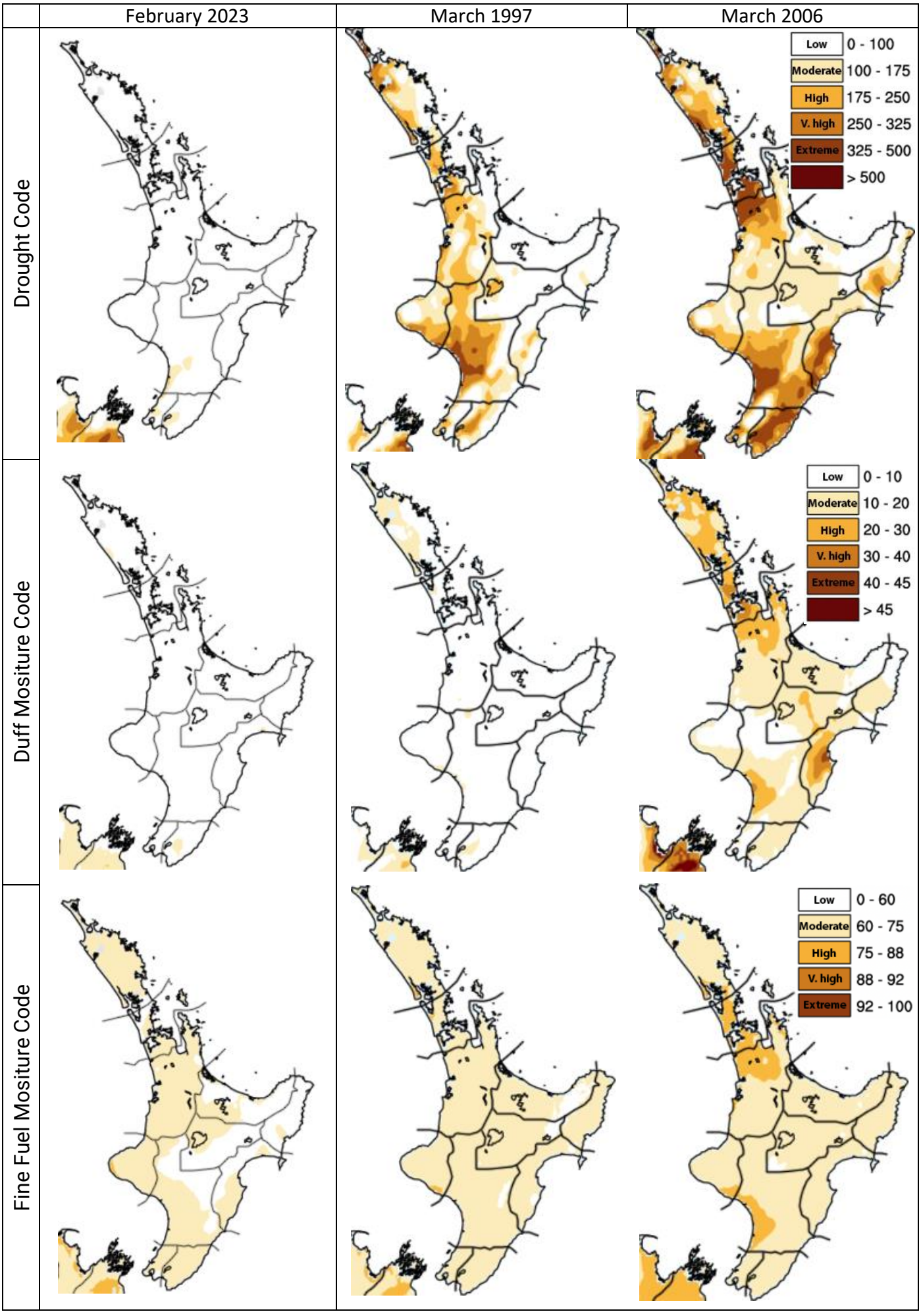


Figure 11: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (bottom).

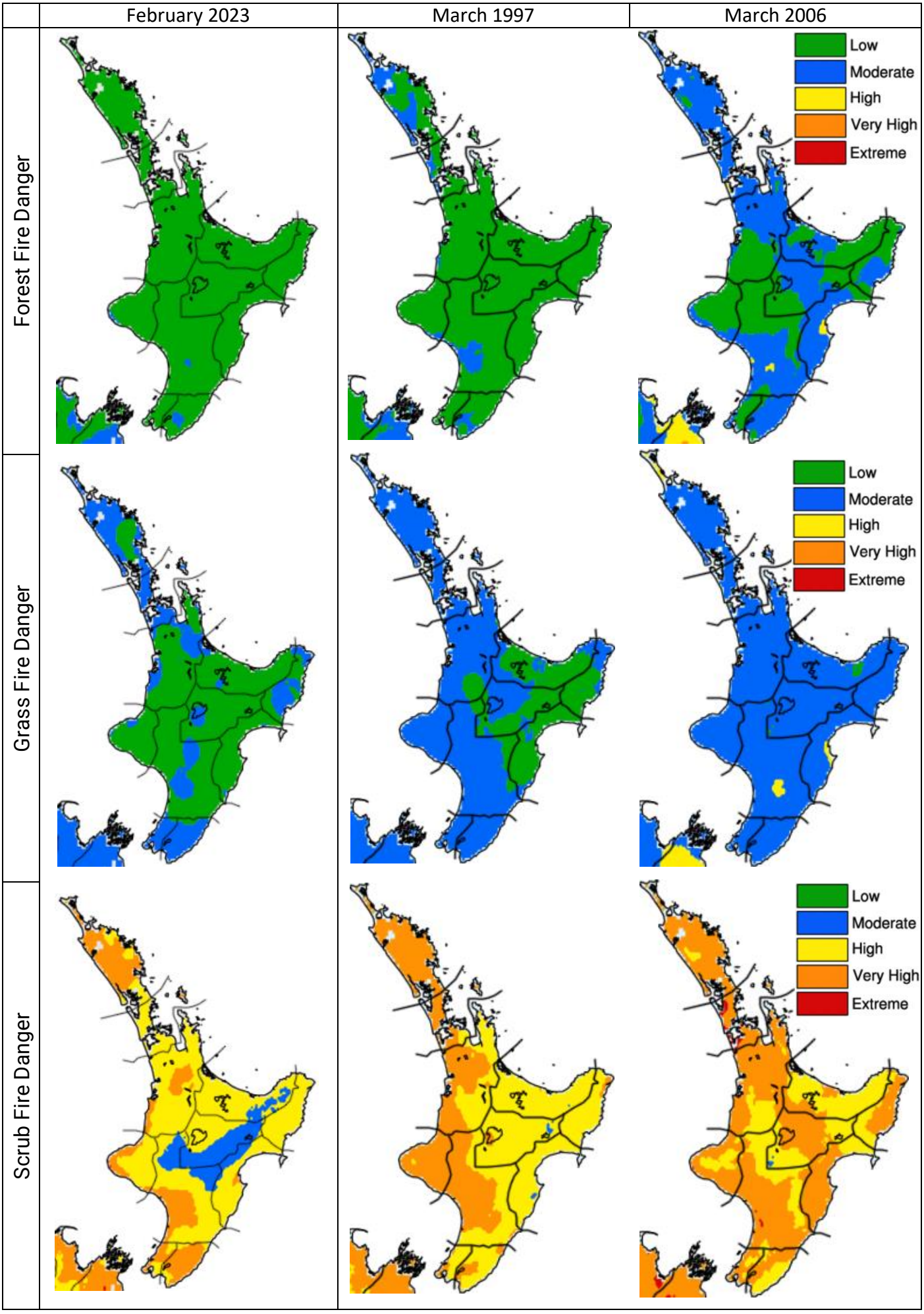


Figure 12: The most recent observed month (left column) and analogue months for March (middle and right columns); monthly average for the Forest Fire Danger (top), Grass Fire Danger (middle) and Scrub Fire Danger (bottom).

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