# North Island Monthly Fire Danger Outlook (2020/21 Season)

## ISSUE: February 2021

### Current fire danger situation

New Zealand is trending towards the peak of the fire season, with many locations already experiencing an increase in the number of wildfires and prolonged suppression, as fuels continue to dry out. In general, monthly fire dangers and fire climate severity have elevated into High to Extreme for Northland, Auckland, Northern Waikato, Gisborne, Hawke's Bay, Wairarapa and a pocket around Palmerston North (Figures 4, 5 & 9).

### Fuel and soil moisture status

This is reflected in the current FWI System codes and indices (FFMC, DMC, DC, and BUI). These codes indicate the ease of ignition, the amount of fuel available for combustion, and how deep-seated and prolonged mop-up could be.

In general, most stations are recording BUI and DC values well above or on trend with the historical average for this time of the year. Locations with BUI and DC values between on trend to well above average are in Northland, Auckland, Waikato, Bay of Plenty, Central North Island, Gisborne, Hawke's Bay and Wairarapa. In contrast, stations that have below average BUI and DC values for this time of the year are found in Taranaki and Wellington. The remaining locations (Whanganui/Manawatu, Chatham Island) have a mix of stations trending above or below the average for this time of the year. Graphs tracking individual station trends daily are available on the Scion website.

Much of the North Island is in soil moisture deficits (Figure 2) and all regions are drier than normal for this time of the year (Figure 3). There is widespread dry to extremely dry soils in Northland, Auckland, Northern Waikato, Western Bay of Plenty, Gisborne, Hawke's Bay and Wairarapa regions (NIWA's NZDI map). The Far North Districts and East Cape are currently experiencing meteorological drought.

### Forecast climate and weather

La Niña conditions remain in the tropical Pacific and international models indicate it has reached its peak strength. It is expected that this event will gradually ease over the remainder of summer and return to Neutral conditions by early Autumn. Despite this weakening pattern for late summer, the non-traditional La Niña is still expected to influence our climate.

Over the next three months (February to April), higher than normal air pressure is predicted to dominate. New Zealand will experience a mix of easterly and south-westerly winds. Extended dry spells and sporadic heavy rain is expected to continue during this fire season. The ongoing unusually dry conditions across parts of the upper North Island are also likely to continue. Air temperatures are expected to be either above average or near average. Rainfall is likely to be near normal or below normal.

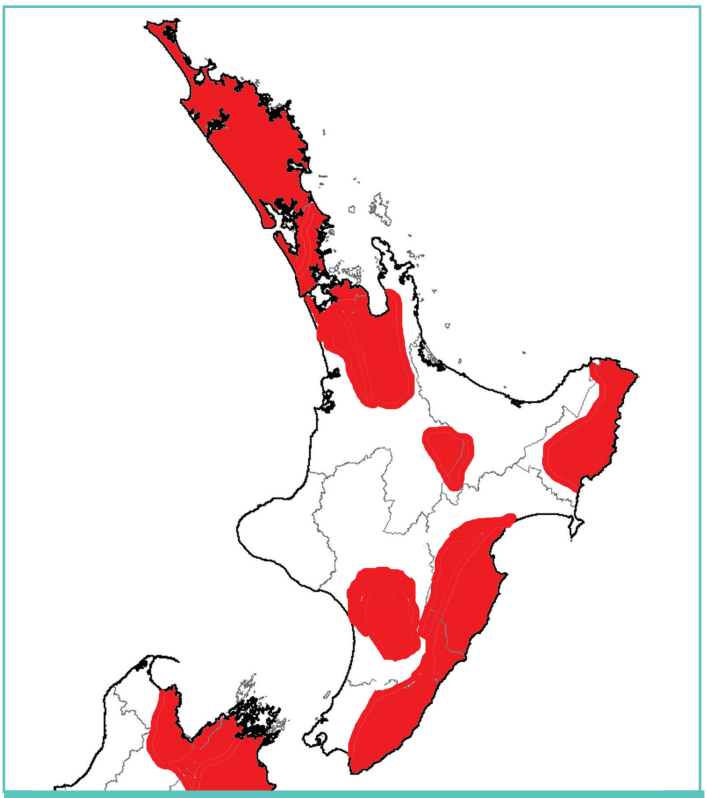
Both islands will have changeable weather that averages out warmer than normal this month. A continuation of extended dry spells is expected, interspersed with unsettled weather. High pressure will dominate and bring a dry start to the month. In between these highs, especially in the middle of the month, wet weather might be allowed in. The country is also likely to experience temperature bounces from the month average before returning to normal summertime weather.

### Locations to watch

February is characteristically the hottest period of the year. Forecasted above average temperatures and below normal soil moisture levels will continue to dry vegetation out, further elevating the fire risk and contributing to deeper burning, and potentially faster moving fires. A lack of rainfall over an extended period will result in medium to heavy fuels being available to burn, contributing to deeper burning fires that will require prolonged mop-up.

Fire dangers typically peak in the months of February or March before declining over the month of April. The fire seasons coinciding with moderate strength La Niña conditions occurred in 2010/11, 2007/08, 1999/00, and 1998/99 and are potentially good indicators for what to expect this coming fire season (Figure 11). However, this fire season has not followed traditional La Niña weather patterns and has resulted in northern locations being unusually drier than normal.

Areas to keep an eye on for High to Extreme fire dangers are those currently experiencing dry to very dry soils, elevated fuel moisture codes and forecasted warm dry spells. These locations include Northland, Auckland, northern Waikato, Gisborne, Hawke's Bay, Wairarapa (Map 1). However, if substantial rainfall events (much like in December) occur, this will improve soil and fuel moistures and consequently reduce the potential for wildfire outbreaks. With very dry soils across northern and eastern locations, rainfall is less easily absorbed into the ground; this will also increase the possibility of flooding if these regions experience heavy rainfall.



Map 1. Locations identified as specific areas of interest that have or may develop an elevated risk of High to Extreme fire danger over the next three months.

## Background

The purpose of these monthly outlooks is to provide a heads up on current and potential fire danger as we transition from spring to summer and, later, into autumn. This is not a detailed fire seasonal outlook for specific localities, nor does it summarise fire potential (which depends on fuel conditions (i.e. grass curing), risks of ignitions, recent fire history and fire management resources available in an area, as well as weather and climate).

It aims to forewarn fire agencies of current and potential fire danger conditions that can be used as a prompt for local and regional discussions on fire potential. Continue your pre-planning, by discussing where conditions are at, where they are heading, and what this might mean for fire risk in your patch and for your neighbours.

## EXPECTED CLIMATE OUTLOOK:

The ENSO outlook remains at La Niña conditions. Current model projections indicate that this La Niña event has reached its peak and is expected to gradually return to neutral during late summer or early autumn. International models are forecasting La Niña to continue over the next three months (70% during February – April). ENSO neutral conditions are favoured (66%) during May to July with neutral conditions favoured (47%) during August to October. Despite this weakening pattern for late summer, La Niña is still expected to influence our climate for February and into Autumn. A non-traditional central Pacific-based La Niña event continues, resulting in unusually cool Sea Surface Temperatures (SSTs) in the central Pacific. Cooler than average sea temperatures are expected to continue for several months. This non-traditional La Niña has produced uncharacteristically dry conditions across the upper North Island. The influence on our climate patterns are expected to continue over the next three months

To help understand what the fire season could look like during the next three months, recent past events (historical analogues) reminiscent of a moderate La Niña included 1998/99, 1999/00, 2007/08 and 2010/11. Weak La Niña seasons included 2000/01 and 2011/12. However, each historical La Niña event has resulted in different weather patterns for New Zealand. Our weather is very dependent on where the high-pressure systems sit (which determines the air flow over New Zealand).

**Tropical Cyclone outlook**

To date, five Tropical cyclones have developed in the south west Pacific (Yasa, Zazu, Ana, Bina & Lucas). La Niña may have peaked, but we are only just approaching the peak of the tropical cyclone season.

The risk for New Zealand to be affected by an ex-tropical cyclone this season remains elevated. The risk is considered above normal, with equal probabilities of an ex-tropical cyclone passing either to the east or west of the North Island. Significant rainfall, damaging winds, and coastal damage by waves are possible in the lead up to and during these events. These cyclone events can reduce the fire risk in affected areas, with effects often being spread over a large area, especially if a decaying storm system interacts with other existing weather systems.

### This month: February 2021

Continued extended dry spells interspersed with unsettled weather is forecast for February. High pressure at the start of the month continues the dryness across the country with the Southern Ocean providing some welcome relief for some. The second half of the month is predicted to bring with it changeable weather. As the high pressure becomes weaker and gives way to low pressure systems, the country will experience temperature bounces from the typical average for the month before returning to normal summertime weather.

### Further ahead:

Over the next three months (February – April 2021), higher than normal air pressure is forecast over New Zealand, which can encourage periods of below normal rainfall. A mix of easterly and south-westerly winds are also expected. With high pressure dominating, extended dry spells are expected to continue over the next three months.

Air temperatures will likely be above average for northern regions, and near average or above average for remaining regions. Rainfall is likely to be near normal or below normal in the north and east of the North Island, and near normal for the remaining regions. Soil moisture levels and river flowers are expected to be below normal in the north and east of the North Island, and near normal or below normal for remaining locations.

### Regional Breakdown (Figure 1):

**Temperatures are most likely to be:**

- above normal (50% chance) for Northland, Auckland, Waikato and Bay of Plenty;
- above normal (45%) or near normal (40%) for Gisborne, Hawke's Bay, Wairarapa, Central North Island, Taranaki, Whanganui, Manawatu and Wellington.

**Rainfall is most likely to be:**

- near normal (40%) or below normal (35% chance) for Northland, Auckland, Waikato, Bay of Plenty, Gisborne, Hawke's Bay and Wairarapa;
- near normal (45%) for Central North Island, Taranaki, Whanganui, Manawatu and Wellington.

**Soil moistures and river flows are most likely to be:**

- below normal (45% chance) for Northland, Auckland, Waikato, Bay of Plenty, Gisborne, Hawke's Bay and Wairarapa;
- below normal (40-45% chance) or near normal (40%) for Central North Island, Taranaki, Whanganui, Manawatu and Wellington.

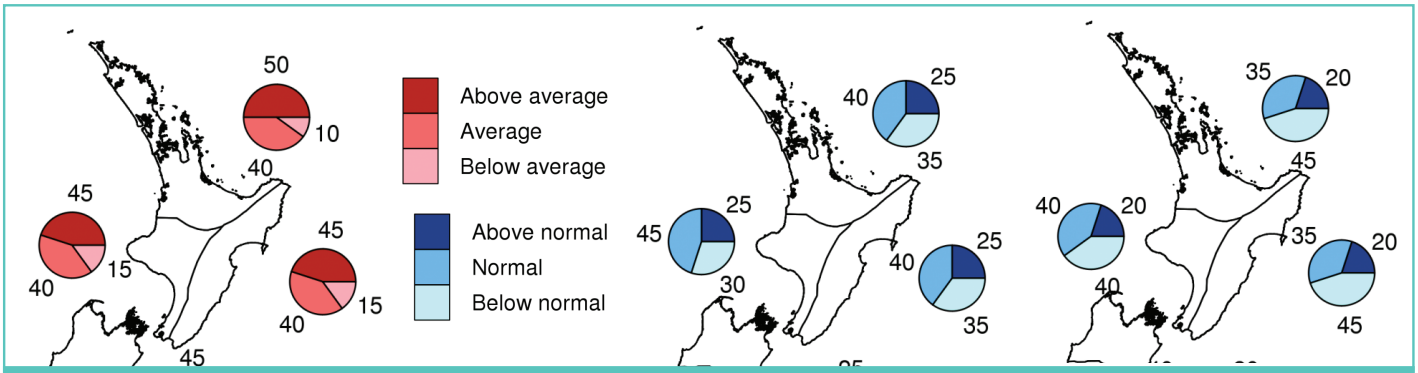



Figure 1. Outlook for February to April 2021: air temperature (left), rainfall (middle), available soil moisture (right). Source: NIWA.

## Last month: January 2021

Weather during January has been very interchangeable. Parts of the North Island experienced thunderstorms. But most notably, north and east of the North Island have experienced drier than normal conditions (atypical of La Niña). Several regions also experienced hot weather, with Napier, Gisborne and Masterton recording 35ºC on the 28th.

## Soil moisture (Figure 2 & 3)

In general, eastern and upper North Island locations have been windy, hot and dry. As a result, the dryness has expanded significantly across much of the North Island compared to last month, with soil moisture levels well below 50% storage capacity for all regions (Figure 2). The exceptions being small pockets in Taranaki and Greater Wellington.

The driest soils (red) are in Northland, Auckland, pockets of Waikato, Gisborne, Hawke's Bay and Wairarapa. This is also reflected in the soil moisture anomaly map (Figure 3), where soils are drier than normal across the North Island.

NIWA's Drought Index (NZDI) indicates severe meteorological drought is occurring in Northland's Far North District and meteorological drought is occurring in the East Cape. Very dry to extremely dry soils are present in Northland, Auckland, Northern Waikato, Western Bay of Plenty, Gisborne, Hawke's Bay and Wairarapa.

## Fine Fuel Status

The moisture content of fine fuels under forest canopies or scrublands, and grass pastures (as they brown off) dramatically affects the ignition potential and ability of a wildfire to spread. High amounts of moisture increase the heat and thermal conductivity of fuel, so that more heat is required in order for the fuel to reach its ignition temperature. As grasses cure, and become drier, less heat is required to ignite and sustain a fire.

If a heat source is present in fine fuels with a FFMC of 86 or more, or grass curing over 80%, ignition will be easy, and a fire can still spread. Under warm and windy conditions, don't be surprised to observe incredible rates of spread and flame lengths, even with shorter grass. Light, flashy fuels are one of the common denominators of tragedy fires.

## Grass growth & curing:

As summer progresses, many parts of the country that are experiencing lack of rainfall will observe landscapes changing from a vibrant green to yellow or a bleached blonde colour. Cured grass at this stage heightens the potential for a fire to ignite and spread in these fuels. The risk of grass fires starting and spreading in these areas is amplified further by high temperatures, low humidity and strong winds.

Depending on where you are in the country, grass curing could be patchy over a series of paddocks/area, especially during the 40 – 80% curing period. Or if you are experiencing summer droughts, curing will become more continuous in the dry bleaching phase of 70 – 100% curing. Above 80% curing, fuel moisture content begins to be significantly influenced by the environmental factors (humidity, temperature and wind).

For areas experiencing high curing values, wildfires burning under these high grass curing conditions can produce large to very tall flame heights (2 m+), spread very quickly, be very intense and much more difficult to suppress.

## The finer details:

The degree of grassland curing represents the proportion of dead material in a grassland fuel complex, expressed as a percentage. It is an important input for models to predict rate of fire spread and determine fire danger levels in grasslands.

Grassland curing will affect fire behaviour in several ways: it increases the amount of dead material present and affects fuel moisture content. The result is an increased chance of fire ignition, fire intensity and rates of spread. The moisture content of fine grass fuels (as well as pine litter and other fine fuels) also dramatically affects the ignition potential and ability of a wildfire to spread. High amounts of moisture increase the heat and thermal conductivity of fuel, so that more heat is required for the fuel to reach its ignition temperature. As grasses cure, and become drier, less heat is required to ignite and sustain a fire.

In partially cured grasslands, enough dead fuel needs to be present to ignite and sustain fire spread. Surrounding green grass with higher fuel moisture contents will require substantial heat input to burn off excess moisture and ignite. If there is not enough heat to ignite the greener sections of the grass, fire spread will either be very patchy or not spread at all. Burning under these conditions will produce very small flame heights, be low intensity and easily suppressible.

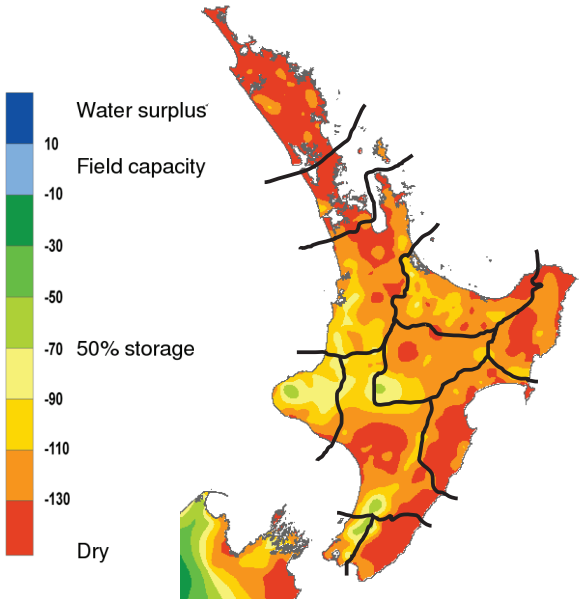



Figure 2. Soil moisture deficits as of 10/02/2021.
Source: NIWA.

*Note: Soil moisture deficit means the amount of water needed to bring the soil moisture content back to field capacity, which is the maximum amount of water the soil can hold.*

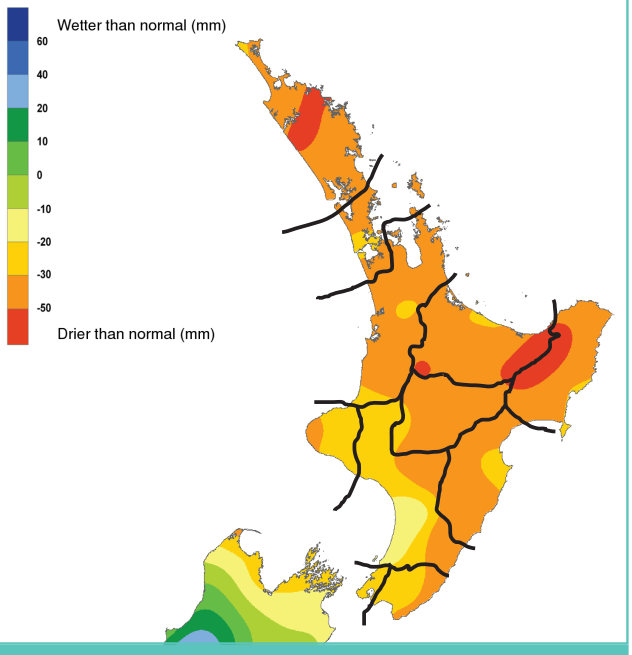



Figure 3. Soil moisture anomaly as of 10/02/2021.
Source: NIWA.

*Note: Soil moisture anomaly means the difference between the historical normal soil moisture deficit (or surplus) for a given time of year and actual soil moisture deficits.*

In some areas, the presence of dead matted material from the previous season's growth (thatch) can contribute to the ease of a fire starting and spreading. The material is often hidden underneath lush green grass that appears to have low curing (30 - 50%). However, thatch can increase a fires ability to carry and sustain a fire. These fires will typically produce small flame heights and spread in a patchy manner. It is often necessary to part the current season's grass to examine how much thatch is underneath. Even if a paddock has been harvested or grazed, there is often a couple centimetres of dead grass remaining.

## What does typical La Niña mean for NZ?

New Zealand's climate is influenced by two key natural cycles: the El Niño-Southern Oscillation (ENSO) and the Interdecadal Pacific Oscillation (IPO). Both these operate over the Pacific Ocean and beyond, and cause fluctuations in the prevailing trade winds and in the strength of the subtropical high-pressure belt.

El Niño and La Niña are opposite phases of the global ENSO climate cycle. The two phases disrupt the typical wind and rainfall patterns for New Zealand. Neutral conditions encourage far more variability in weather patterns for New Zealand, whereas El Niño or La Niña tend to have more predictable patterns.

It's important to note that ENSO events have an important influence on New Zealand's climate, but account for less than 25% of seasonal rainfall and temperatures. La Niña is only an important climate driver for New Zealand over long durations (2-6 months) when a moderate or strong event is in force. If a weak La Niña occurs, it means our 'local' climate players (the Southern Ocean southerlies and Tasman Sea lows) will continue to take turns ruling our weather.

This is a good reminder that local climate patterns (blocking Highs over or near New Zealand, Lows over the Tasman Sea or to the north of the country, and the Southern Ocean storms) generally 'trump' climate patterns such as El Niño and La Niña.

### Typical La Niña effects on New Zealand

La Niña can encourage warmer than average sea temperatures, and fuel cyclones. The north can experience frequent lows and subtropical storms, occasionally stretching down as far as Canterbury. New Zealand is typically warmer than average during a La Niña, although there are regional and seasonal exceptions. During La Niña, more high-pressure systems than normal lie over the east of the country (South Island and Chatham Islands). This generally leads to more north-easterly and easterly winds (as opposed to westerlies).

### Typical La Niña effects on the North Island

For the North Island, this means northern and eastern parts are wetter than normal. It can typically mean a wetter, milder and cloudier spring. Summer tends to be warmer and more humid than average. The exceptions being eastern locations experiencing onshore winds and cloudy skies.

Outbreaks of warm north-easterly winds bring rain to areas in the north and east of the North Island, especially Gisborne, Coromandel and Northland. Above normal summer and autumn rainfall often occurs over the far north of New Zealand (Coromandel northwards).

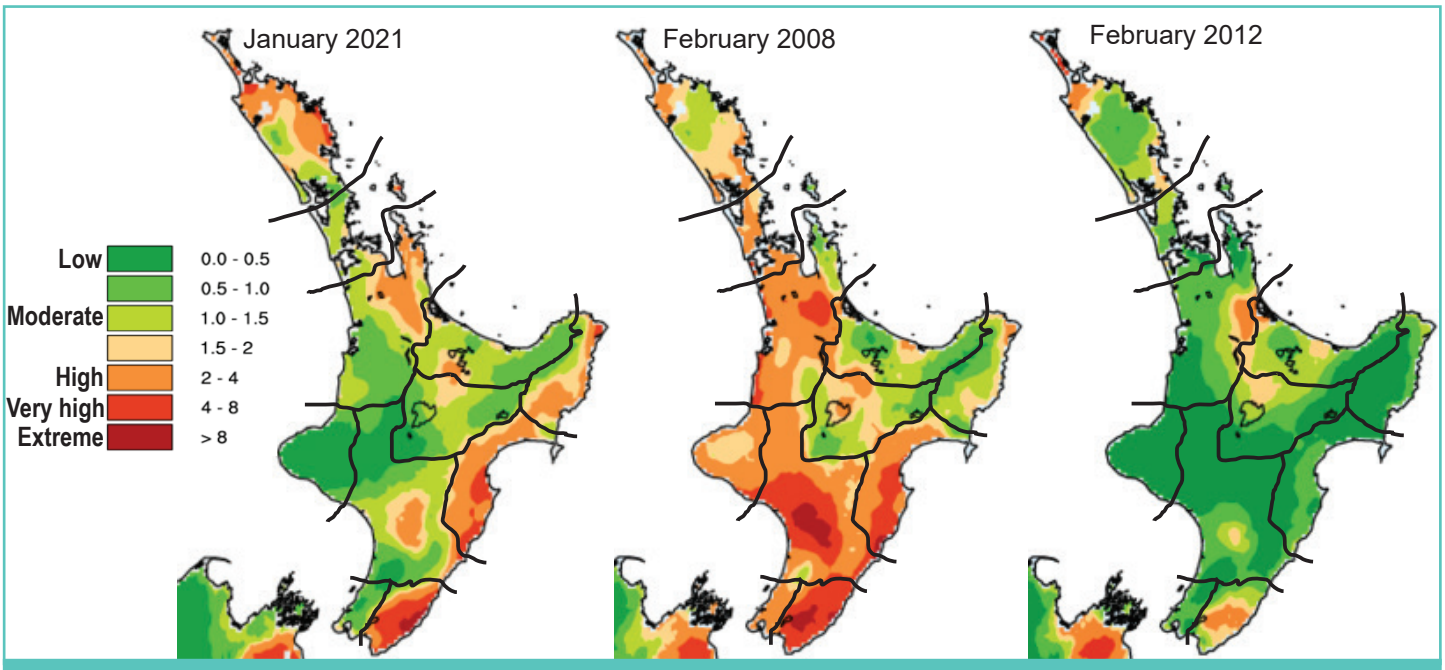



Figure 4. Monthly average Severity Rating for: the previous month (left), and expected average monthly values during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

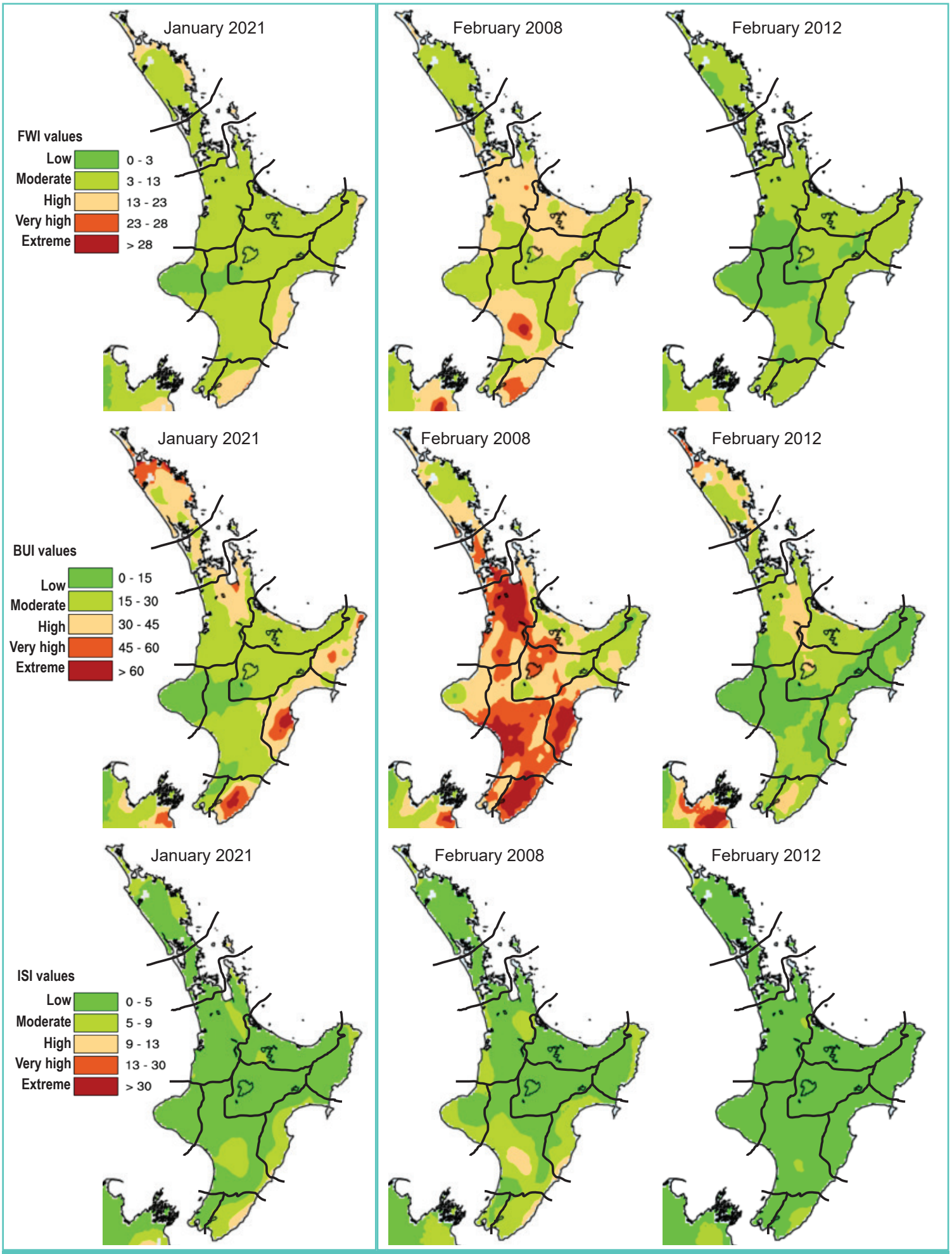



Figure 5. Previous Monthly Average for the: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below).

Figure 6. Expected average Monthly values of: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below); and during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

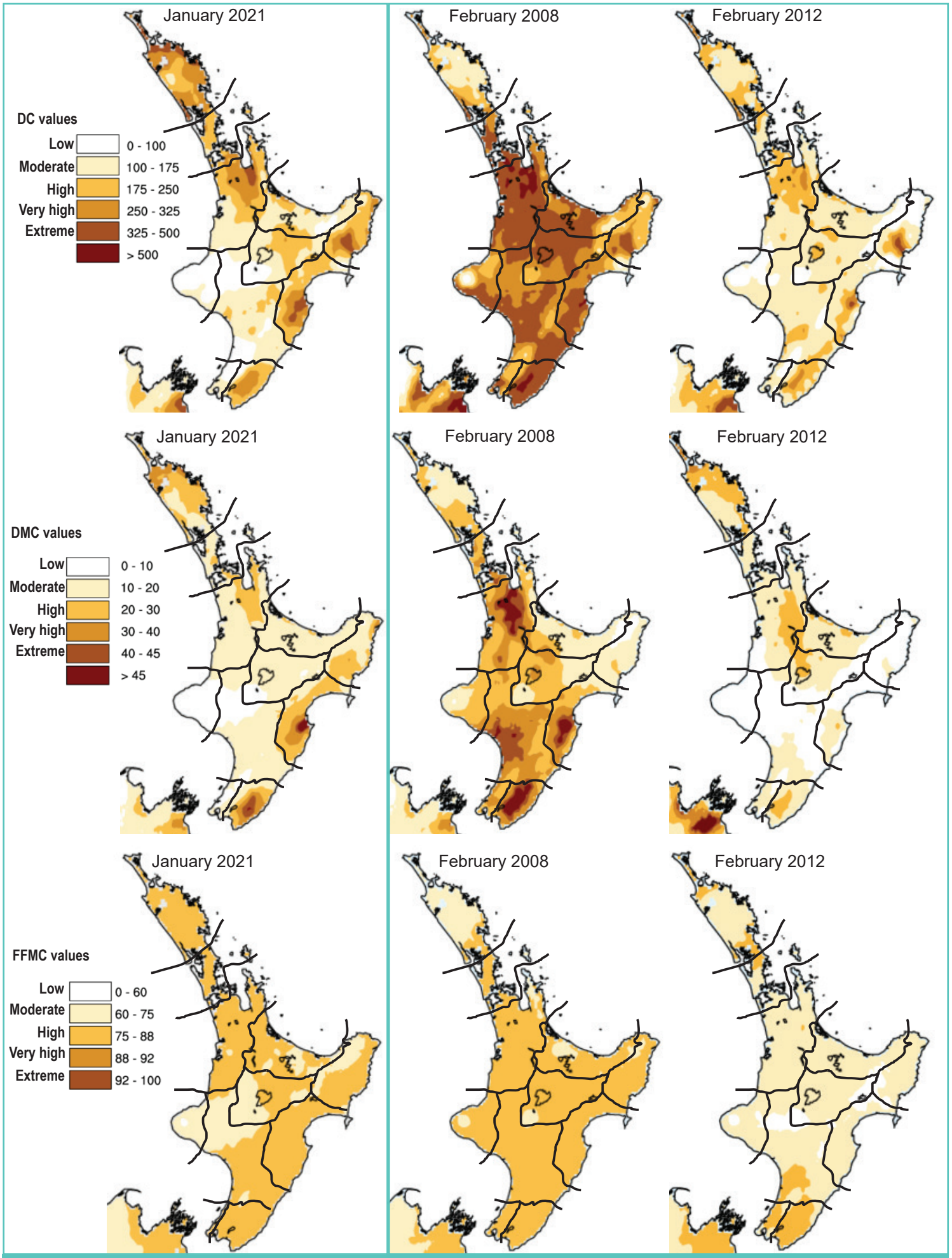



Figure 7. Previous monthly average for the: Drought Code (top), Duff Moisture Code (middle) and the Fine Fuel Moisture Code (below).

Figure 8. Average monthly values of: Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (below); and during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

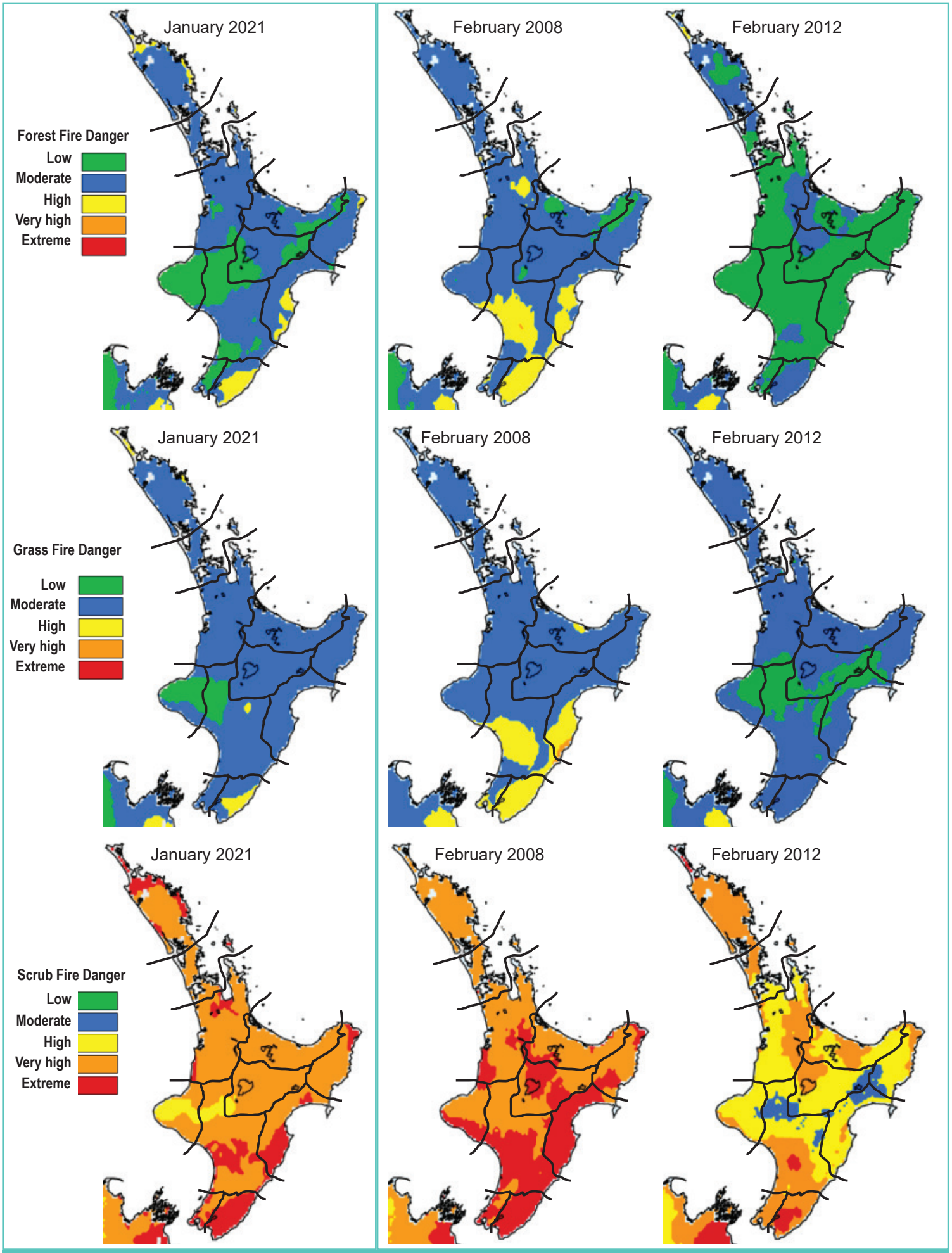



Figure 9. Previous Monthly Average for: Forest Fire Danger (top), Grassland Fire Danger (middle) and Scrub Fire Danger (below).

Figure 10. Expected average monthly values of: Forest Fire Danger (top), Grassland Fire Danger (middle) and Scrub Fire Danger (below), during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

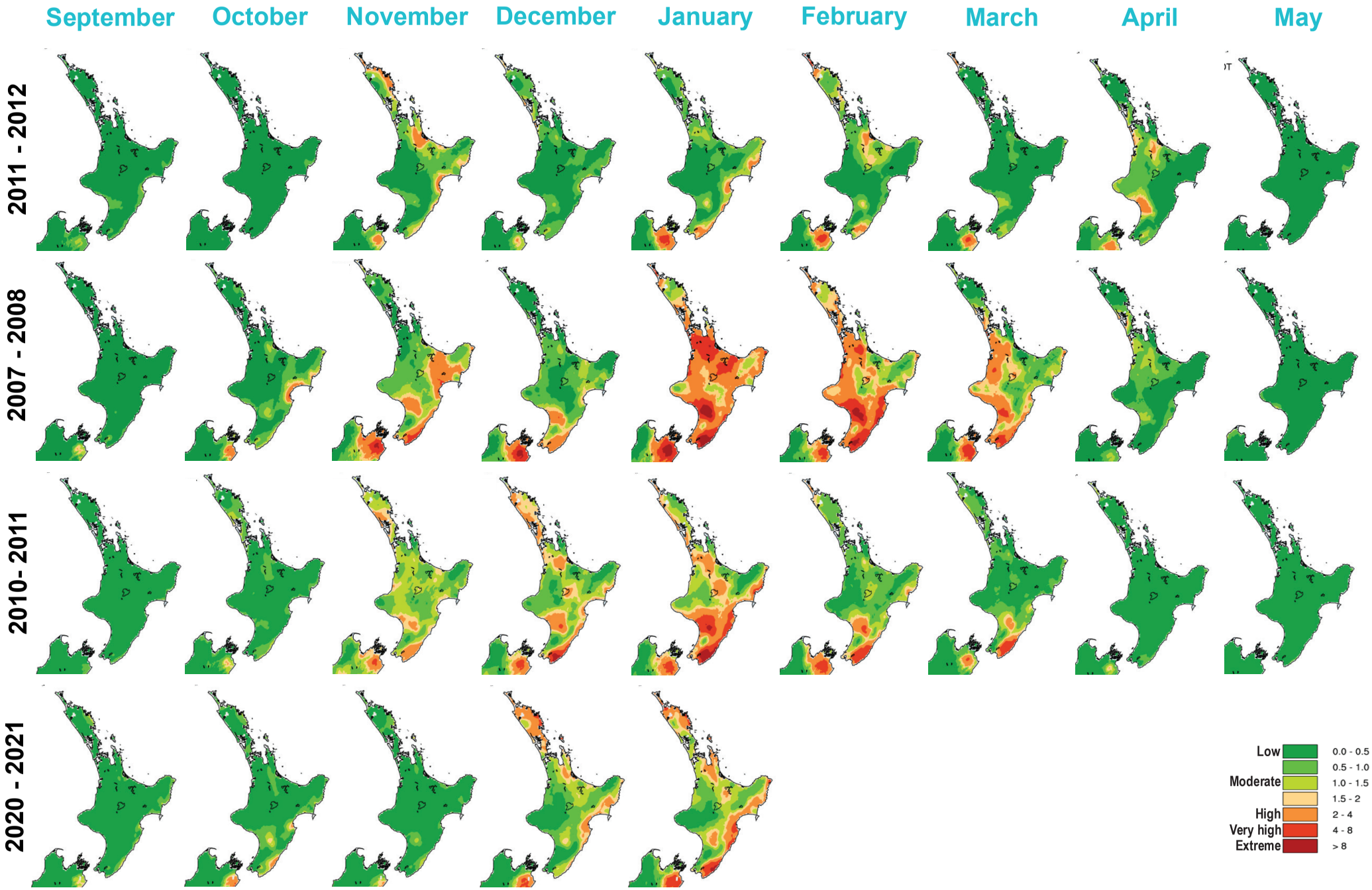



**Figure 11. New Zealand Fire Season Severity (monthly)**
The years of 2007/08, 2010/11, 1999/00, and 1998/99 and are ideal comparisons for what the North Island might experience over the next few months. These years were moderate strength La Niña years, 2011/12 was a weak La Niña event. DSR values of less than one equates to low fire behaviour potential, 1-3 moderate fire potential, 3-7 high to very high fire potential, and above 7 extreme fire behaviour potential.

## Note:

**Tracking trends**
Comparisons of fire dangers for individual indicator stations for different regions are not shown in this outlook due to the low fire danger and severity across the country. As fire dangers increase, more detailed regional outlooks will recommence highlighting where Buildup Index (BUI), Drought Code (DC) and Cumulative Daily Severity Rating (CDSR) values sit in comparison with previous fire seasons.

For fire managers who are interested in tracking fire season trends for all your weather stations, the graphs are available on the Scion Rural Fire Research website under tools.

## Background info on FWI codes and indicies:

**Fine Fuel Moisture Code (FFMC)**
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 (DMC)** 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 + | Difficult & extensive |

**Drought Code (DC)** 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 + | Difficult & extensive |

**Buildup Index (BUI)**
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 (ISI)** 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 (FWI)**
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 (DSR)** 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 (MSR)** 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 |


## Acknowledgements:
Fire Danger interpretation was from information gathered from the Average Monthly Maps for: Severity Rating, FWI, BUI, ISI, DC, DMC, FFMC, Grassland FDC, Scrub FDC & Forest FDC. These maps were obtained from the Fire and Emergency New Zealand's Fire Weather System powered by Eco Connect.

Information on the Expected Climate Outlook was gathered from:
- MetService, Rural Monthly outlooks:
  www.metservice.com/rural/monthly-outlook
- NIWA, Seasonal Climate outlook:
  www.niwa.co.nz/climate/sco
- Australian Bureau of Meteorology Climate outlooks
  http://www.bom.gov.au/climate/ahead/?ref=ftr

**Front Cover Image:** 2020 Research Burns (V Clifford, Scion).