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

ISSUE: December 2020

Current fire danger situation

In general, monthly fire danger and fire climate severity are Low to Moderate across much of the North Island (Figures 4, 5 & 9).

Fuel and soil moisture status

The Low to Moderate fire danger levels are reflected in the current FWI System codes and indices (BUI, DC, DMC and FFMC). These codes indicate the ease of ignition, the amount of fuel available for combustion, and how difficult and prolonged mop-up could be. Fuel dryness typically peaks either in February or March across the North Island before declining over the month of April. Currently, fuels are damp, with Low to Moderate fuel moisture (Figure 7), across much of the North Island, making it difficult for a fire to ignite, spread and become deep-seated.

Rainfall continues to affect heavy and medium-sized fuels in the North Island. Regions with DC and BUI values generally below the historical trend for this time of the year are: Bay of Plenty, Central North Island, Taranaki, Whanganui/Manawatu, Hawke's Bay, Wairarapa and Wellington. Regions with stations that are either on trend or below include: Northland, Auckland, Waikato, Gisborne, and the Chatham Islands. Graphs tracking individual station trends are available on the Scion website.

Soil moisture levels across most of the central North Island are at or nearing field capacity and are wetter than normal for this time of the year (Figure 2 and 3). However, soils in Northland, Auckland, Hauraki and Gisborne are showing signs of dryness, with soil moisture below 50% storage and drier than normal (Figure 3).

Forecast climate and weather

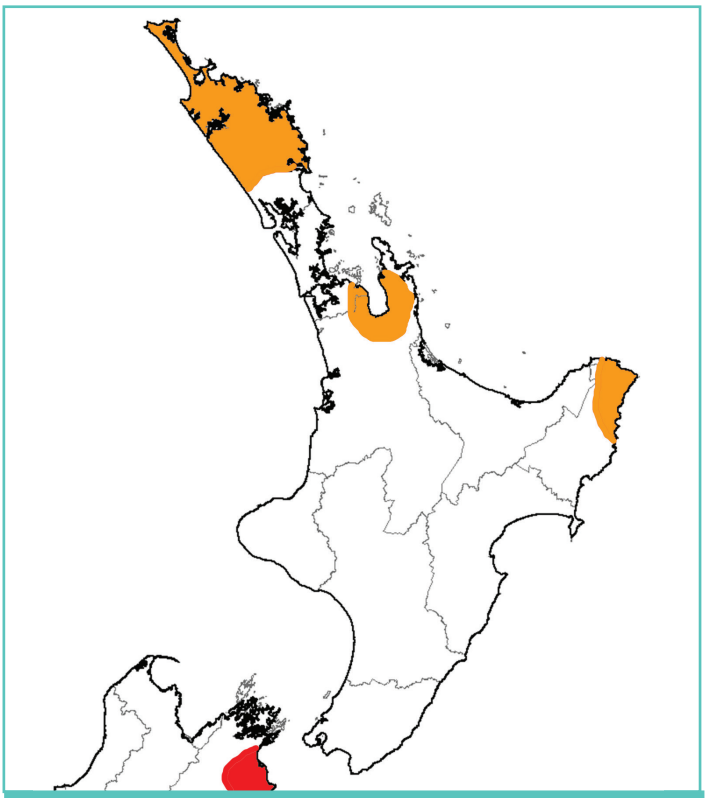
A moderate to strong La Niña event remains in the tropical Pacific Ocean. La Niña weather patterns are signalled for December and will likely continue through until February, where Neutral conditions are forecast for winter. High pressure systems are forecast to centre over the south east of the country, with lows situated to the northwest. This combination draws north-easterly winds from the tropics across New Zealand.

Over the next three months (December – February), dry conditions are expected for summer with above average air temperatures. However, warm humid tropical disturbances are also expected and may result in heavy rainfall and flooding. Unusually warm seas surrounding New Zealand are expected to develop over summer, resulting in a marine heatwave. Rainfall is likely to be near normal or above normal with extended dry spells interspersed with unsettled periods of weather. Soil moisture levels and river flows are likely to be near normal or below normal for western locations, and near normal for remaining locations. For the month of December, a colder than usual start is expected, however it is forecast to be warmer than normal in the second half. It will be wetter than normal for western locations. But drier than usual for most regions in the second half of December.

Locations to watch

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). As we transition into summer, the combination of warm temperatures, low rainfall and strong gusty winds will dry out soils and vegetation, elevating the fire risk and contributing to the potential for fast moving fires.

Over the next three months, the risk of wildfire outbreaks will likely be Low for much of the North Island as it is anticipated rainfall events are likely under a La Niña climate driver. As a result, fire dangers and severity for December are expected to be Low to Moderate for most of the North Island. However, the risk could elevate for those regions that continue to experience below normal rainfall, above normal air temperatures and have soil moisture deficits. Areas to keep an eye on (due to current soil moisture status and forecasted warm dry conditions for the second half of the month) include: Northland, Auckland, Hauraki and Gisborne (East Cape). However, we are currently tracking similar to last year, where rainfall kept the fire dangers and severity Low until January/February.



Map 1. Locations identified as specific areas of interest that have or may develop an elevated risk of high 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 (if you haven't done so already), by discussing where conditions are at, where they are heading, and how this can drive awareness about what this might mean for fire risk in your patch and for your neighbours.

EXPECTED CLIMATE OUTLOOK:

One of the major climate drivers for New Zealand is the El Niño–Southern Oscillation (ENSO). The ENSO indices still signal for a moderate to strong La Niña event in the tropical Pacific Ocean. Models indicate this La Niña event is weaker than that experienced in 2010/11. It is also forecast for a progression towards a central Pacific La Niña, rather than the traditional east-based phase. This will likely impact New Zealand's summer, where we will likely experience drier westerlies and wetter northerlies.

International models indicate that this event is close to its peak, building up to December/January, and to remain until at least February 2021. La Niña is expected to be the major climate driver over the next three months before transitioning towards neutral conditions by Autumn. According to international models, there is a 97% probability for La Niña conditions over the next 3 months (December 2020 – February 2021). For March – May 2021, the probably is 57% and 42% for neutral conditions. Neutral conditions are favoured for June – August 2021 (56%).

Current sea surface temperatures around New Zealand and the Tasman Sea have cooled off (compared to October). Sea surface temperatures are now close to normal around our coast line. The outlook is for unusually warm seas forming over the next three months, which will have an impact on land air temperatures.

To help understand what the fire season could look like for 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. Each historical La Niña event has resulted in different weather patterns for New Zealand, with our weather very dependent on where the high-pressure systems sit (which determines the air flow over New Zealand).

Tropical Cyclone outlook

There is a heightened risk for New Zealand to be affected by an ex-tropical cyclone this season. 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. Past years like this current season suggest that at least 3 cyclones could reach category 3 strength (considered severe, with 118 km/h winds).

This month: December 2020

December is forecast to experience spring like weather, with dry spells interrupted by periods of unsettled weather. Energetic westerly fronts will result in unsettled periods, and produce decent amounts of rainfall, especially for western locations. The second half of the month will see a trend towards more summer like conditions for most regions. Northern and eastern locations may receive a touch of rainfall with the presence of north-easterlies at the end of the year. The first half of the month will be cooler; however, temperatures will bounce back to above average in the second half of December.

Further ahead:

Over the next three months (December – February 2021), north-easterly air flows are expected with air pressure systems higher than normal to the east of the South Island and lower than normal to the north-west of New Zealand.

Drier than normal conditions are expected for summer, with intermittent moist sub-tropical weather that could reach the North Island and cause heavy rainfall and flooding.
Unusually warm sea surface temperatures surrounding New Zealand could develop into a marine heatwave over summer. Air temperatures are expected to be above average for all regions with elevated humidity also expected.

Rainfall is forecast to be near normal or above normal. Dry spells are expected to be interrupted with unsettled periods. Rainfall for the upper North Island resulting from 'La Nina' flavoured events may develop slowly during Dec/Jan.

Soil moistures are forecast to be near normal or below normal in the west, and near normal in the north. There are no strong indicators for the east of the North Island. River flows are also expected to be near normal or above normal in the north, and near normal for remaining locations.

Regional Breakdown (Figure 1):

Temperatures are most likely to be:

- above average (80% chance) for Northland, Auckland, Waikato and Bay of Plenty;
- above average (75%) for Central North Island, Taranaki, Whanganui, Manawatu, Wellington, Gisborne, Hawke's Bay and Wairarapa.

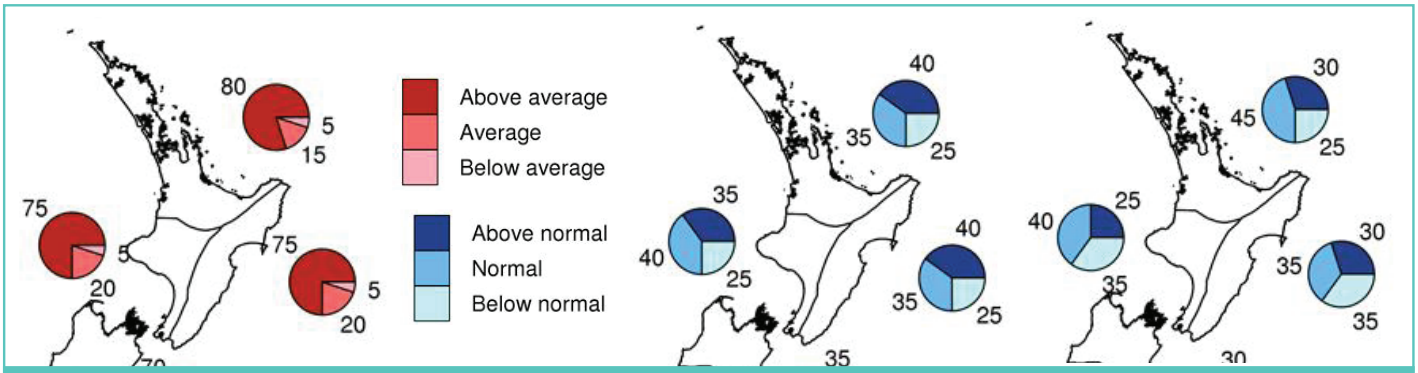


Figure 1. Outlook for December 2020 to February 2021: air temperature (left), rainfall (middle), available soil moisture (right). Source: NIWA.

Rainfall is most likely to be:

- above normal (40% chance) or near normal (35%) for Northland, Auckland, Waikato, Bay of Plenty, Gisborne, Hawke's Bay and Wairarapa. Note, heavy rainfall and the chance for floods is possible this season.
- near normal (40%) or above normal (35%) for the Central North Island, Taranaki, Whanganui, Manawatu and Wellington.

Soil moistures and river flows are most likely to be:

- near normal (45% chance) for soil moistures, and near normal to above normal (40%) river flow levels for Northland, Auckland, Waikato and Bay of Plenty.
- near normal (40%) or below normal (35%) soil moistures, while river flow levels are likely to be near normal (45%) for Central North Island, Taranaki, Whanganui, Manawatu and Wellington.
- near the climatological average (soil moisture levels) and most likely to be near normal (river flows) for Gisborne, Hawke's Bay and Wairarapa.

Last month: November 2020

Looking back, high pressure air tended to move north-east through the Tasman and lodging to the east around the Chatham Islands. The North island experienced relatively dry conditions. Frequent lows also moved across the north of the country, bringing heavy rainfall events that affected northern and eastern locations. November was wetter than normal across the North Island. In general, November monthly temperatures were above the average. The exception was Wellington and Wairarapa, that experienced a gloomy cold end to the month.

November seas surface temperatures were cooler than that observed in October.

Soil moisture (Figure 2 & 3)

During the last two weeks, significant rainfall has occurred over western and Central North Island locations (including parts of Waikato, Taranaki, Hawke's Bay and Wellington). Remaining locations have received small amounts including parts of Northland, East Cape and northern Waikato.

Dry soils (50% storage or less) are found in the Far North, western Northland, Hauraki District and East Cape (Figure 2). In contrast, soil moistures in remaining locations (central, lower and western North Island) are nearing or at field capacity (because of significant rainfall over the last few weeks).

This is also reflected in the soil moisture anomaly map (Figure 3). Drier than normal soils (compared to historical average) are found across Northland, Auckland and East Cape. In contrast, normal to wetter than normal soils are present in in remaining locations.

According to NIWA's Drought Index (NZDI), dry conditions are present in the Aupouri Peninsula, in the Far North. There are currently no locations across the North Island in meteorological drought.

Fine Fuel Status

Although BUIs may seem below levels considered extreme, fine fuels under forest canopies or scrublands, and grass pastures (as they brown off), can still contribute to fast fire spread and large fire sizes, even under moderate soil moisture dryness and wind strengths.

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. Don't be surprised to see 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:

This spring and into summer has resulted in climatic conditions (warm temperatures and high soil moistures) to support abundant grass growth and green landscapes. In these areas, grass curing is likely to be very low (10-40%). If a fire was to start in these fuels, fire spread would be difficult. Any burning will produce small flame heights and low intensities for easy suppression. This will become more of a concern once these green grasslands eventually dry out at the peak of summer. A transition towards prolonged warm dry conditions will trigger the maturing process of grasslands and set the curing process in motion. Areas of lush green grass will form seeds and begin turning yellow over the next few months. Higher than normal grass fuel loads could contribute to increased fire intensities and faster rates of spread during the peak of summer.

Some landscapes may already have started to form a mixture of

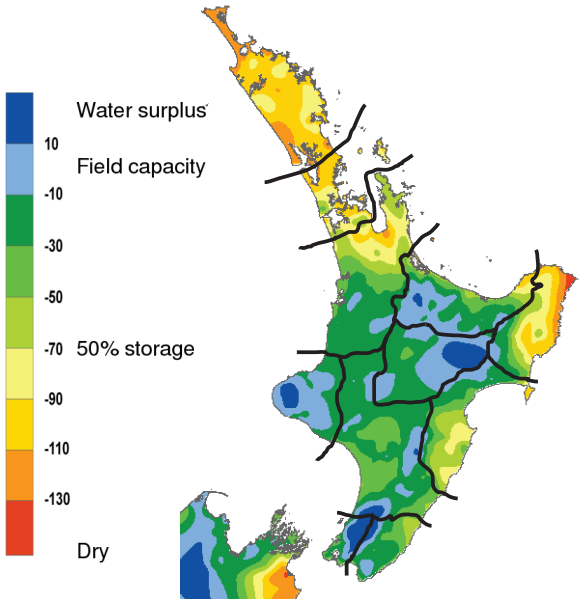


Figure 2. Soil moisture deficits as of 06/12/2020.
Source: NIWA.

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.

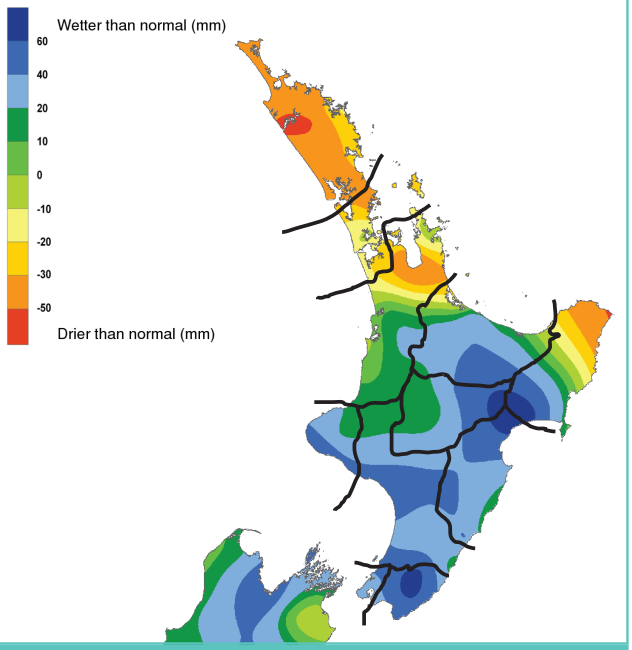


Figure 3. Soil moisture anomaly as of 06/12/2020.
Source: NIWA.

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.

green and brown as grasses begin the curing phase, (40-70% curing range). Any grass fires will be able to spread more easily in these locations. For locations that will experience a combination of warm and continued dry conditions, the potential for a fire to ignite and spread rapidly in windy weather is elevated.

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.

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 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.

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).

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).

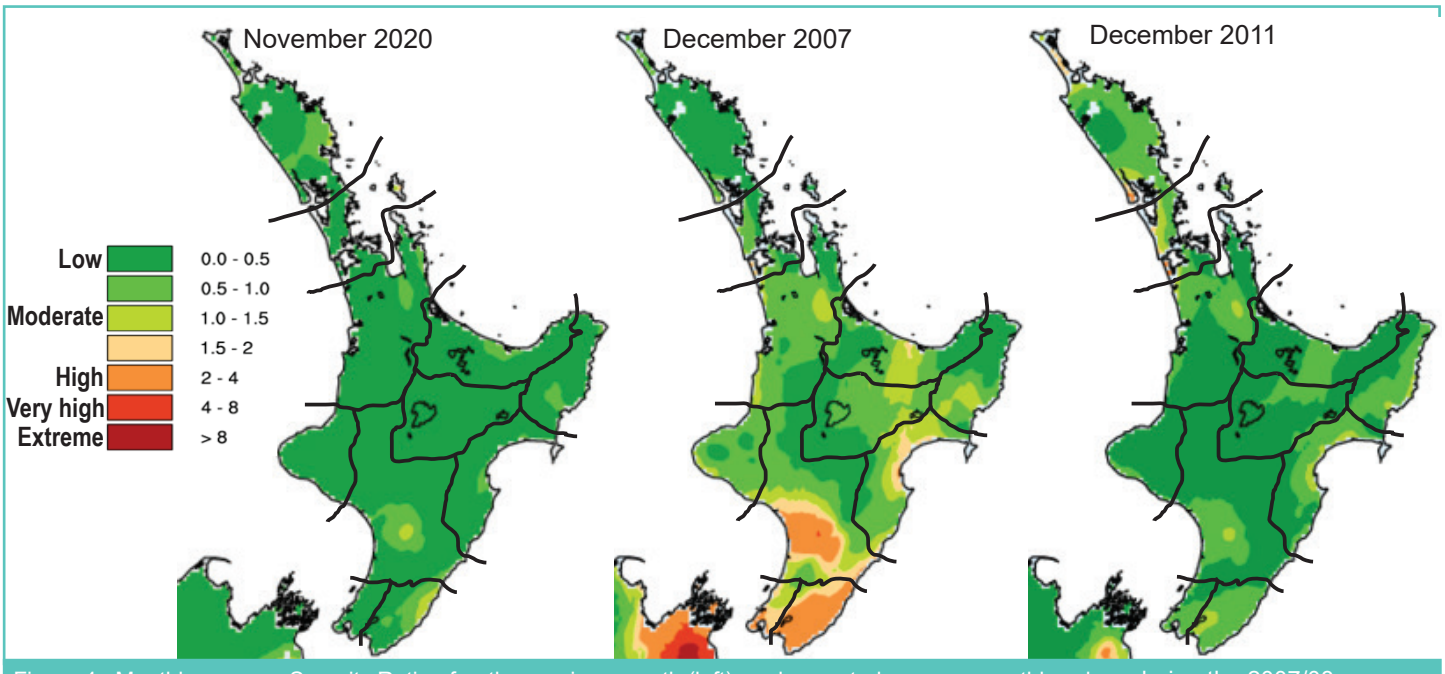


Figure 4. Monthly average Severity Rating for: the previous month (left), and expected average monthly values during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

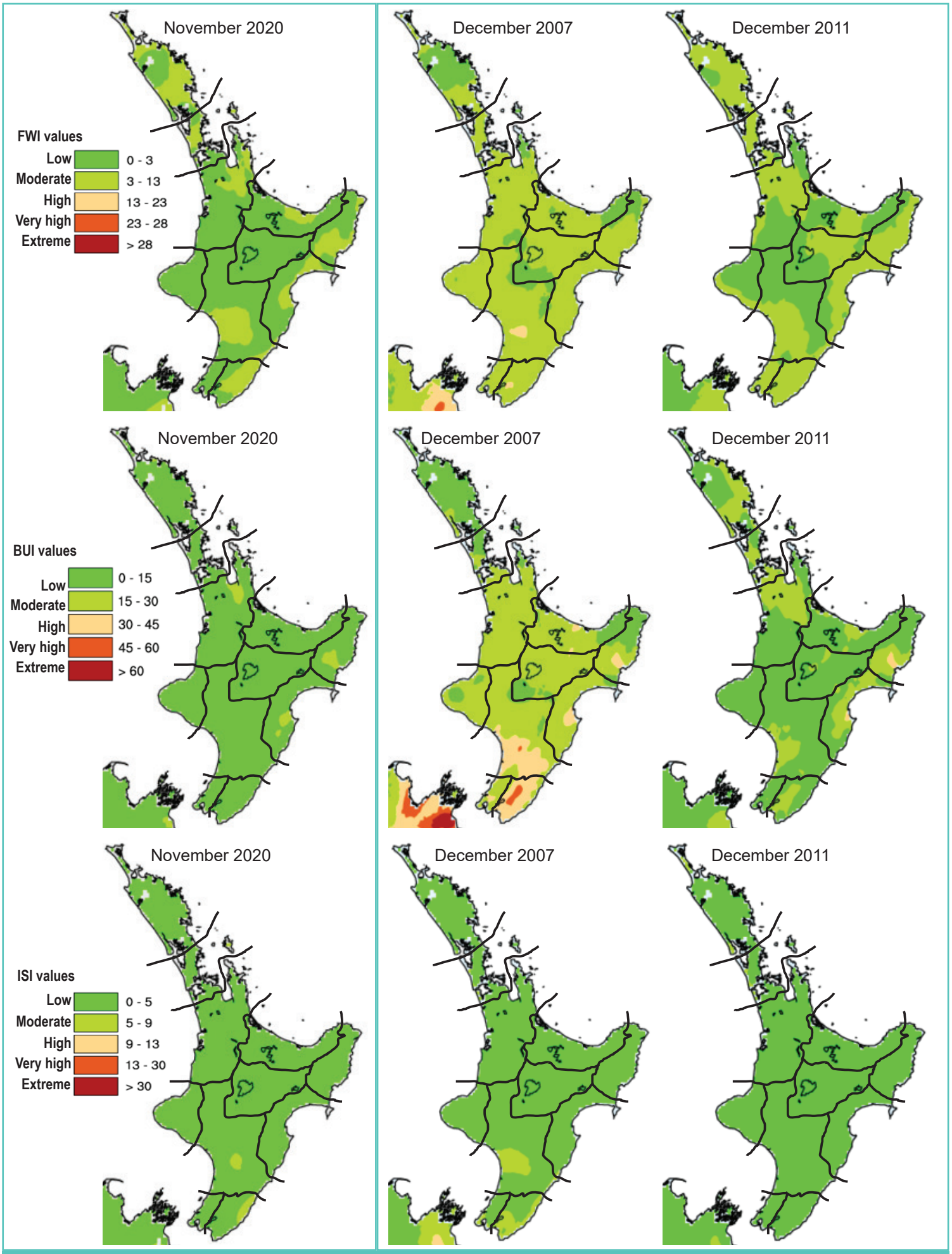


Figure 5. Previous Monthly Average for the: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below).

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.

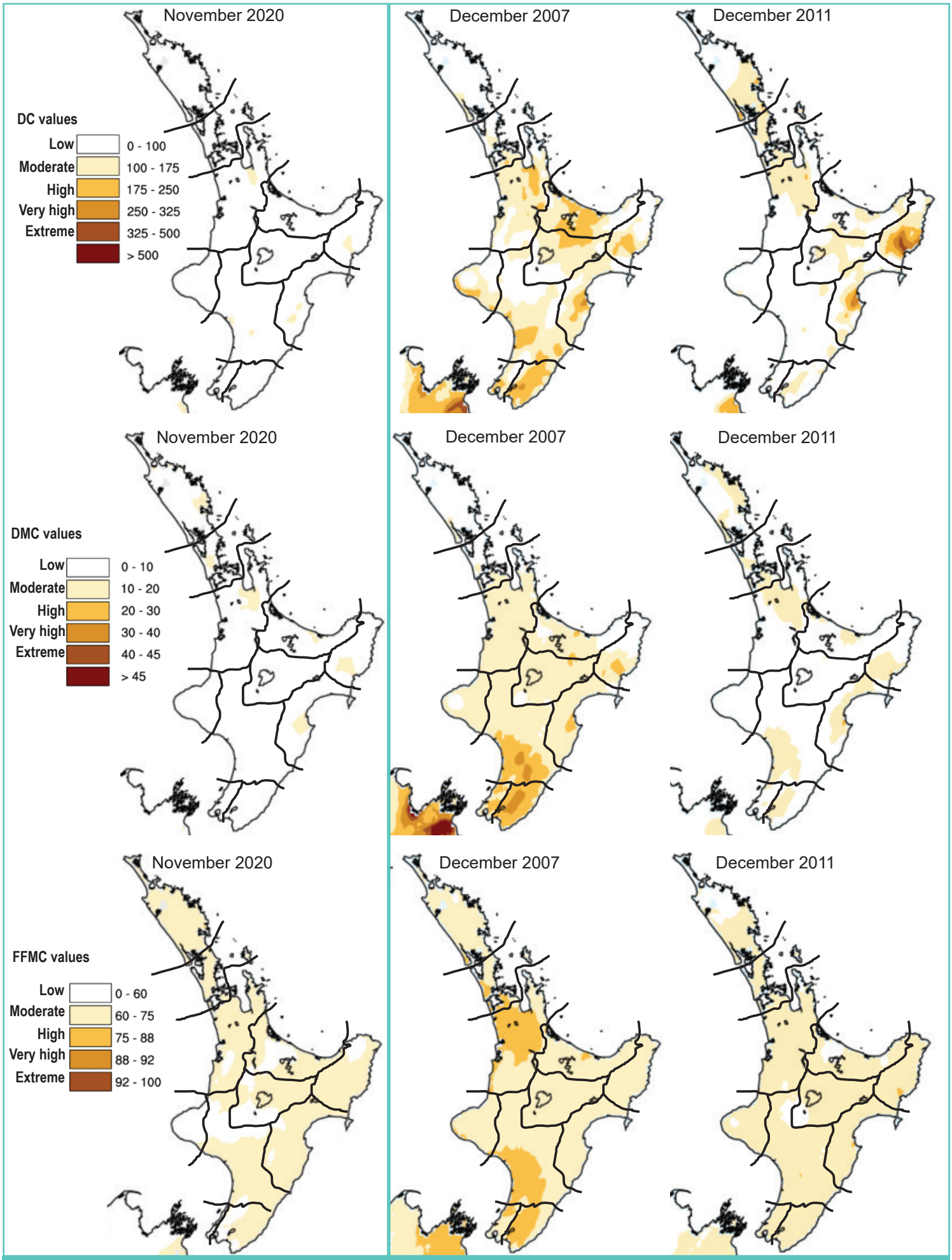


Figure 7. Previous monthly average for the: Drought Code (top), Duff Moisture Code (middle) and the Fine Fuel Moisture Code (below).

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.

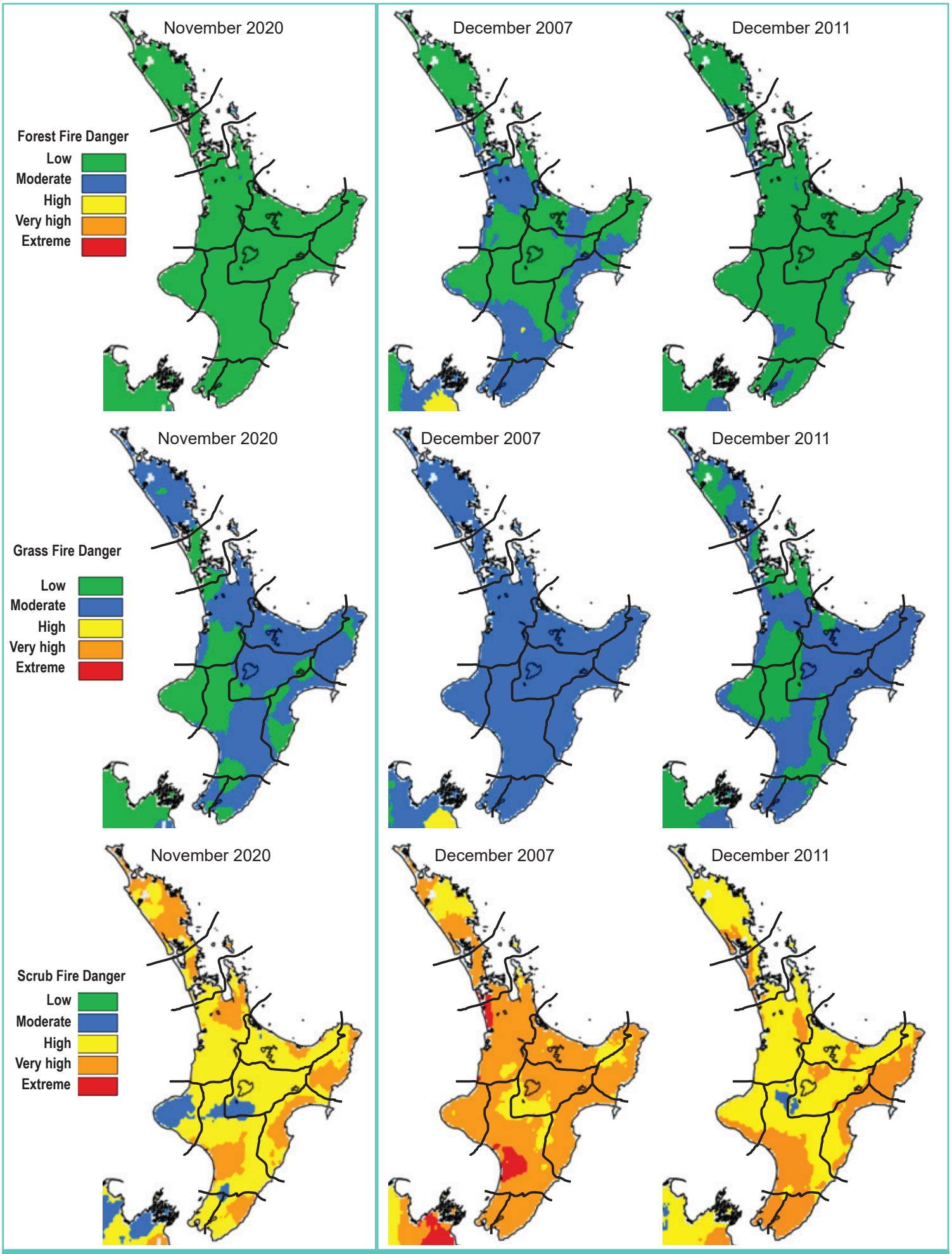


Figure 9. Previous Monthly Average for: Forest Fire Danger (top), Grassland Fire Danger (middle) and Scrub Fire Danger (below).

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.

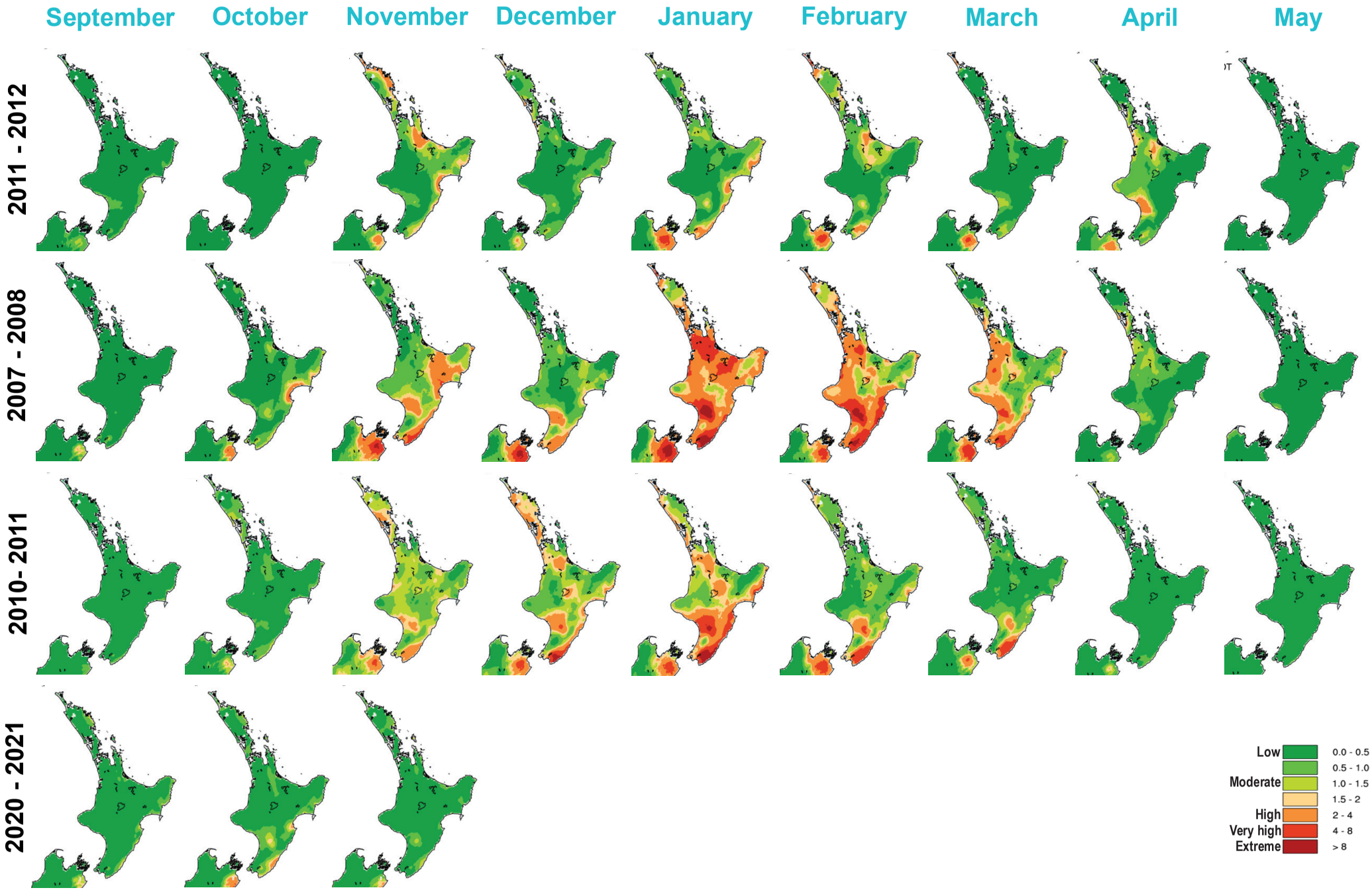


Figure 11. New Zealand Fire Season Severity (monthly)
The years of 2007/08, 2010/11, 1999/00, and 1998/99 and are ideal comparisons for what the North Island might experience over the next few months. These years were moderate strength La Niña years, 2011/12 was a weak La Niña event. DSR values of less 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 monthly on the Scion Rural Fire Research website. If tracking is required on a more frequent basis (as opposed to the monthly analysis done here), please contact Scion for the data.

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).