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

ISSUE: November 2020

Current fire danger situation

In general, monthly fire dangers and fire climate severity are Low to Moderate across much of the South Island (Figures 4, 5 & 9). The exceptions being Marlborough, mid-Canterbury, inland South Canterbury and pockets of Otago, where High to Extreme conditions exist.

Fuel and soil moisture status

This is 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 across the South Island typically peaks either in January or February. Currently, fuels are damp across much of the South Island, making it difficult for a fire to ignite, spread and become deep-seated (Figures 5-6 & 7-8). Medium to heavy fuels continue to show signs of dryness (Very high to Extreme levels) in Canterbury and Otago.

Rainfall (or lack of) has continued to affect heavy and medium-sized fuels in the South Island. Regions with DC and BUI values generally above the historical trend for this time of the year include: Canterbury. Regions with above average DCs but below average BUIs include: Mid-South Canterbury and Otago. Remaining regions (Nelson, Marlborough, West Coast and Southland) are either on trend or below average for this time of the year. Graphs tracking individual station trends are available on the Scion website.

Soil moisture levels across the West Coast and Southland are at field capacity and are about normal for this time of the year (Figures 2 and 3). However, soil moisture is below 50% storage in many eastern locations and soils are drier than normal in Marlborough, Canterbury (north and south) and Otago (central and coastal).

Forecast climate and weather

A moderate to strong La Niña event is now well underway in the tropical Pacific Ocean. La Niña weather patterns are signalled for November and will likely continue through until February. High pressure systems are forecast to centre over the south east of the country, with intermittent lows in the Tasman Sea. This combination draws moist, warm north-easterly winds from the tropics across northern New Zealand. This coming season, there is an elevated risk of significant weather impacts from a passing ex-tropical cyclone. There are also indications for a marine heatwave developing in the waters surrounding New Zealand, which can elevate air temperatures further.

Over the next three months (November – January), New Zealand is expected to experience above average temperatures. Some significant warm spells are also forecast as we transition from spring into summer. Normal or below normal rainfall levels are expected for South Island regions. In general, the current dryness in November is expected to transition towards more rainfall in January. For the first half of summer, conditions will lean towards dry, until more subtropical moisture sweeps down from the north. Soil moisture levels and river flows are most likely to be below normal in the east, near normal or below normal in the north, and near normal or above normal in the west of the South Island.

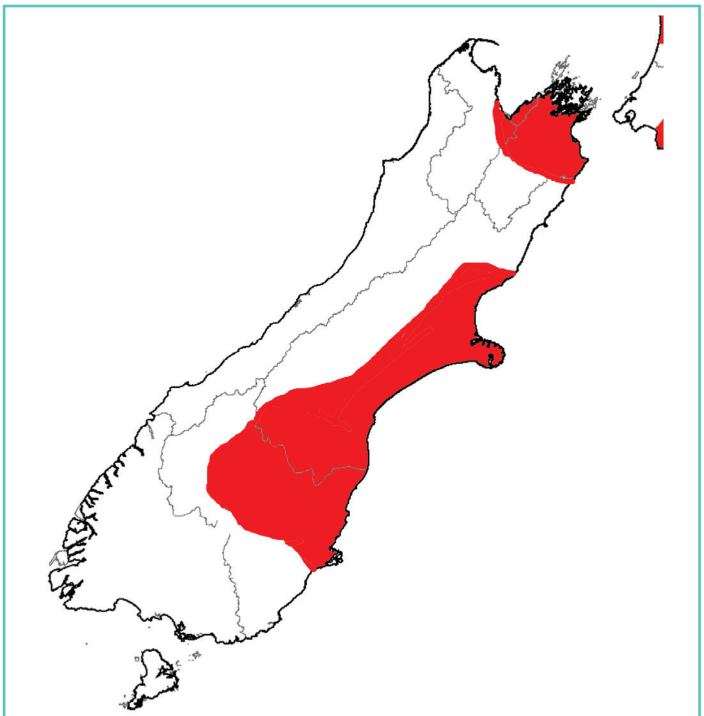
For the month of November, Buller, Nelson and Marlborough are forecast to be wetter than normal. In contrast, the current dryness is expected to continue in other areas, with the south of the South Island expected to be drier than normal. November temperatures are predicted to run well above average.

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 from spring to summer, the combination of warm temperatures, low rainfall and strong gusty winds in the east and south of the South Island will dry out soils and vegetation, elevating the fire risk in these regions and contributing to the potential for fast moving fires.

Over the next three months, the risk of wildfire outbreaks will be low for the west of the South Island up until the Christmas/New year period. However, areas that continue to experience below normal rainfall and low soil moisture levels and above normal air temperatures will develop an elevated risk. These locations include Canterbury (north, mid and south) and Otago (central and coastal), and potentially also Nelson and Marlborough.

Warmer and drier than normal conditions are anticipated for November. As a result, landscapes will continue to dry out and become more susceptible to fires starting and spreading. There are places of concern due to current soil moisture status, forecasted below normal rainfall and increases in air temperature. Specific places to watch currently include Marlborough, Canterbury (central & south), and Otago (central, northern & coastal).



Map 1. Locations identified as specific areas of interest that have or may develop an elevated risk of high fire danger 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. Now is the chance to carry out 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). During the 2020 winter (June to August) and early spring (September), the ENSO was neutral but developing towards La Niña conditions. La Niña is now currently underway in the tropical Pacific and the ENSO outlook remains at La Niña levels for November. International climate models suggest there is a 96% chance that La Niña will continue until the end of summer. For February to April 2021, the probability for La Niña declines to 59% and 40% for ENSO-neutral conditions.

Oceanic and atmospheric forecasts indicate moderate to strong La Niña conditions are likely during summer. Most models are predicting La Niña to peak in December, with around half the models anticipating a strong event, the others suggesting it may not be as severe. To help understand what the fire season could look like in 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).

There is a possibility that the peak strength could reach levels similar to the La Niña seasons of 2010–12 (a moderate year followed by a weak year). There is a chance weather patterns could match that of the brief event in the 2017/18 season (classed as a neutral season). If the season follows a climatic trend for 2017/18, warm seas (compared to average) will likely occur in November-December, and a marine heatwave may develop, pushing up air temperatures for all regions of the country, and provide fuel to cyclones approaching from the north.

Tropical Cyclone outlook

November marks the start of the tropical cyclone season for the Southern Hemisphere (which runs from November to April). On the odd occasion, cyclone activity can still happen outside this period. In general, La Niña conditions result in average to below average cyclone activity in the South Pacific. On average, about 10 tropical cyclones form in the South Pacific between November and April, and at least one of these affects New Zealand, not as a Tropical Cyclone but as a large-scale low-pressure system called an ex-tropical cyclone.

This season, up to 8 named cyclones are expected to form in the south-west Pacific. Past years similar to this current season suggest that at least 3 cyclones could reach category 3 strength (considered severe, with 118 km/h winds).

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.

This month: November 2020

High pressures are forecast over areas in the east and south of the country, with intermittent Tasman lows and easterly winds across northern New Zealand (a typical weather pattern associated with La Niña).

Some rainfall is signalled for the first half of the month due to the presence of northern Tasman Sea lows. Buller, Nelson and Marlborough are expected to see a wetter than normal November overall. However, dryness will follow in the second half, with Canterbury and Otago expected to experience dry conditions. Below normal monthly rainfall totals are forecast across the south of the South Island, with near normal-to-below normal rainfall for Canterbury.

Well above average temperatures are expected for all regions.

Further ahead:

Over the next three months (November – January 2021), New Zealand will often find itself stuck in the middle of high pressure to the south-east and low pressure to the north-west. This set up is commonly associated with La Niña events, and allows for warm humid air to be pulled southwards from the tropics across New Zealnd. North-easterly air flows are also more common with this set up. Above average air temperatures are forecast for all regions across New Zealand. Our surrounding sea surface temperatures are currently warm and are expected to continue to get warmer over the next three months. If the warmth continues to persist over the next few months, New Zealand will likely experience a marine heatwave which will have an upward influence on air temperatures (as experienced during the 2017/18 season, where New Zealand had its hottest summer on record).
Rainfall is most likely to be near normal or below normal for southern half of the country. November is expected to remain dry for the South Island as a whole. However, there is the chance of moisture further out, with sub-tropical or tropical disturbances likely during December-January.

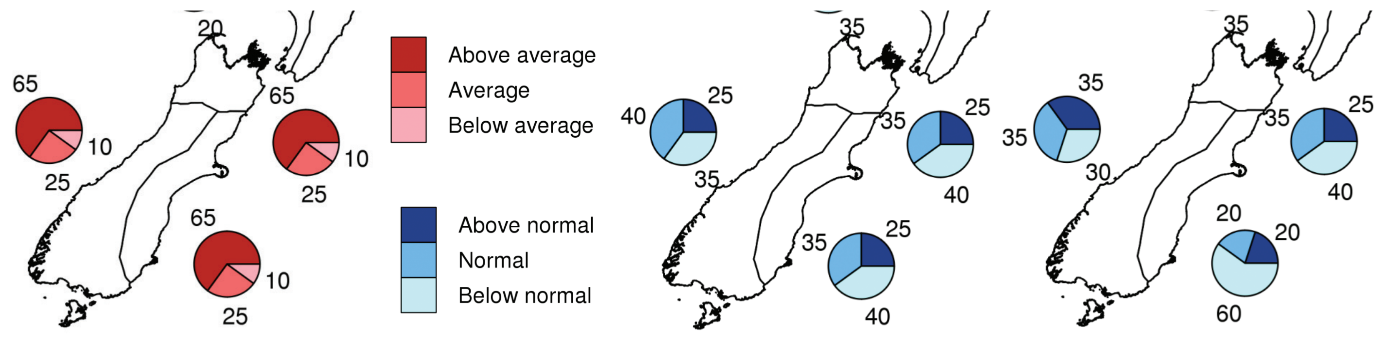


Figure 1. Outlook for November 2020 to January 2021: air temperature (left), rainfall (middle), available soil moisture (right). Source: NIWA.

Soil moisture levels and river flows are expected to be below normal in the east of the South Island, near normal or below normal in the north of the South Island, and near normal or above normal in the west of the South Island.

Regional breakdown (Figure 1):

Temperatures are most likely to be:

- above average (65% chance) for Tasman, Nelson, Marlborough, Buller, West Coast, Alps and foothills, inland Otago, Southland, coastal Canterbury and eastern Otago.

Rainfall totals are most likely to be:

- below normal (40% chance) or near normal (35%) for Tasman, Nelson, Marlborough, Buller, coastal Canterbury and east Otago;
- near normal (40%) or below normal (40%) for the West Coast, Alps and foothills, inland Otago and Southland.

Soil moisture levels are most likely to be:

- below normal (60%) for coastal Canterbury and east Otago;
- below normal (40% chance) or near normal (35%) for Tasman, Nelson, Marlborough and Buller;
- average (near their climatological value) for the West Coast, Alps and foothills, inland Otago and Southland.

Last month: October 2020

Looking back, intense highs were common during October, often sitting near the Chatham Islands. This resulted in an extremely dry October for northern and eastern regions of the South Island. In contrast, Southland and the West Coast of the South Island saw near normal to above normal rainfall.

October monthly temperatures were well above average (typically 1.5°C above the monthly average). Intermittent westerly winds produced unusual heat in eastern regions of both islands during the month. Once highs became stationary east of the country, warm northerly air flooded across all regions.

Sea surface temperatures (Tasman Sea and New Zealand coast) warmed considerably compared to normal. Pockets of ocean temperatures in the Tasman Sea and around the New Zealand coastline were 3 degrees above average.

Soil moisture (Figure 2 & 3)

Eastern locations have had a relatively dry start to spring, especially for Canterbury and Otago. The dryness has intensified over the past month in Marlborough, Canterbury (north, mid and south) and Otago (northern, central and coastal), which are experiencing soil moisture deficits (below 50% storage). The dryness is expected to continue for these locations during November. If this continues, meteorological drought could emerge for some areas of southern Canterbury and northern Otago by the end of November. In contrast, soil moisture levels are at or nearing field capacity along the West Coast and Southland regions (Figure 2).

This is also reflected in the soil moisture anomaly map (Figure 3), where drier than normal soils are found in inland and coastal areas of Canterbury (especially Banks Peninsula and coastal Selwyn District) and Otago. Meanwhile, the wettest soils for this time of the year are found in pockets near Nelson, on the West Coast and in Southland. We are seeing more rainfall on the West Coast than typically during La Nina as a result of increased westerly airflows. This rainfall is likely to continue for the foreseeable future. There will be some drier weeks mixed in.

According to NIWA's Drought Index (NZDI), dry and very dry conditions are forming along the coast between Canterbury and Otago. However, meteorological drought is not currently occurring.

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 surprising flame lengths, even with shorter grass. Light, flashy fuels are one of the common denominators of tragedy fires.

Grass growth & curing:

During spring, grasses are undergoing a period of growth, and much of the countryside is looking green and lush.
Normally 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 as we transition from spring into summer. 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

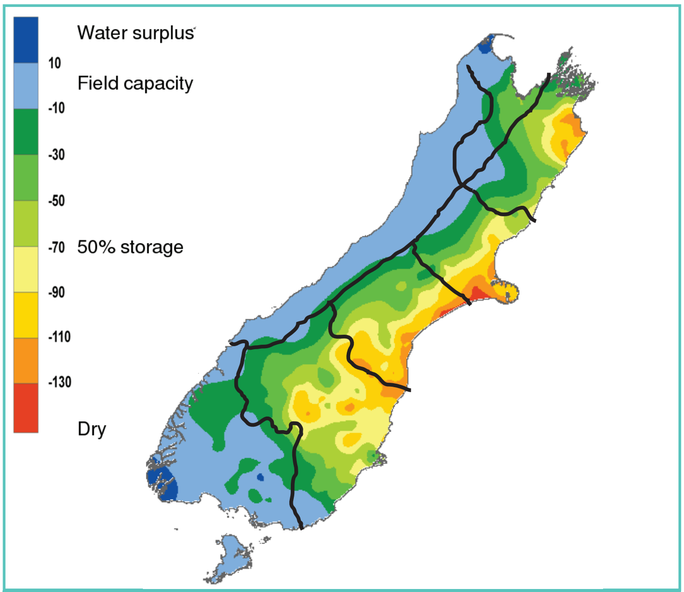


Figure 2. Soil moisture deficits as of 01/11/2020.
Source: NIWA.

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.

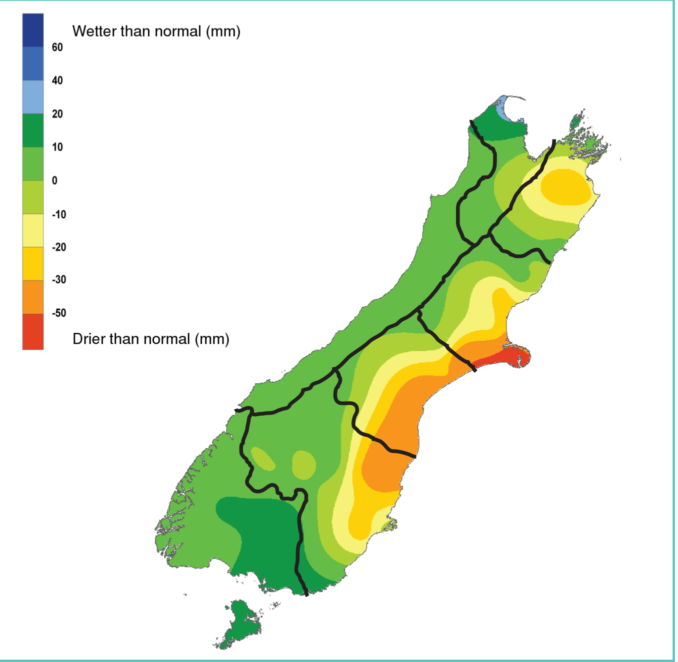


Figure 3. Soil moisture anomaly as of 01/11/2020.
Source: NIWA.

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.

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.

For locations that are experiencing notable winter and spring soil moisture deficits, grasslands will be dry and dead (cured), increasing the potential for a fire to ignite and spread. Dead material can also come about from snow and frost curing. We've already seen an early start to the fire season in Otago and Mid-South Canterbury, where the risk of fires has been exacerbated by grasses cured heavy frosts and strong, gusty NW and SW winds.

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.

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.

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.

ENSO in particular has a significant effect on New Zealand's weather, explaining around 25% of seasonal temperature and rainfall differences. 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.

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 South Island

For the South Island, under La Niña we tend to observe less wind and reduced rainfall in the south and south west in spring. Coastal Marlborough and Canterbury can be cloudier and cooler, with a chance of more rain than in non-La Niña years. During a La Niña summer, anticyclones are more frequent over southern New Zealand, bringing dry weather and the West Coast, Southland and western parts of Otago tend to dry out. However, areas such as Central Otago and South Canterbury can experience drought in both El Niño and La Niña.

Note:

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.

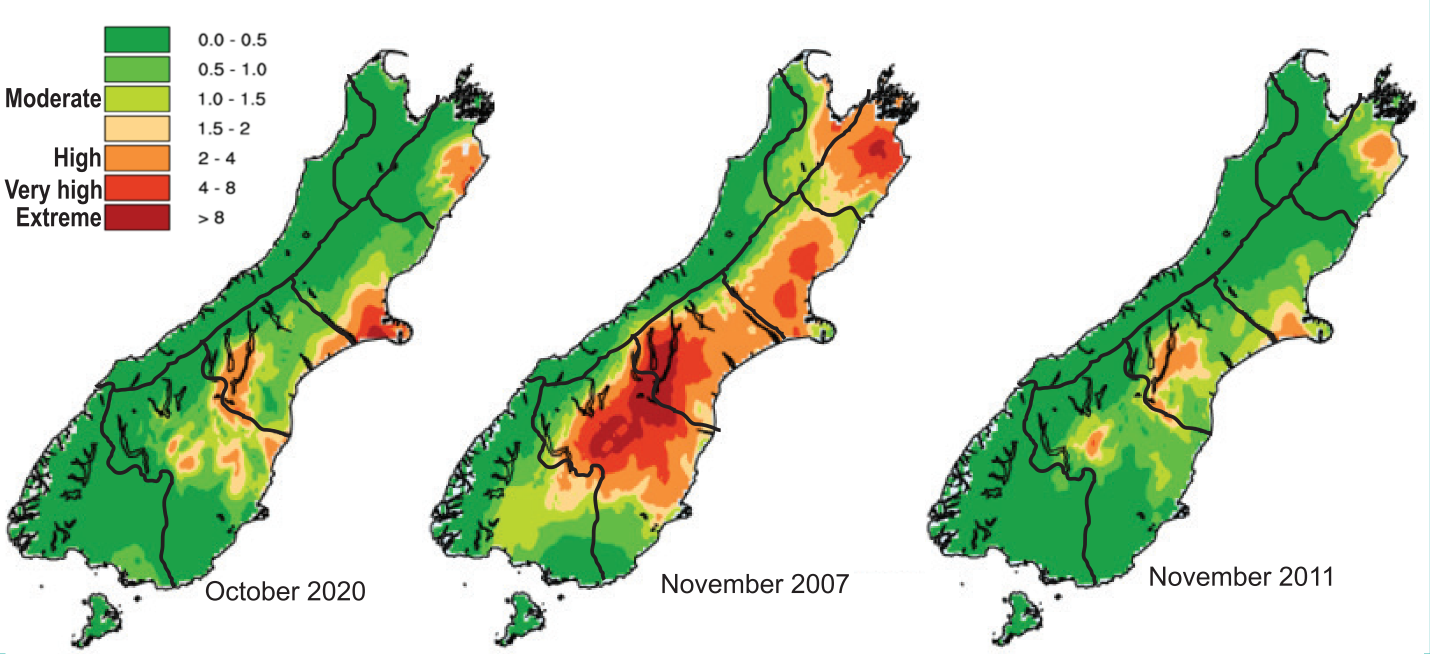


Figure 4. Monthly average Severity Rating for: the previous month (left), and expected average monthly values during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year

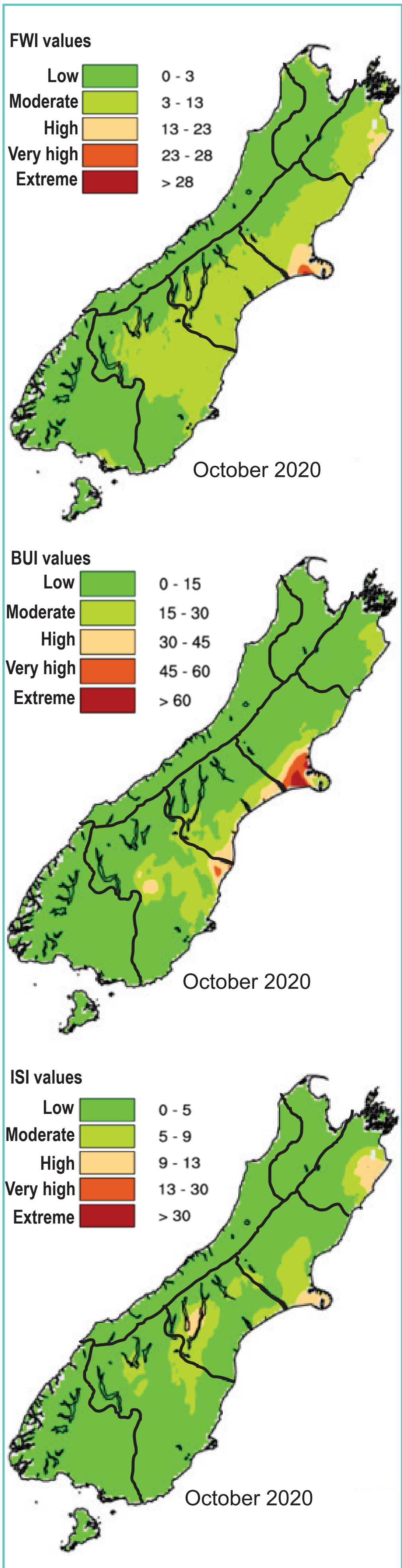


Figure 5. Previous Monthly Average for the: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below).

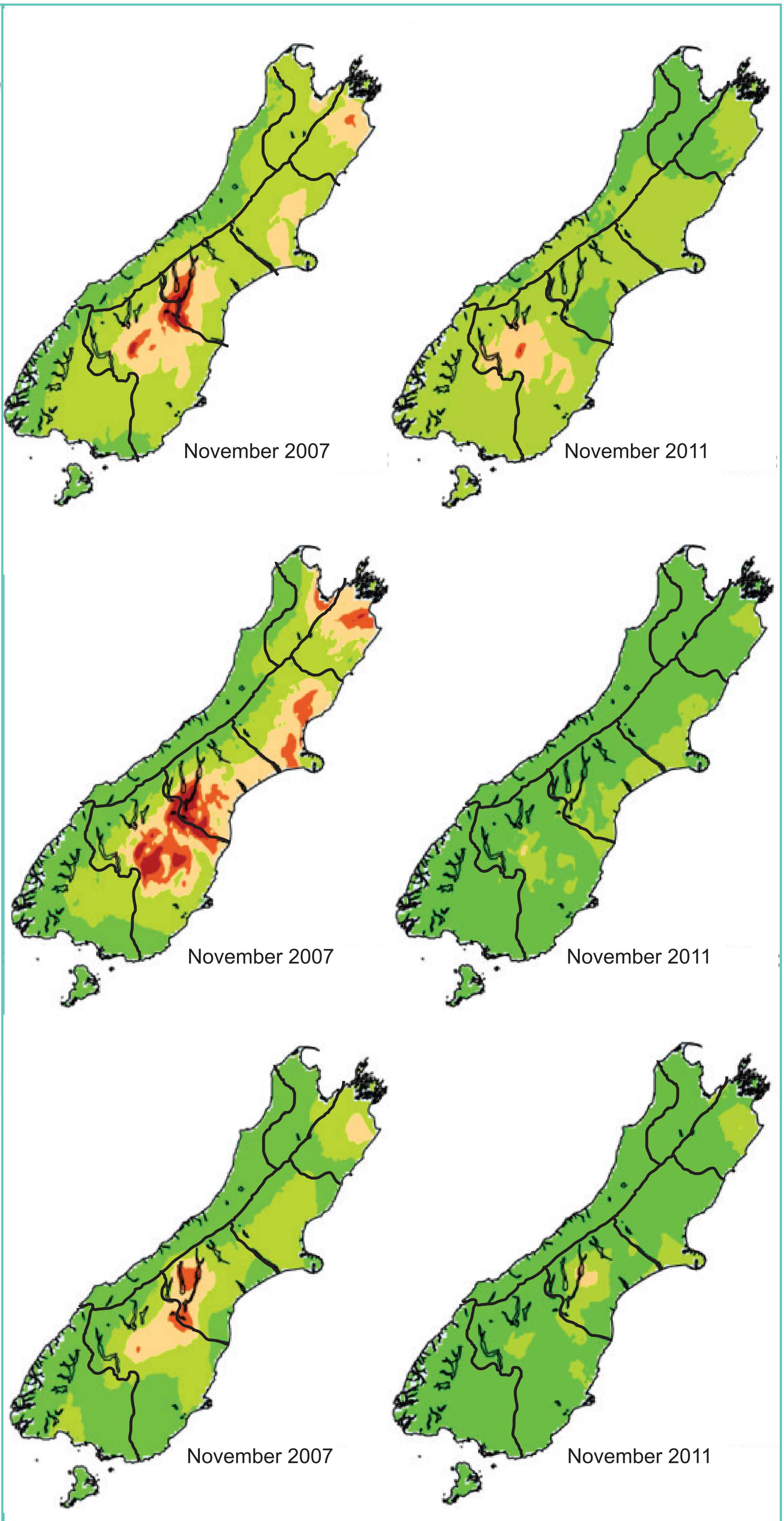


Figure 6. Expected average Monthly values of: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below); and during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

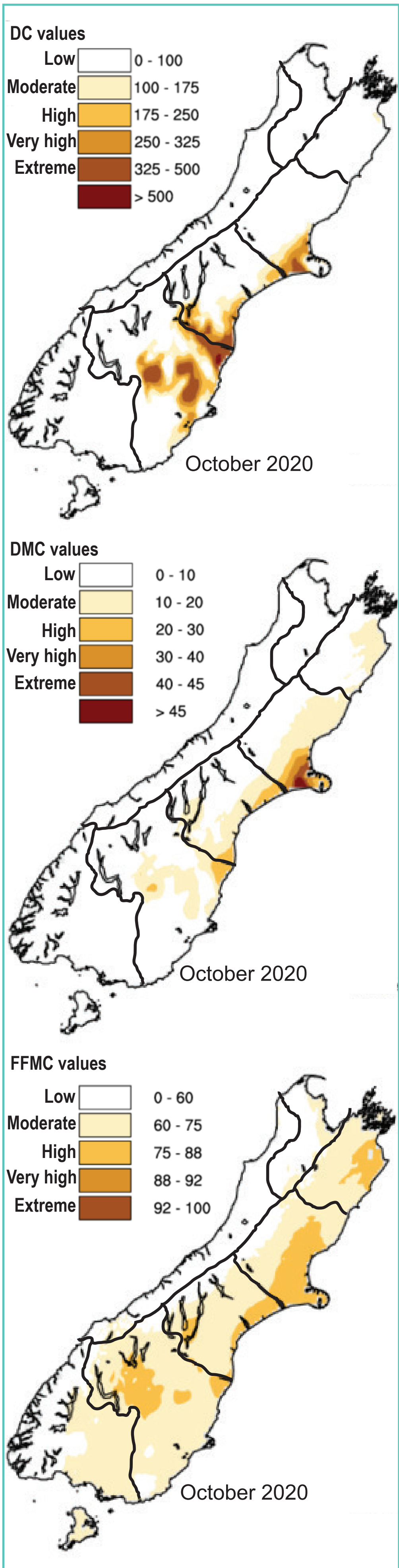


Figure 7. Previous monthly average for the: Drought Code (top), Duff Moisture Code (middle) and the Fine Fuel Moisture Code (below).

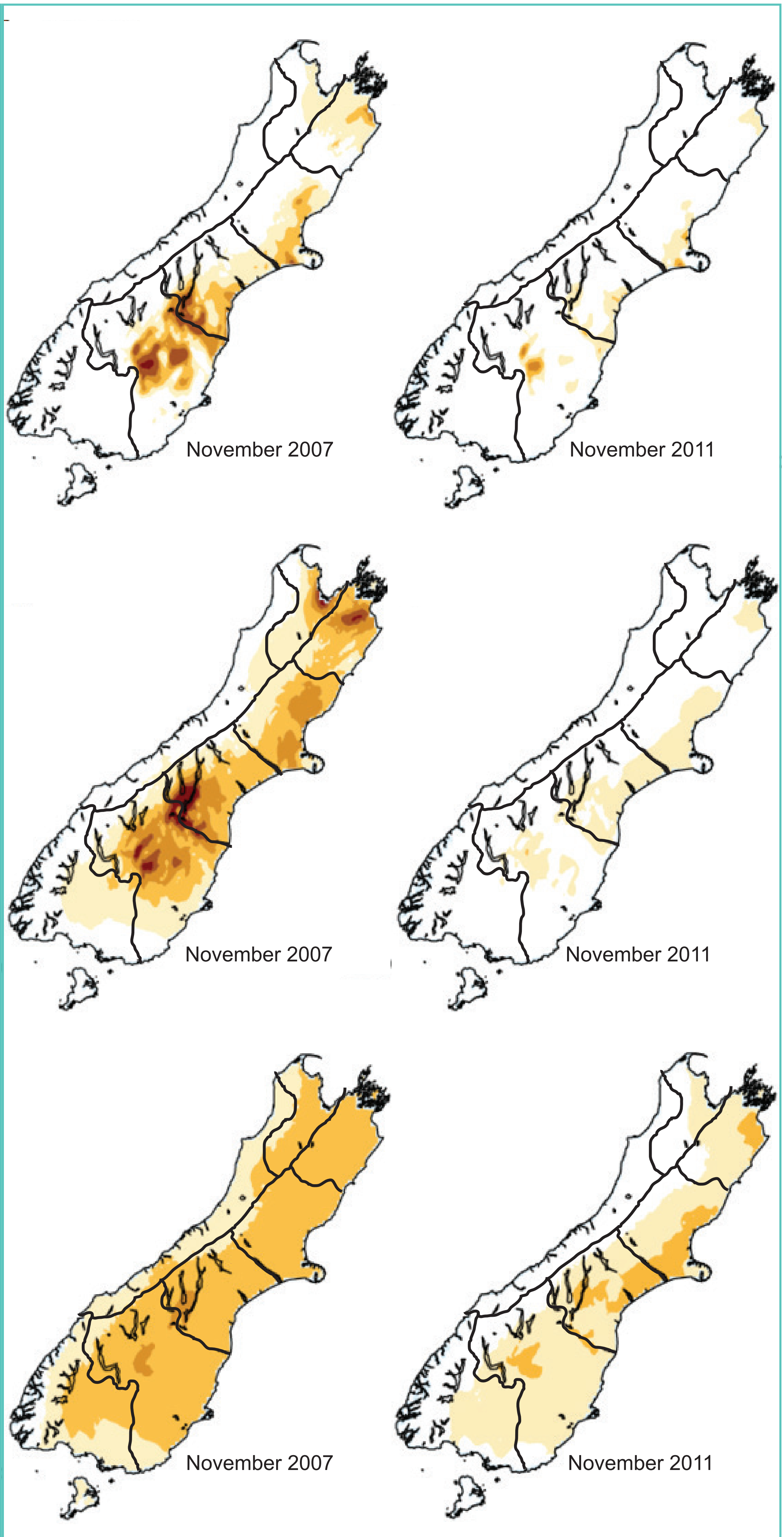


Figure 8. Average monthly values of: Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (below); and during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

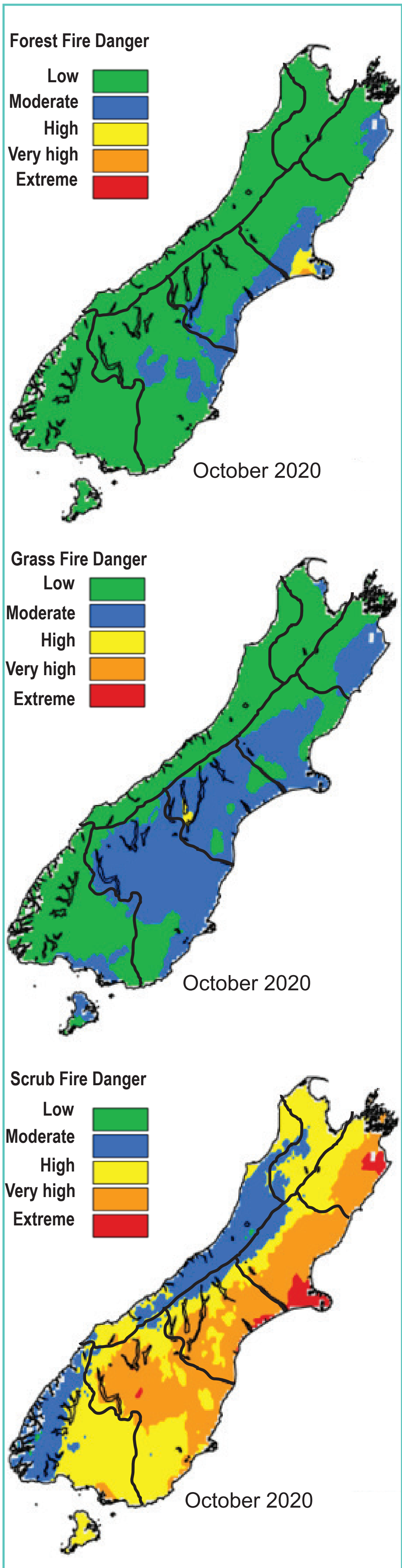


Figure 9. Previous Monthly Average for the: Forest Fire Danger (top), Grassland Fire Danger (middle) and Scrub Fire Danger (below)

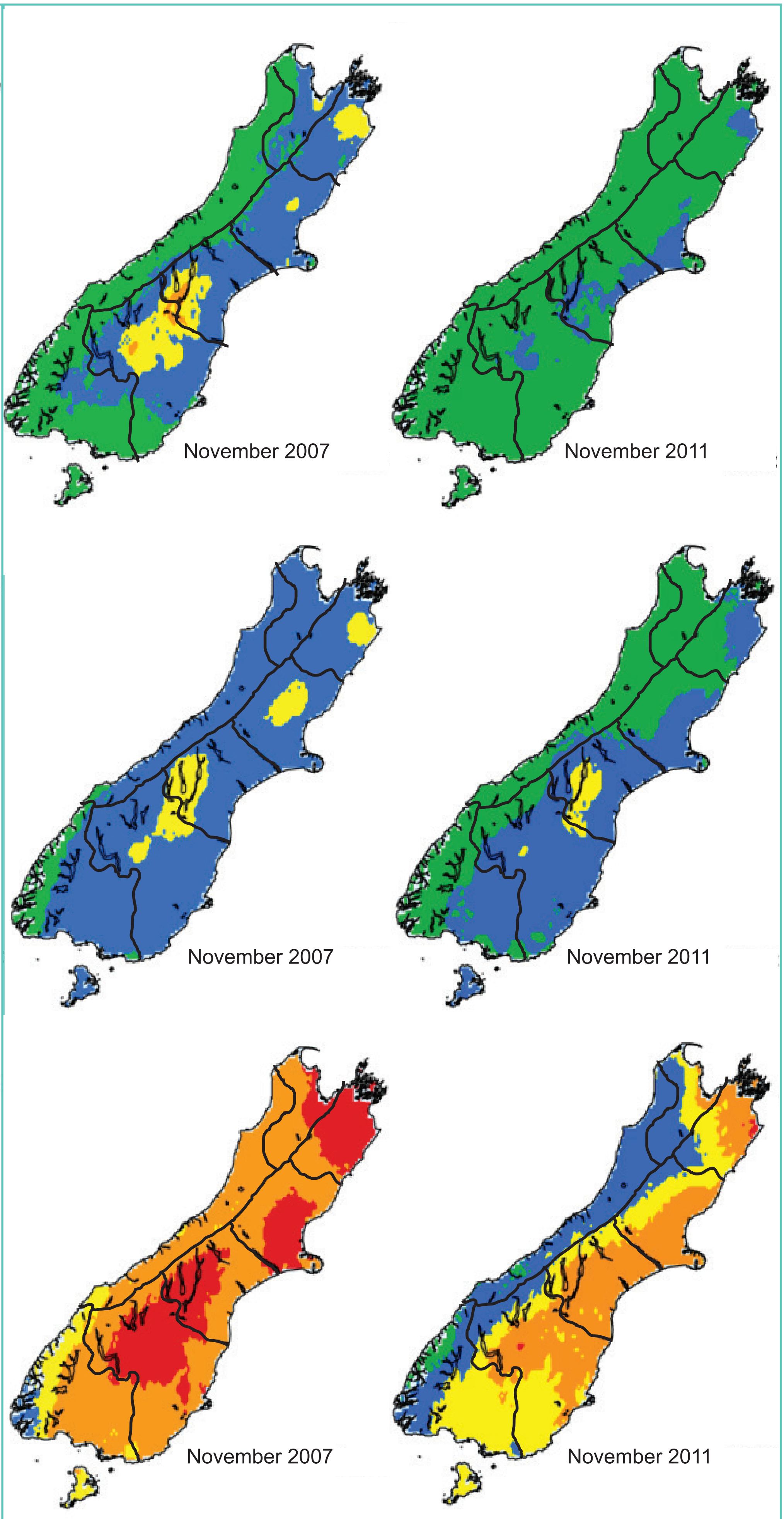


Figure 10. Expected average monthly values of: Forest Fire Danger (top), Grassland Fire Danger (middle) and Scrub Fire Danger (below), during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

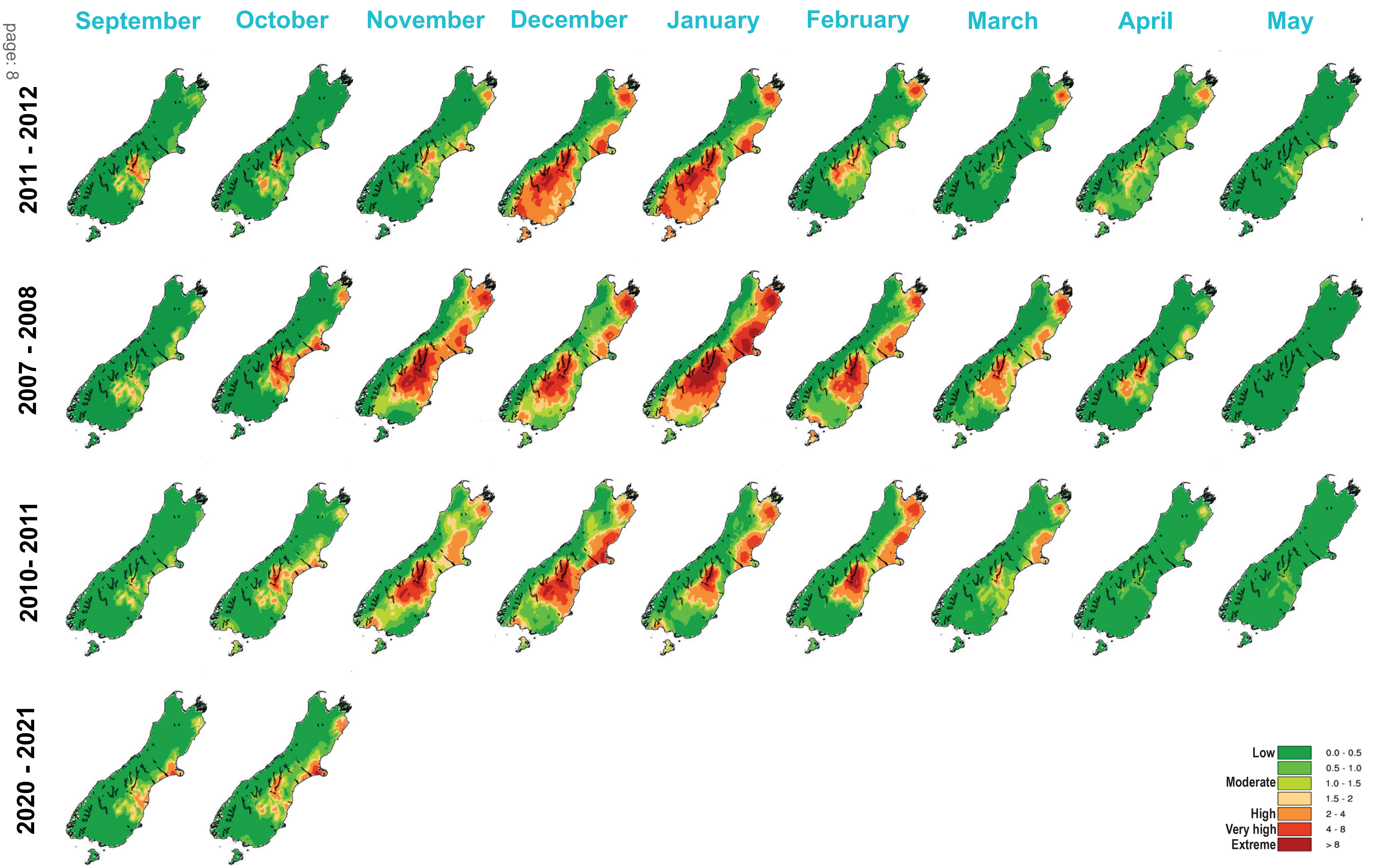


Figure 11. New Zealand Fire Season Severity (monthly)
The years of 2007/08, 2010/11, 1999/00, and 1998/99 and are ideal comparisons for what the North Island might experience over the next few months. These years were moderate strength La Niña years, 2011/12 was a weak La Niña event. DSR values of less 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).