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

ISSUE: March 2021

Current fire danger situation

Many locations are at or near the peak of fire season activity (typically Feb/March). In general, February monthly fire dangers and fire climate severity were High to Extreme for eastern locations (parts of Nelson/ Tasman, Marlborough, Canterbury and Otago) (Figures 4, 5 & 9). In contrast, much of the West Coast and Southland regions remain Low to Moderate.

Fuel and soil moisture status

This is reflected in the current FWI System codes and indices (FFMC, DMC, DC, and BUI) in Figures 5 and 7. These codes indicate the ease of ignition, the amount of fuel available for combustion, and how deep-seated and prolonged mop-up could be. Marlborough, Canterbury, Mid-South Canterbury and Otago stations are generally recording BUI and DC values above or on trend with the historical average for this time of the year. In contrast, Nelson/Tasman is recording values generally well below or on trend for this time of the year. Other locations (Southland and West Coast) have values either above or below the historical average for this time of the year, which likely depends on climatic zones. Graphs tracking daily trends for individual station are available on the Scion website: www.ruralfireresearch.co.nz/tools/trends

Nearly all of the east coast is currently in soil moisture deficits (Figure 2), which is about normal for this time of the year. Dry-to-very dry soils are located across the north and eastern South Island (Marlborough, Nelson/Tasman, parts of mid & north Canterbury and Central Otago. In contrast Fiordland and Westland are currently wetter than normal (Figure 3).

Forecast climate and weather

Non-traditional La Niña conditions remain in the tropical Pacific and international models indicate it has reached its peak strength and has been weakening the past few weeks. Despite this weakening pattern, this La Niña event is still expected to influence our climate over the next three months.

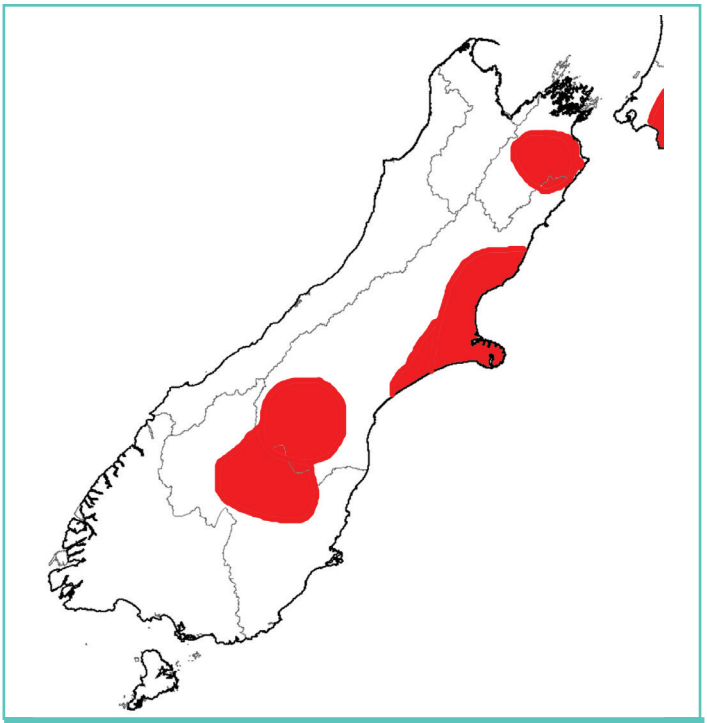
Over the next three months (March – May 2021), weather patterns are expected to become more variable as the effects of the 2020/21 La Niña event eases and we progress into autumn. Low-pressure systems are forecast to become more common during autumn.

March marks the start of meteorological autumn for New Zealand, and the likelihood of extreme heat has passed. In general, the weather generally remains settled but leans towards cooler days for March and into autumn. March is forecast to be another month of two halves. The first half is forecast to experience more south-westerly winds and run a little cooler than last month, with occasional cool snaps also expected. An increase in cyclone activity may impact New Zealand in the first half of the month. This could result in heavy rainfall and flooding for impacted regions (more likely for the North Island). The second half of the month will feel more summer like with a return of high pressure, westerly winds and settled weather. Overall, the month will lean towards warmer than average, with eastern and northern locations leaning drier than average.

Locations to watch

In general, fire danger and fire climate severity typically peak in February/March and decline over March/April. This decline is expected to occur as we progress into autumn. However, the risk of further fire outbreaks remains high for some locations.

Based on the forecast for warm and drier conditions to continue in March for northern and eastern locations, plus the current soil moisture status and elevated FWI codes and indices, areas to keep an eye one for High to Extreme fire dangers are: Marlborough, Canterbury and Otago (Map 1). However, this may change with any major rain events that will improve soil and fuel moistures and consequently reduce the potential for wildfire outbreaks.



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 for March remains at non-traditional La Niña conditions. This season's La Niña has passed its peak and has been weakening over the last few weeks. International models are forecasting La Niña to continue over the next three months (56% during March - May). The probability drops further during June to August (33%) with a return to ENSO-neutral conditions favoured (56%). Neutral and La Niña conditions are equally favoured (40-45% chance) for spring (September – November).

Regardless of a weakening La Niña, it is still expected to impact New Zealand's weather patterns into autumn. A negative Southern Annular Mode (SAM) is forecast, resulting in cooler, unsettled weather and westerly winds for the first half of March. During April and May, convective activity may become more frequent in the eastern Pacific and South America, which will contribute to more low-pressure systems around New Zealand, resulting in cooler weather.

Tropical Cyclone outlook

La Niña may have peaked, but we are now in the peak of tropical cyclone season. Tropical cyclone activity is expected to increase this month, which may bring much needed moisture closer to New Zealand.

The tropical cyclone season for the Southern Hemisphere runs from November to April, with the odd one occurring outside this period. On average, about 10 tropical cyclones form in the South Pacific between November and April. To date, five Tropical cyclones have developed in the south west Pacific (Yasa, Zazu, Ana, Bina & Lucas).

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.

Fire season analogues

To help understand what the fire season could look like during the next three months, fire seasons coinciding with moderate strength La Niña conditions occurred in 2010/11, 2007/08, 1999/00, and 1998/99. Weak La Niña seasons included 2000/01 and 2011/12. These past events (historical analogues) reminiscent of moderate or weak La Niña are potentially good indicators for what to expect this coming fire season (Figure 11).

This fire season (2020/21) has not followed traditional La Niña weather patterns and has resulted in northern locations being unusually drier than normal. Each historical La Niña event has resulted in slightly 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). The South Island is currently tracking like the 1998/99 and 2010/11 seasons that were moderate La Niña events.

This month: March 2021

With the start of autumn, while temperatures tend to run a little cooler than summer, the weather is usually the most settled with long sunny days. As autumn progresses (during March to May), expect frosts to occur from time to time in cooler locations. Some southern locations have already experienced a few frosts in February.

March is forecast to be another month of two halves. The first half will feel cool, with weather fronts bringing rain and thunderstorms over the country. Winds are likely to shift south-westerly and drag temperatures down. A tropical cyclone (Niran) has formed in the Coral Sea near the Queensland coast, and has the potential to drift near New Zealand and bring with it much needed moisture. There is uncertainty in how this will track, and whether the expected high pressure (that may or may not eventuate) will protect New Zealand from Niran. The second half of the month will feel more summer like with high pressure returning and settled weather. Winds will shift back to westerlies and bring with it about normal air temperatures.

Further ahead:

During the next three months (March – May 2021), weather patterns are expected to become more variable as the effects of the 2020/21 La Niña event eases and we progress into autumn. Temperatures are likely to be near normal for the east of the South Island, and near normal to above normal in remaining regions. The occasional cool snap is expected, especially in the first half of March. The west of the South Island is likely to experience near or below normal rainfall, with near normal rainfall for remaining locations. Low-pressure systems are forecast to become more common. Cyclone activity may impact New Zealand in the first half of the month, that could result in heavy rainfall and flooding for impacted regions (more likely for the North Island). Soil moisture levels and river flows are expected to be near normal for the east coast, and near normal or below normal for remaining locations.

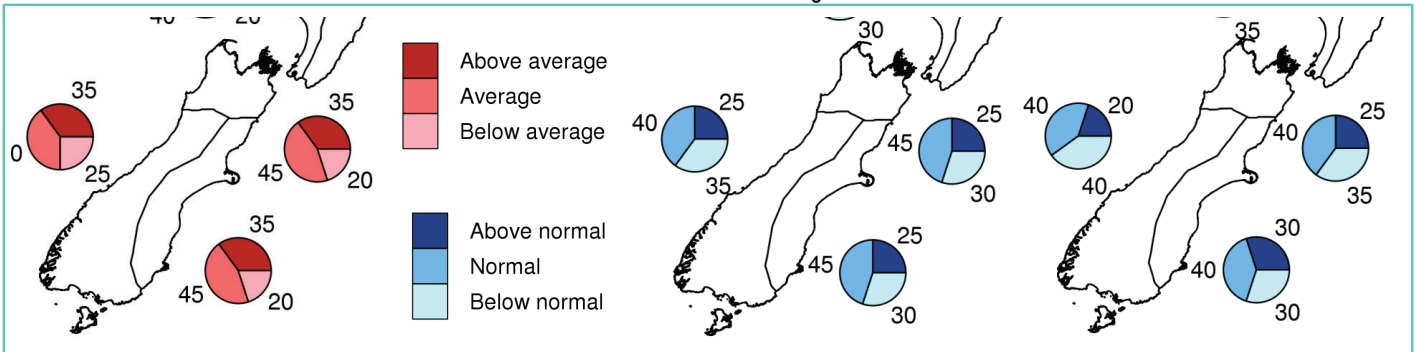


Figure 1. Outlook for March to May 2021: air temperature (left), rainfall (middle), available soil moisture (right). Source: NIWA.

Regional breakdown (Figure 1):

Temperatures are most likely to be:
- near normal (45% chance) for Tasman, Nelson, Marlborough, Buller, coastal Canterbury and eastern Otago;
- near normal (40%) or above normal (35%) for West Coast, Alps and foothills, inland Otago, and Southland.

Rainfall totals are most likely to be:
- near normal (45% chance) for Tasman, Nelson, Marlborough, Buller, coastal Canterbury and east Otago;
- near normal (40%) or below normal (35%) for the West Coast, Alps and foothills, inland Otago and Southland.

Soil moisture levels are most likely to be:
- near normal (40% chance) or below normal (35%) for Tasman, Nelson, Marlborough and Buller;
- near normal (40%) or below normal (40%) soil moistures, while river flows are below normal (45%) for West Coast, Alps and foothills, inland Otago and Southland;
- near normal (40%) for coastal Canterbury and east Otago.

Last month: February 2021

Looking back, February was dominated by high pressure and settled weather, with a mid-month low brining wind and rain to places. Overall, many regions experienced a drier than normal February, especially Canterbury, Otago, and the West Coast. Much of the South Island experienced a sunnier than normal month (except Fiordland). Inland Marlborough, Nelson, Central Otago, Fiordland, and Westland, south of Franz Joseph, observed a warmer than normal month. Temperatures for the remaining locations were about normal. Coastal sea surface temperatures were typically below average to near average during February.

Soil moisture (Figure 2 & 3)

Dry soils are present along the east coast of the South Island, this includes Nelson, Marlborough, coastal Hurunui, Banks Peninsula, Selwyn, Mackenzie, Waitaki, Queenstown Lakes and Central Otago districts (Figure 2). In contrast, soil moisture levels are at field capacity or nearing water surplus along the West Coast.

Soil moisture levels are about normal for this time of the year across much of the South Island (green/yellow) (Figure 3). The exceptions being slightly drier than normal soils present in the Hurunui, Banks Peninsula, Ashburton and Clutha districts. In contrast, wetter than normal soils are present in Fiordland and Stewart Island.

NIWA's Drought Index (NZDI) indicates dry to very dry soils occurring across north-eastern regions (Nelson, Marlborough, North Canterbury and a pocket in Banks Peninsula). There are currently no South Island locations in meteorological drought.

Grass growth & curing:

As we progress through the autumn months, grasslands will start to green up again. However, dead grass remaining from this or previous seasons can contribute substantially to the amount of dead fuel in a grassland and is therefore important to include in your curing estimation. This dead grass is referred to as thatch. Thatch is still capable of carrying a fire through green grass that would not otherwise burn. This influence is particularly important when the current season has curing values around 30%-50%. In the absence of thatch, green grass would not necessarily be able to sustain fire spread. Typical fire behaviour in these grasslands will produce very small flame heights, be smokey, patchy in its progression and will be low intensity.

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 experienced summer droughts, curing will become more continuous in the dry 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 spread very quickly, produce large to very tall flame heights (2 m+), be very intense and much more difficult to suppress. Some areas would also have experienced abundant grass growth over the last month, increasing the fuel loading.

For some parts of the country still undergoing bouts of rainfall, it's not uncommon to see green landscapes with low curing values. These areas can help reduce or halt a fire's spread (depending on the curing amount). However, be careful with grasslands that have a dense continuous top cover of dry grass, fires will still race along the tops.

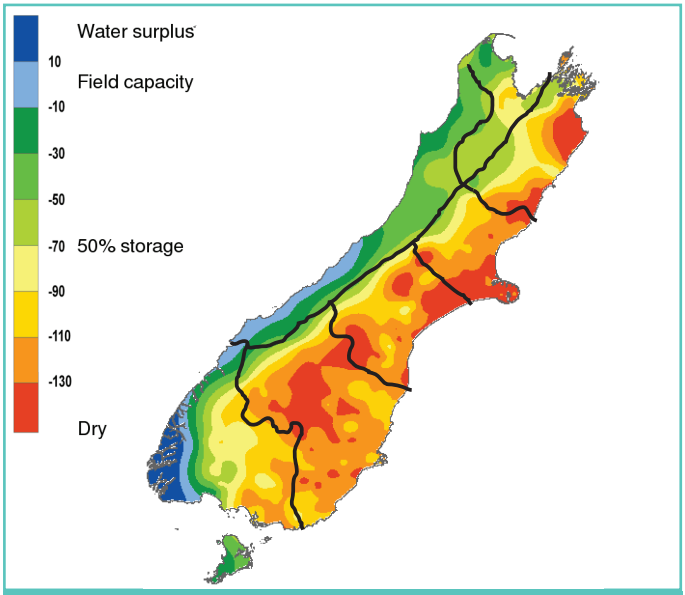


Figure 2. Soil moisture deficits as of 03/03/2021.
Source: NIWA.

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.

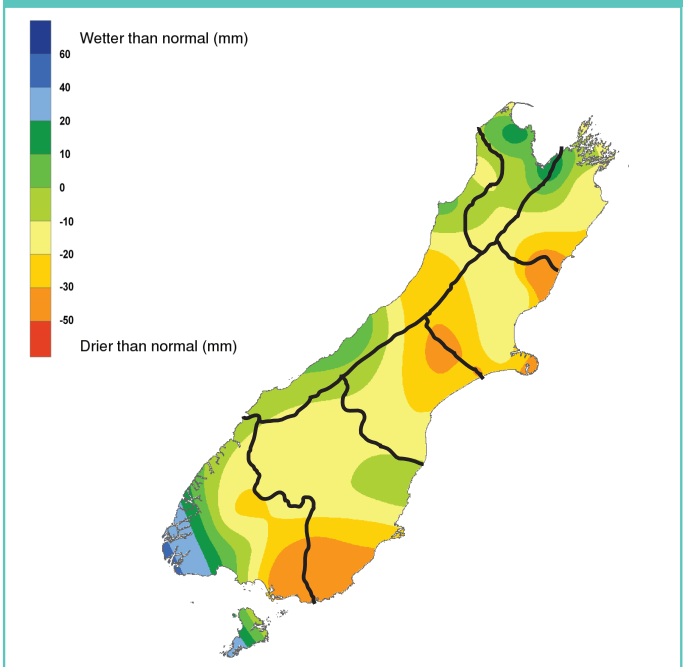


Figure 3. Soil moisture anomaly as of 03/03/2021.
Source: NIWA.

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.

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.

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, incredible rates of spread and flame lengths, even with shorter grass can be observed. Light, flashy fuels are one of the common denominators of tragedy fires.

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 South

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.

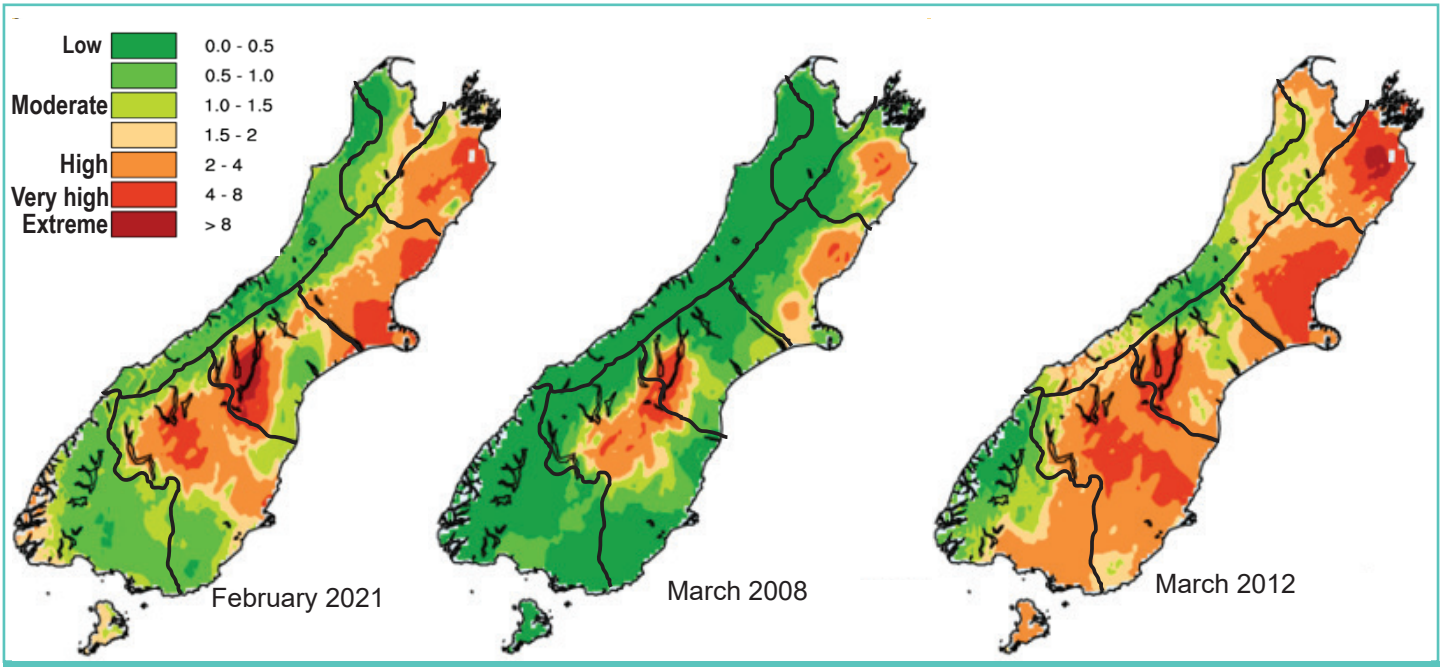


Figure 4. Monthly average Severity Rating for: the previous month (left), and expected average monthly values during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year

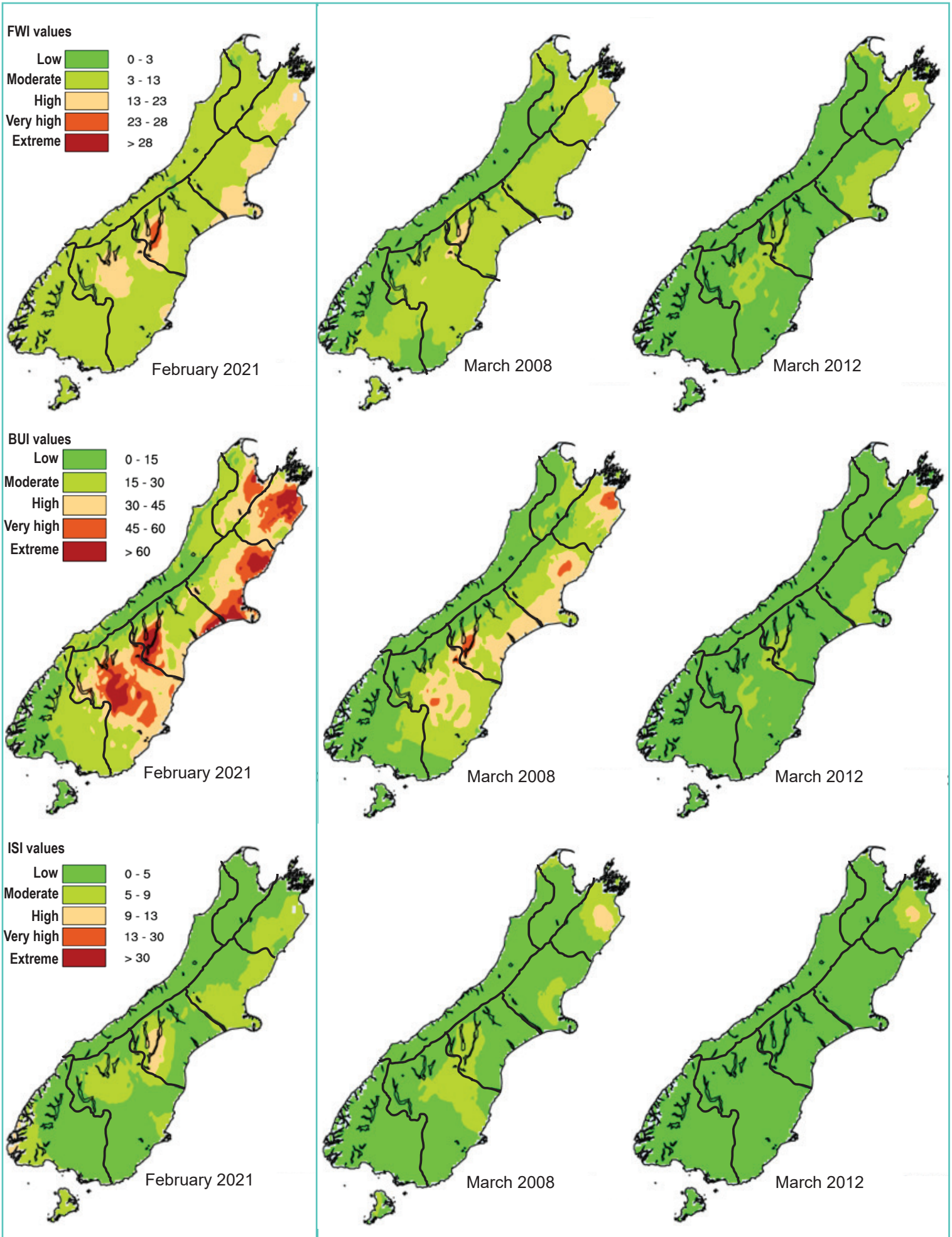
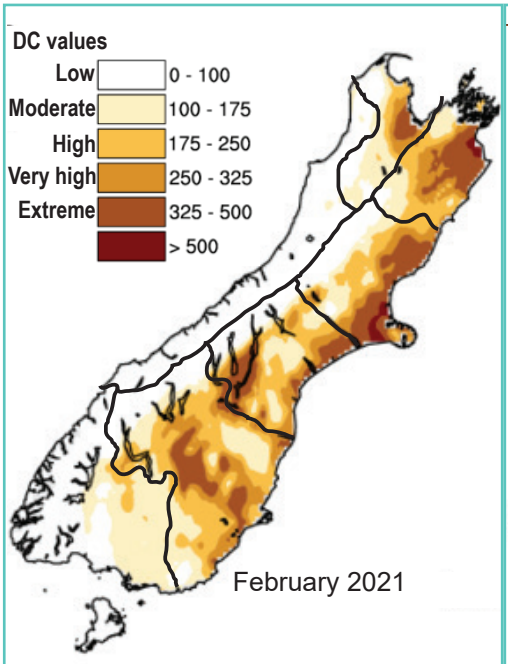
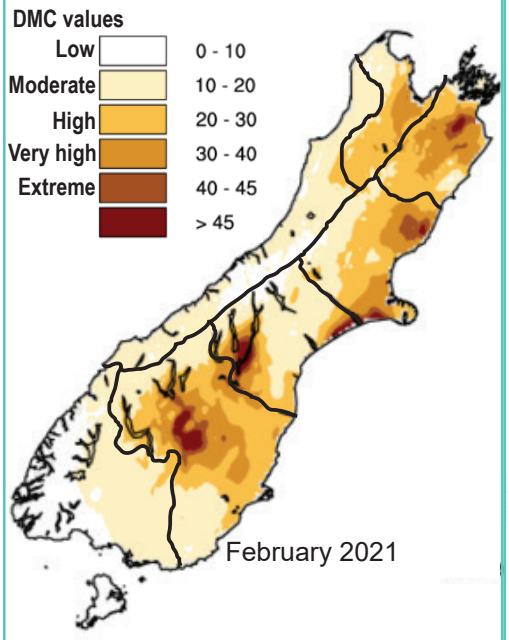


Figure 5. Previous Monthly Average for the: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below).

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.





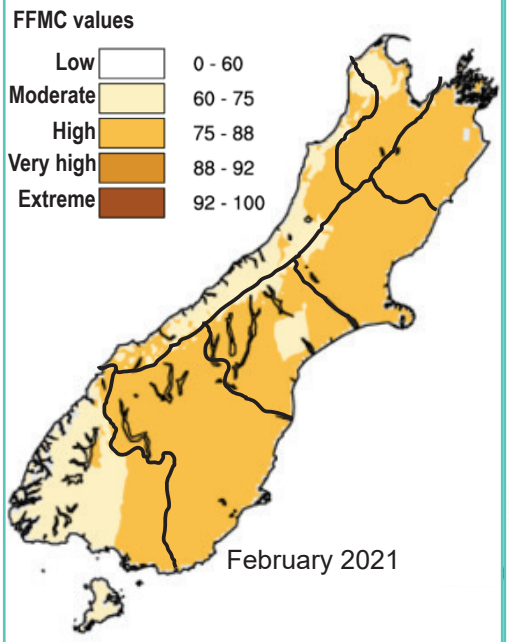


Figure 7. Previous monthly average for the: Drought Code (top), Duff Moisture Code (middle) and the Fine Fuel Moisture Code (below).

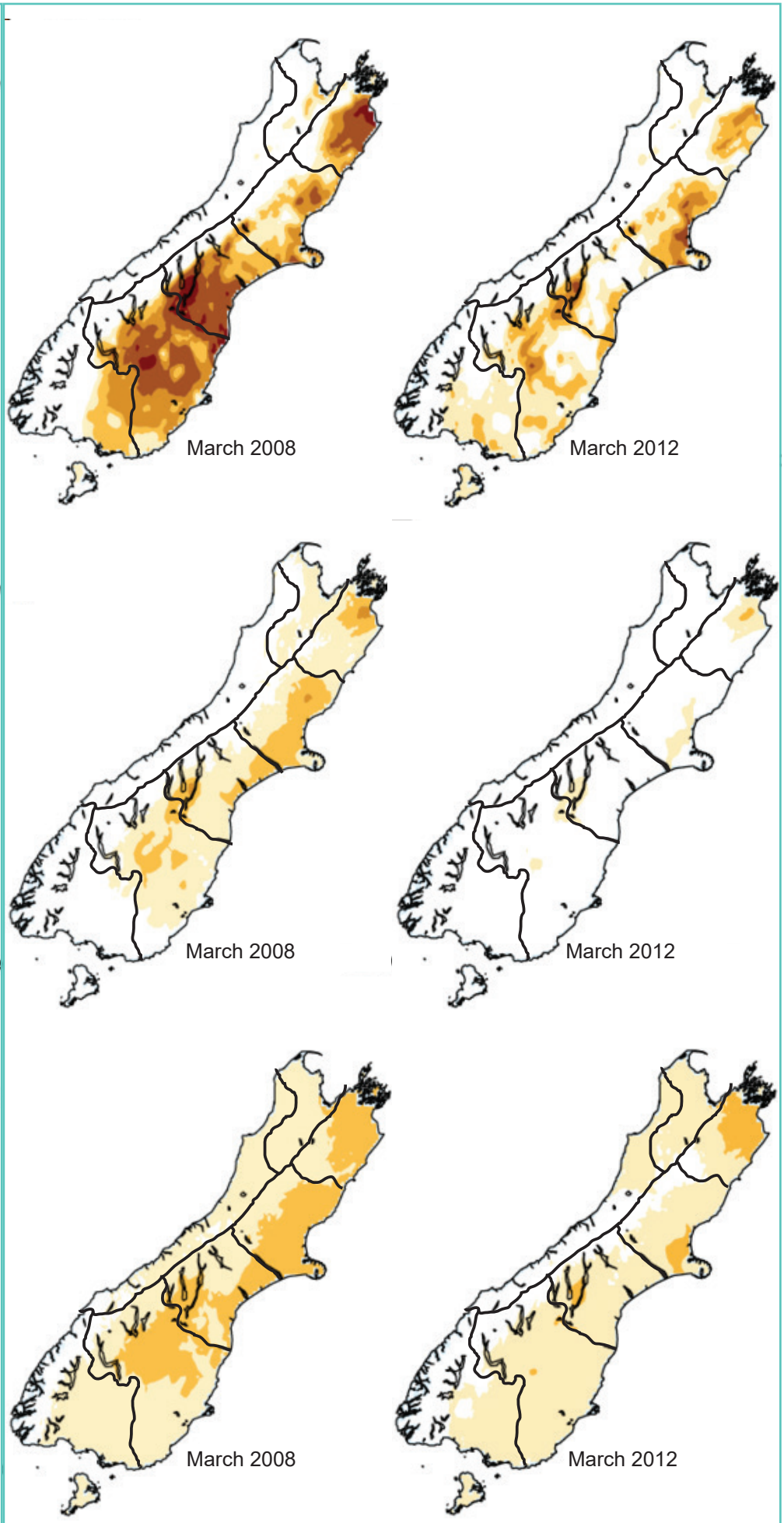


Figure 8. Average monthly values of: Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (below); and during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

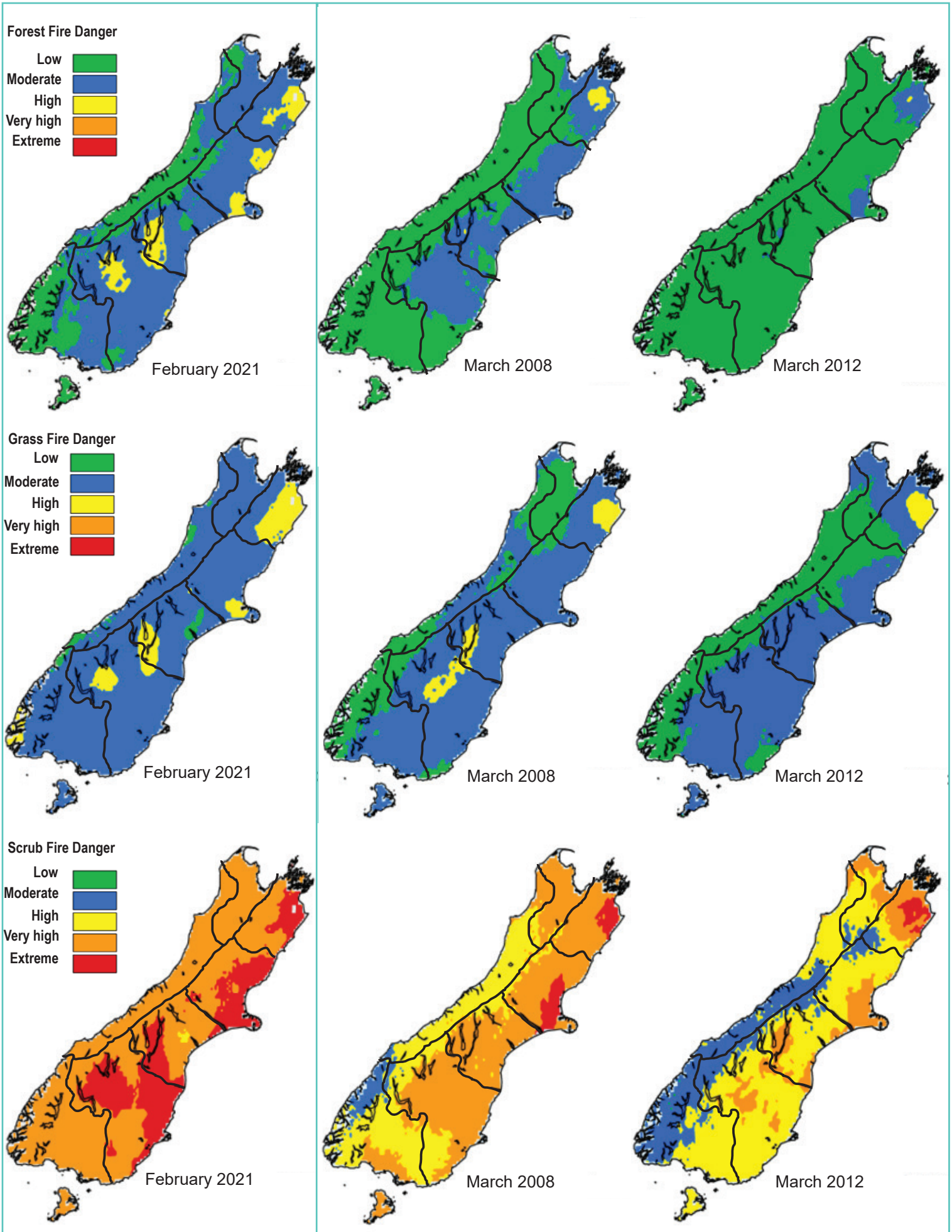


Figure 9. Previous Monthly Average for the: Forest Fire Danger (top), Grassland Fire Danger (middle) and Scrub Fire Danger (below)

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.

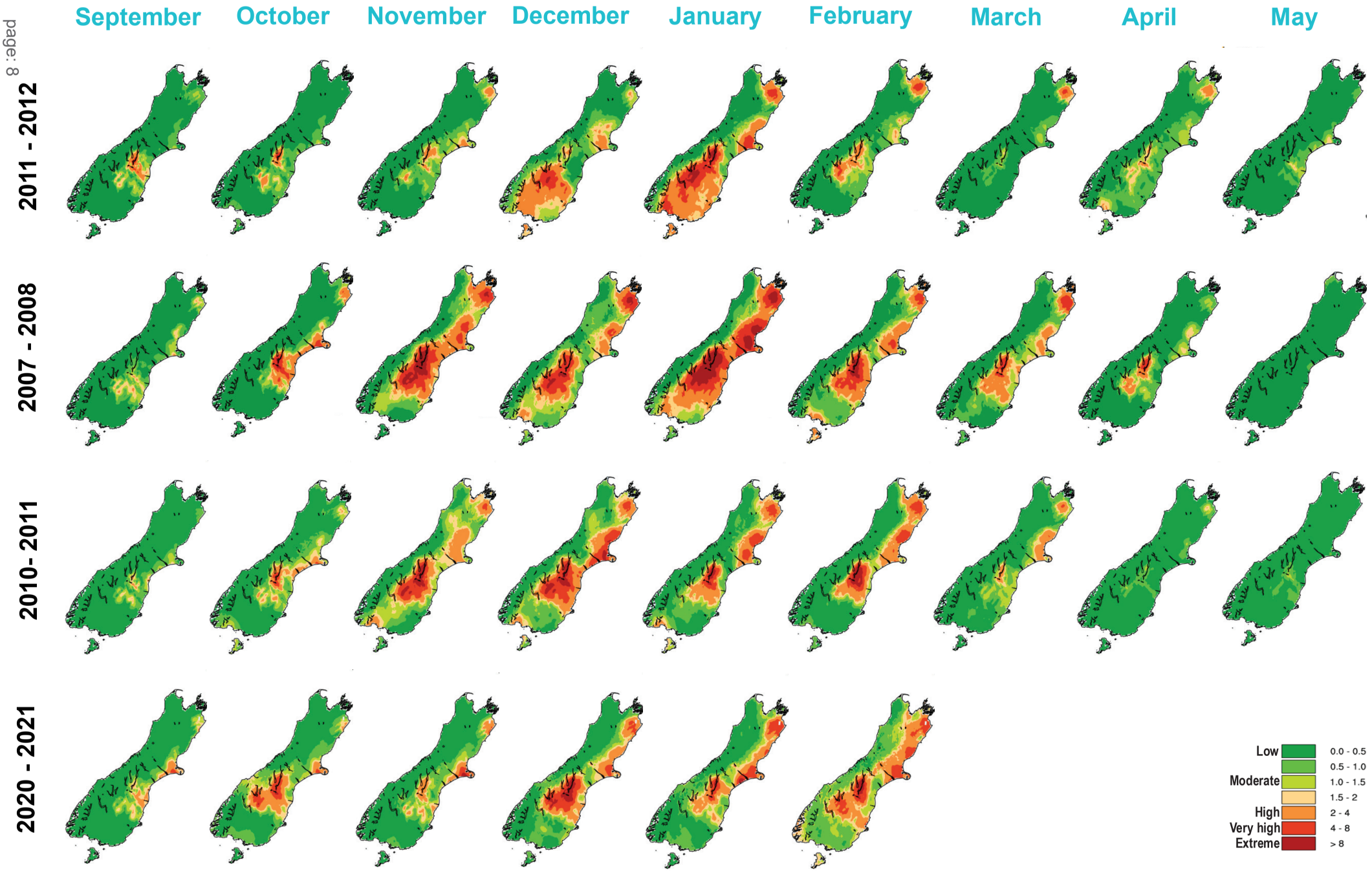


Figure 11. New Zealand Fire Season Severity (monthly)
The years of 2007/08, 2010/11, 1999/00, and 1998/99 and are ideal comparisons for what the South Island might experience over the next few months. These years were moderate strength La Niña years, 2011/12 was a weak La Niña event. DSR values of less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

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