



South 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. In general, monthly fire dangers and fire climate severity have elevated into High to Extreme for eastern locations (Marlborough, Canterbury and Otago) (Figures 4, 5 & 9). In contrast, much of the West Coast and Southland regions remains Low to Moderate

Fuel and soil moisture status

This is reflected in the current FWI System codes and indices (FFMC, DMC, DC, and BUI) (Figures 5 & 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. In general, most stations across the South Island are recording BUI and DC values well below or on trend with the historical average for this time of the year. These regions include Nelson/Tasman, West Coast, Otago and Southland. This is in direct contrast to the North Island that are recording well above values. The remaining regions have stations that are recording either above or below the average for this time of the year. These regions include Marlborough, Canterbury and Mid-South Canterbury. Graphs tracking individual station trends daily are available on the Scion website.

Much of the east coast is currently in soil moisture deficits (Figure 2). Soil moisture levels are less than 50% capacity and considered dry in Nelson/Tasman, Marlborough, Canterbury and Otago. Nelson/Tasman, Marlborough, North Canterbury and southeast Southland are drier than normal for this time of the year, the remaining locations are either about normal or wetter than normal (Figure 3).

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, the non-traditional La Niña is still expected to influence our climate over the next three months.

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. Air temperatures are expected to be either above average or near average. Rainfall is likely to be near normal or below normal.

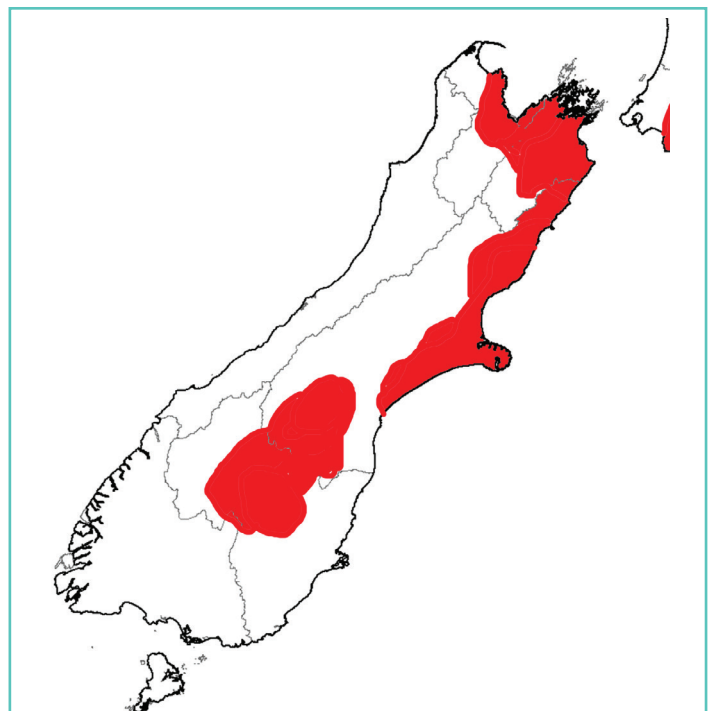
Both islands will have changeable weather that averages out warmer than normal this month. A continuation of extended dry spells is expected, interspersed with unsettled weather. High pressure will dominate and bring a dry start to the month. In between these highs, especially in the middle of the month, 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. With warmer and drier conditions expected for February, vegetation and soil moisture levels will continue to dry out, further elevating the fire risk and contributing to deeper burning, and potentially faster moving fires.

In general, fire danger and fire climate severity typically peak in February and 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). The South Island is currently tracking like the 1998/99 and 2010/11 seasons that were moderate La Niña events. However, this fire season has not followed traditional La Niña weather patterns.

Areas to keep an eye on for High to Extreme fire dangers are those that are more likely to experience a combination of warmer air temperatures, a lack of rainfall, and continued soil moisture deficits. Based on the forecast for continued warmer and drier conditions, the current soil moisture status and elevated FWI codes and indices, specific areas to watch are: Nelson/Tasman, Marlborough, Canterbury and Otago (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.



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 of New Zealand. 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 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 near or above average for all South Island regions. Rainfall is likely to be normal to below normal in the west of the South Island, and near normal for the remaining regions. Soil moisture levels and river flows are expected to be near normal in the east, and near normal or below normal for remaining locations.

Regional breakdown (Figure 1):

Temperatures are most likely to be:

- above normal (45% chance) or near normal (40%) 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:

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

Soil moisture levels are most likely to be:

- near normal (40% chance) or below normal (40%) for Tasman, Nelson, Marlborough and Buller,
- below normal (40-45%) or near normal (40%) for West Coast, Alps and foothills, inland Otago and Southland;
- near normal (45%) for coastal Canterbury and east Otago.

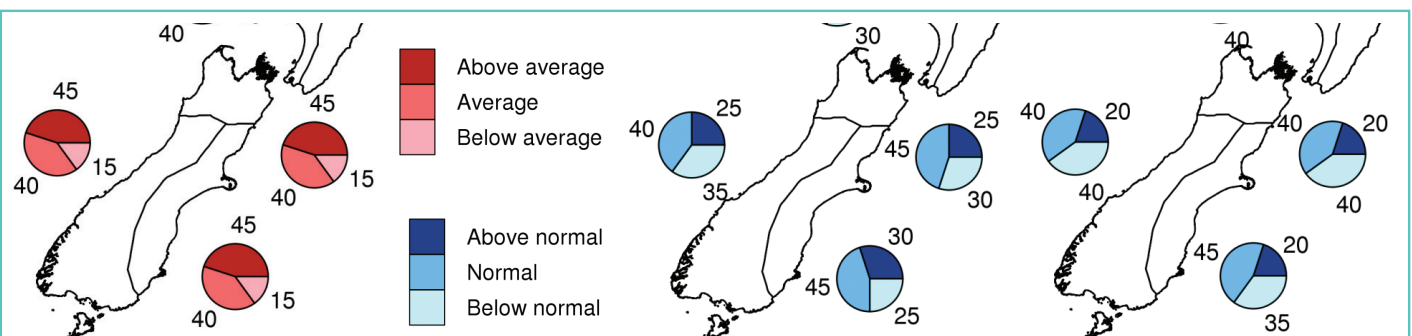


Figure 1. Outlook for February to April 2021: air temperature (left), rainfall (middle), available soil moisture (right). Source: NIWA.

Last month: January 2021

Weather during January has been very interchangeable. Parts of the South Island experienced gales, heavy rain, flooding and hail, even summer snow was also brought to the mountains. But the big wet and chill didn't last long, giving way to north westerlies that pushed the temperature in the high 30's for many eastern locations. Ashburton recorded its highest temperature on the 26th (39°C), and Christchurch reached 35°C on two consecutive days.

Soil moisture (Figure 2 & 3)

In general, eastern locations have been windy, hot and dry and resulted in soils continually drying out over the last month. Soils moisture levels across most eastern locations are now below 50% storage capacity (Figure 2). Dry soils (red and orange) are in Nelson, nearby parts of Tasman, Marlborough, coastal Hurunui District, coastal Selwyn District, South Canterbury, Queenstown Lakes district and Central Otago. In contrast, soil moisture levels are at or nearing water surplus along the West Coast.

Soil moisture levels for this time of the year are about normal for most locations (Figure 3). The exceptions being drier than normal soils present in Nelson/Tasman regions and a pocket in Southland between Invercargill and Dunedin. In contrast, wetter than normal soils are present in and around Reefton and Fiordland along the West Coast of the Island.

NIWA's Drought Index (NZDI) indicates dry conditions are occurring across Nelson, Marlborough, Kaikoura and coastal locations for parts of North and Central Canterbury. There are currently no South Island locations in meteorological drought.

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.

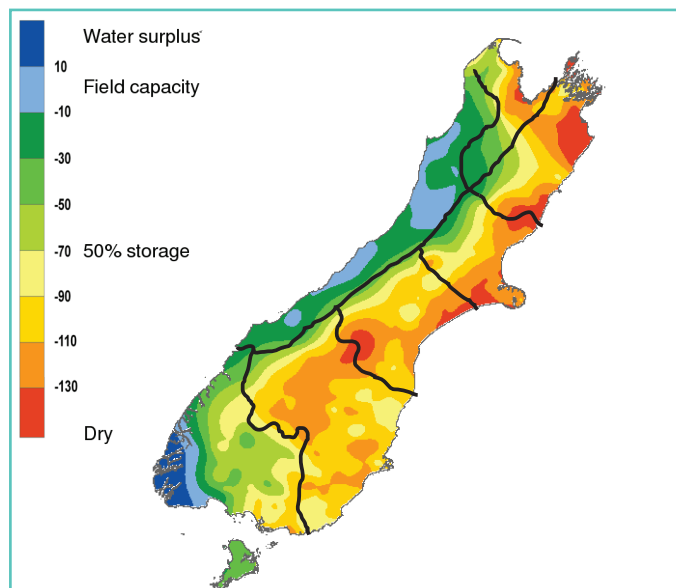


Figure 2. Soil moisture deficits as of 10/02/2021. Source: NIWA.

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.

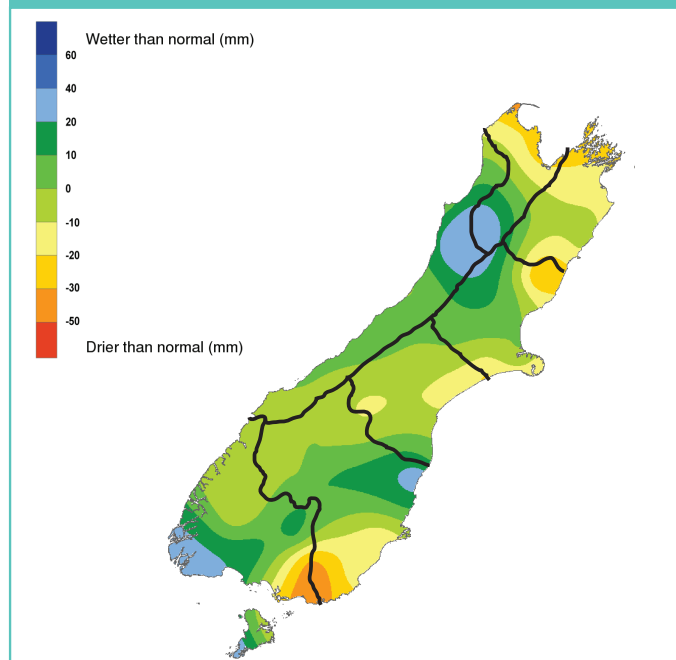


Figure 3. Soil moisture anomaly as of 10/02/2021. Source: NIWA.

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 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 fire's 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 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.

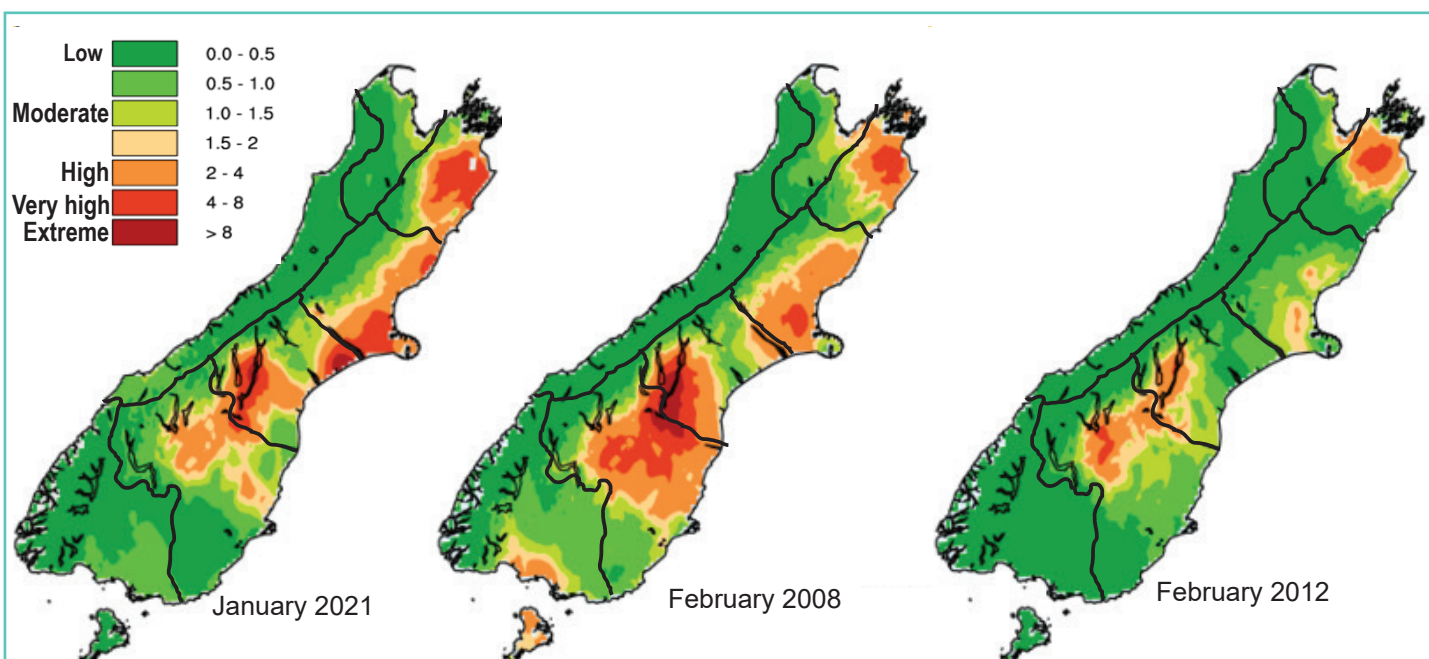


Figure 4. Monthly average Severity Rating for: the previous month (left), and expected average monthly values during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year

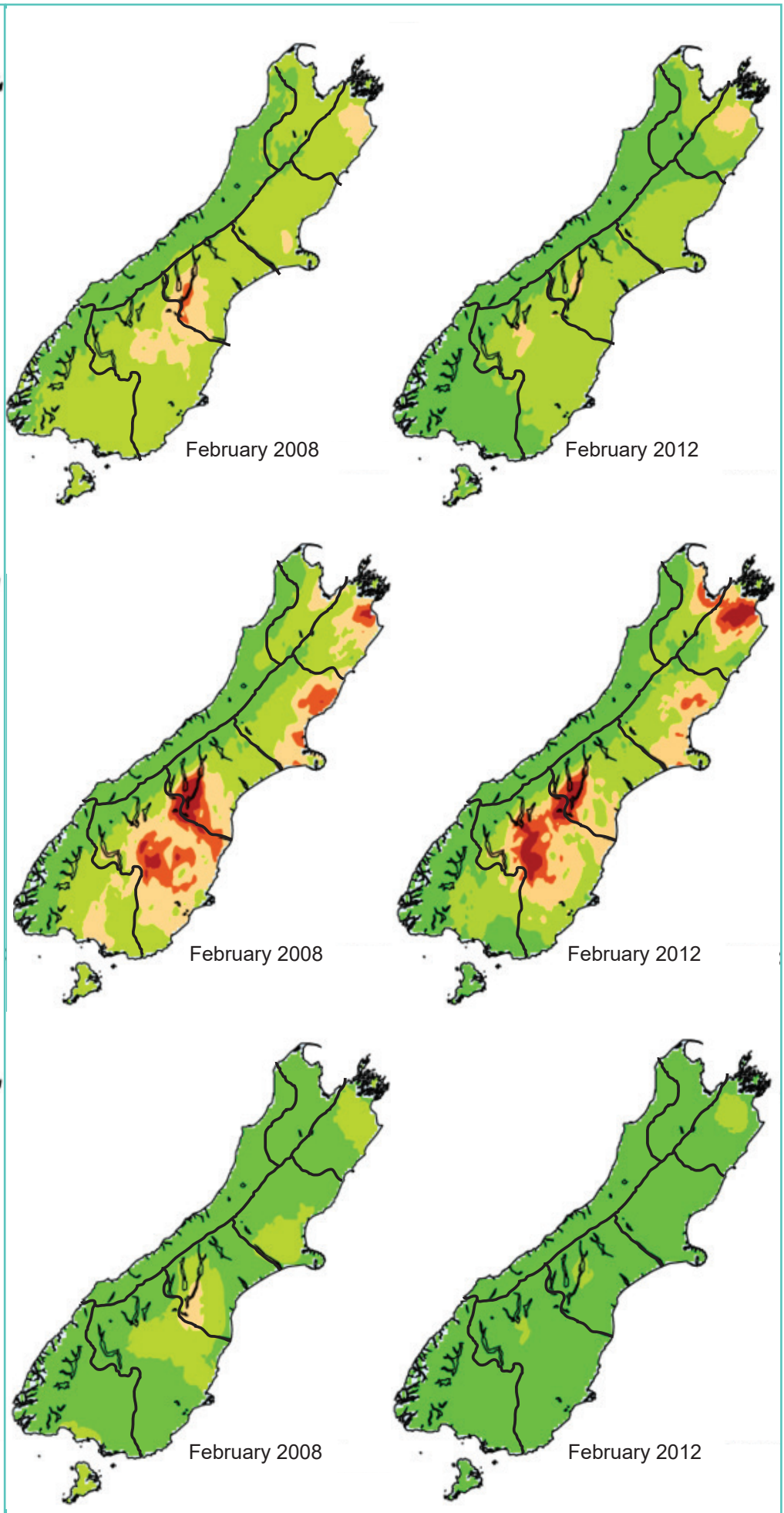
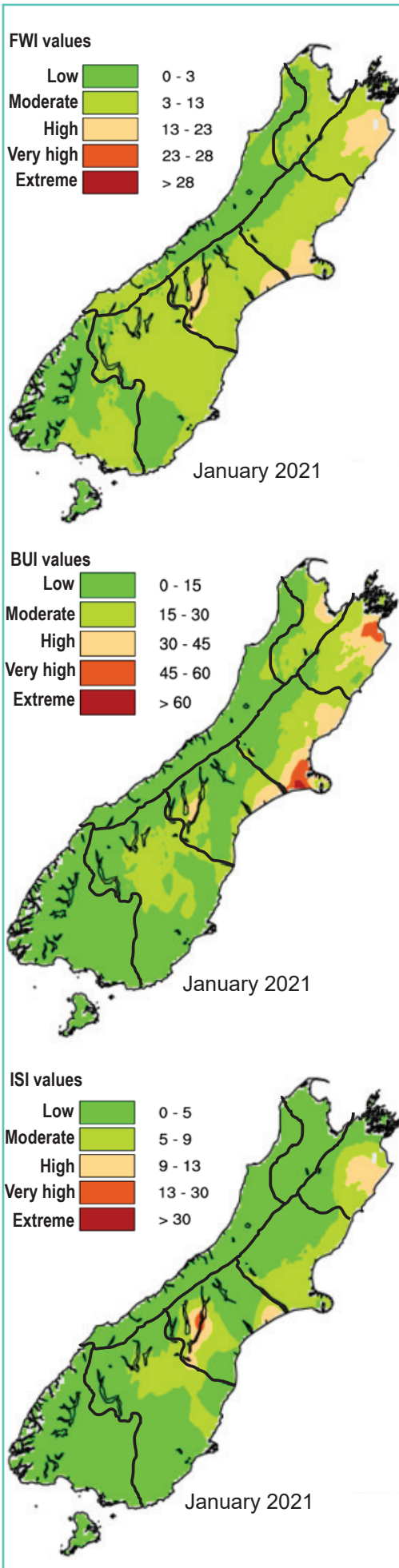


Figure 5. Previous Monthly Average for the: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below).

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.

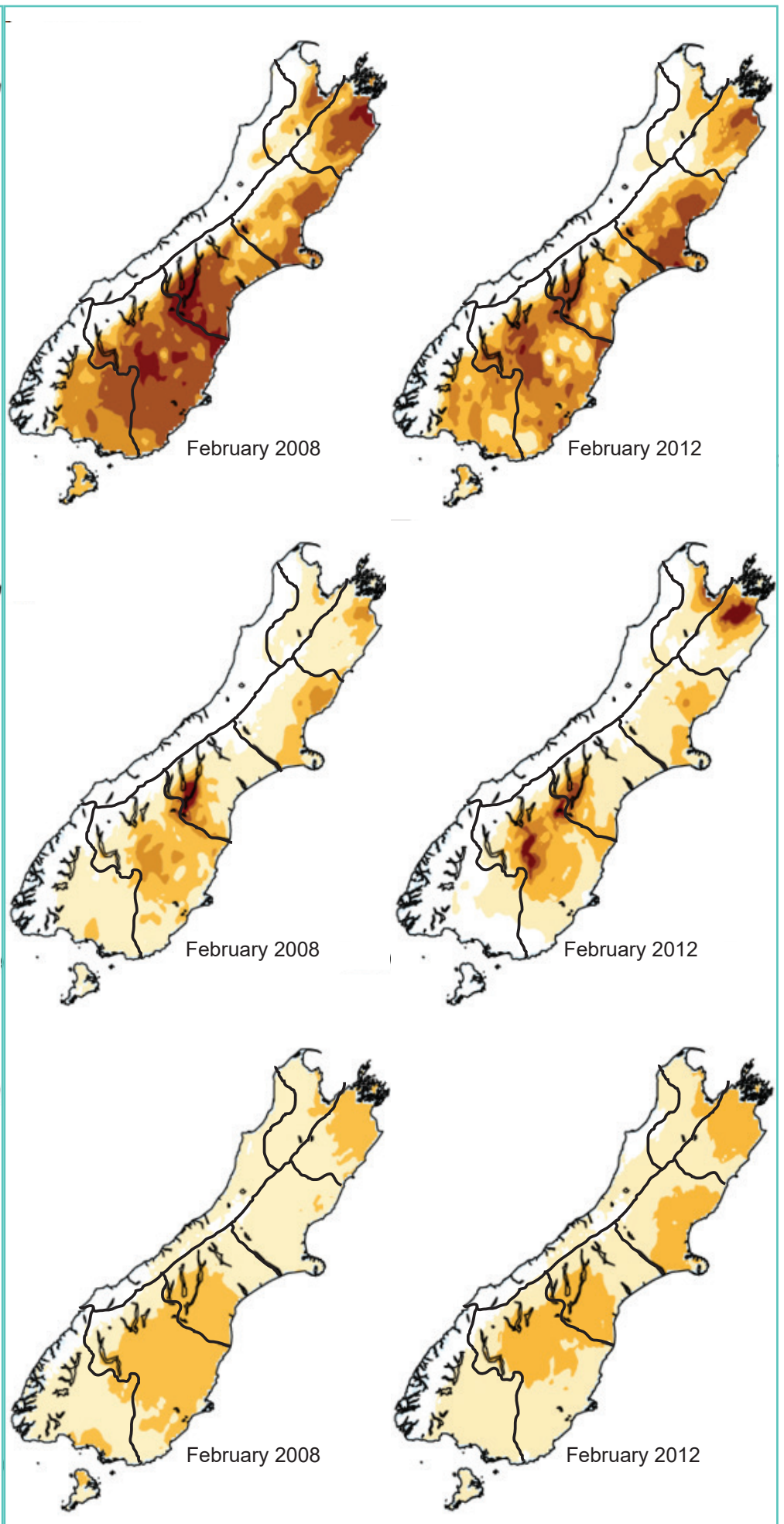
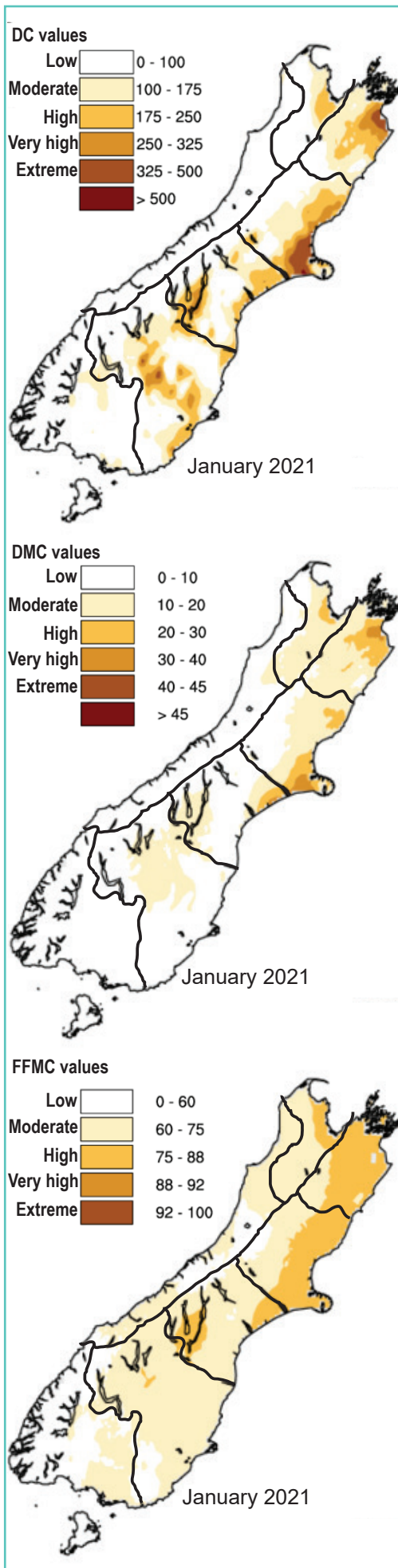


Figure 7. Previous monthly average for the: Drought Code (top), Duff Moisture Code (middle) and the Fine Fuel Moisture Code (below).

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.

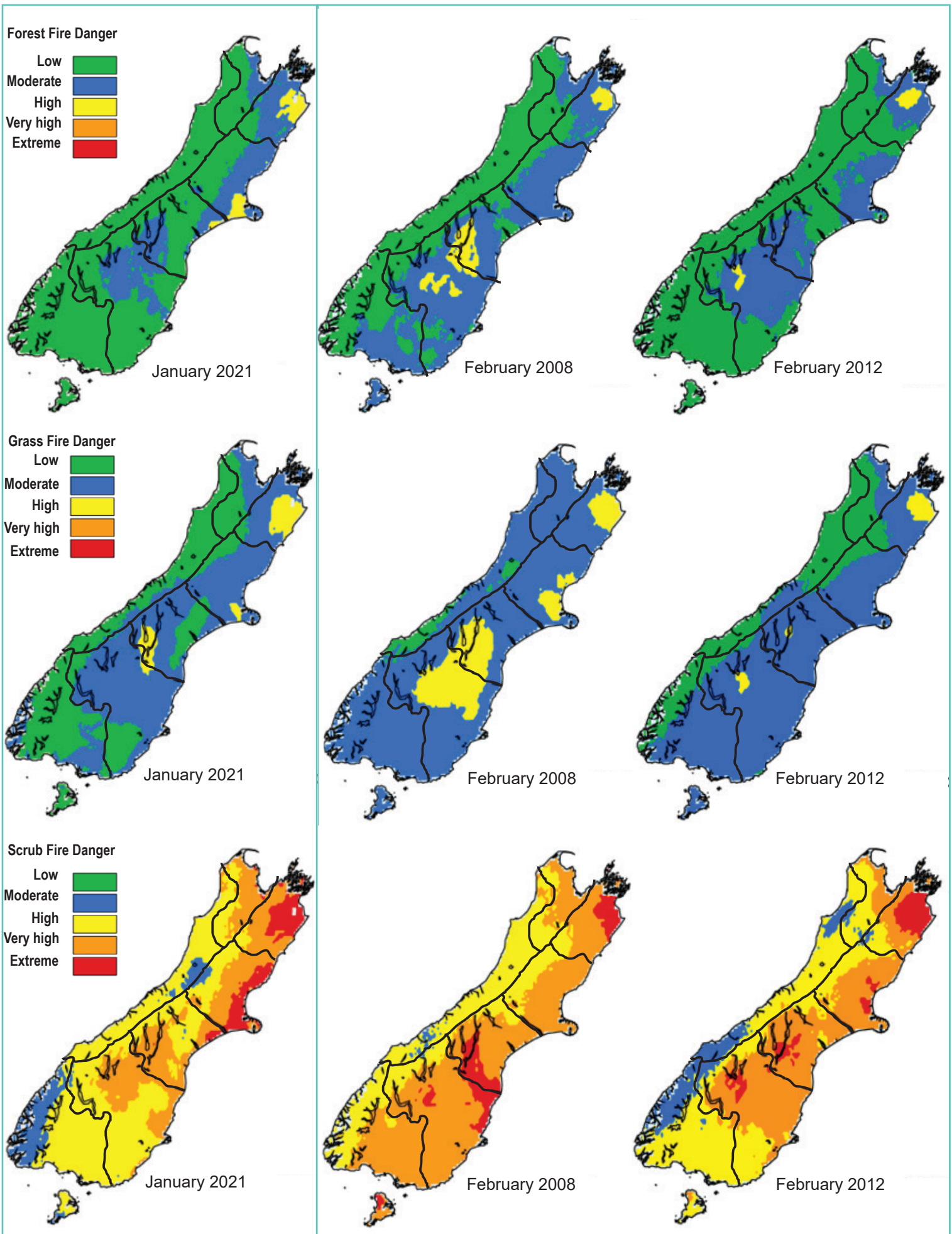


Figure 9. Previous Monthly Average for the: Forest Fire Danger (top), Grassland Fire Danger (middle) and Scrub Fire Danger (below)

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.

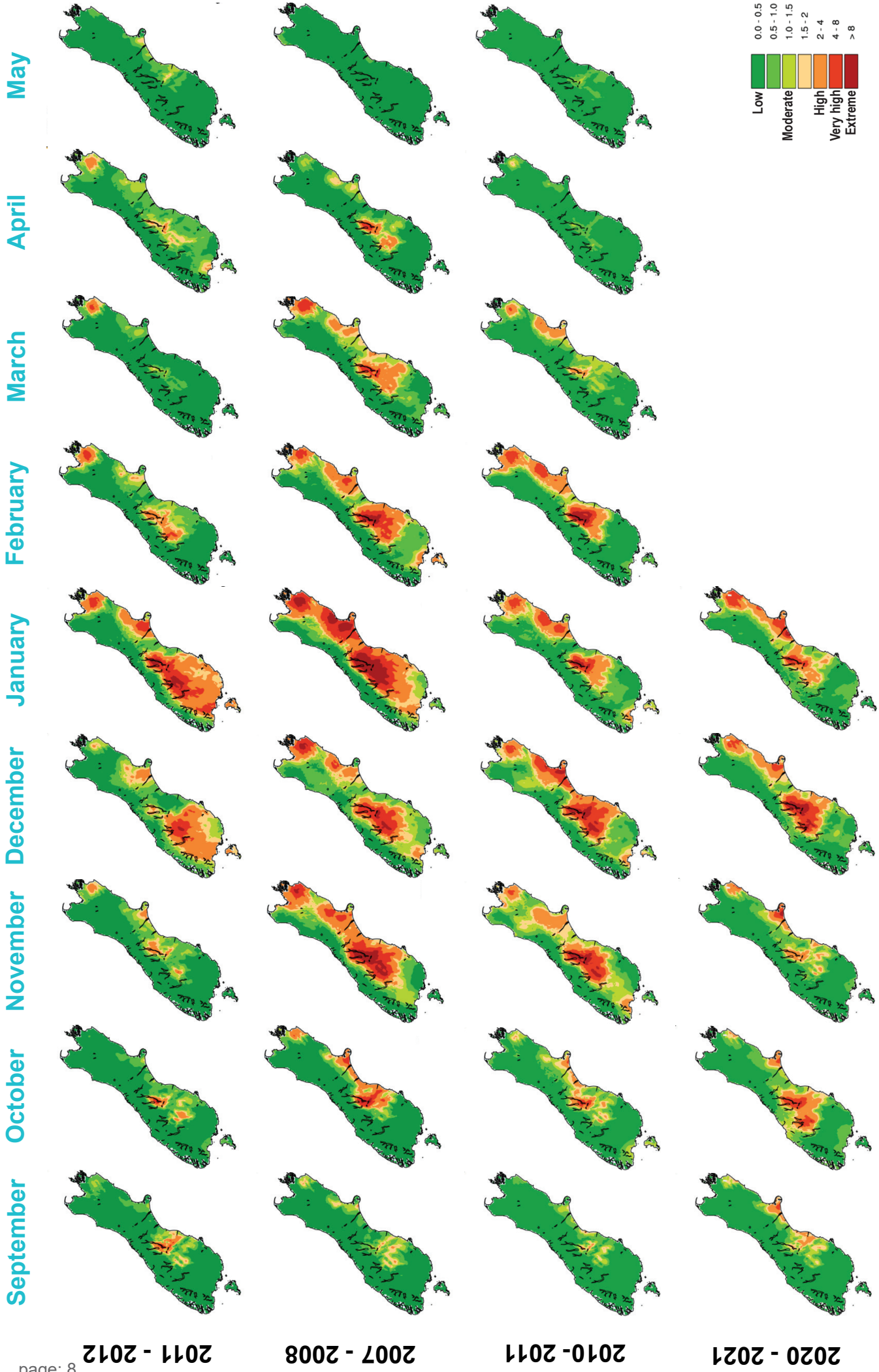


Figure 11. New Zealand Fire Season Severity (monthly)

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=fr>

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