New Zealand Seasonal Fire Danger Outlook 2018/19

ISSUE: South Island, March 2019

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Current fire danger situation & outlook:

The lack of rainfall, hot temperatures and drying winds over January and February have led to very dry soils and vegetation fuels across the South Island. This drove up the fire danger levels for many regions and, as a result, numerous fire outbreaks occurred. On average, Very High to Extreme fire dangers and fire climate severity currently exist in Nelson, Marlborough and Canterbury (Figures 1 & 5). High to Very High ratings are also present in the Tasman, Otago and Southland regions.

This is also reflected in the current FWI System codes and indices, with Very High to Extreme BUI, DC & DMC levels occurring in the Tasman, Marlborough, Canterbury and Otago regions (Figures 5, & 7). Soils also remain dry in northern and eastern areas (Figure 3). Very dry soils are located in Buller, Nelson, Tasman, Marlborough, Canterbury (North and South), Otago (Queenstown Lakes, Central Otago and eastern Otago), and central Southland. This indicates that medium to heavy fuels and deep organic layers are currently very dry and available for combustion. The containment and subsequent control of fires that start in these areas would be difficult and extended.

For the month of March, higher pressure than normal is forecast over the country. Warm weather and prolonged dry conditions are also forecast to continue. There is some relief potentially in the second half of the month for rainfall. Over the next three months, temperatures are expected to be above average across the country. Near normal rainfall is predicted for the north and east of the South Island, and normal to above normal rainfall for the West Coast. Soil moisture and river flows are expected to be near normal for the South Island.

The El Niño–Southern Oscillation (ENSO) index remains neutral, but the Pacific Ocean has continued to warm and touch on El Niño thresholds for the past few months. The ENSO outlook continues to remain at El Niño WATCH, with the precursor oceanic El Niño expected to continue over the next three months, and also potentially into winter and spring. Warm sea surface temperatures are also forecast for the next three months, which will be the likely driver of New Zealand's autumn weather.

The fire season years of 2001/02 (neutral), 2004/05 and 2006/07 (weak El Niños) are possible indicators for what to expect this fire season (Figure 9). In general, fire danger and fire climate severity are expected to peak in February/March for northern and eastern locations, and potentially extend into April/May for Marlborough, North Canterbury and Otago (Figures 1, 6 & 8). Fire dangers are expected to be Low to Moderate for western areas and the far south. With a continuation of warm, dry weather expected for March, the risk of further fire outbreaks still remains high. Vegetation and soil moisture levels will remain elevated, contributing to deeper burning and potentially faster moving fires.

Based on current soil moisture status and the FWI codes and indices, specific areas to watch are: Buller, Nelson/Tasman, Marlborough, coastal and inland Canterbury (north and south), and Otago (Queenstown Lakes, Central Otago and Clutha). Heavy or persistent rainfall is required to reduce the fire dangers and severity in these regions. With very dry soils across northern and eastern locations, rainfall is less easily absorbed into the ground; this will also increase the possibility of flooding if these regions experience heavy rainfall.

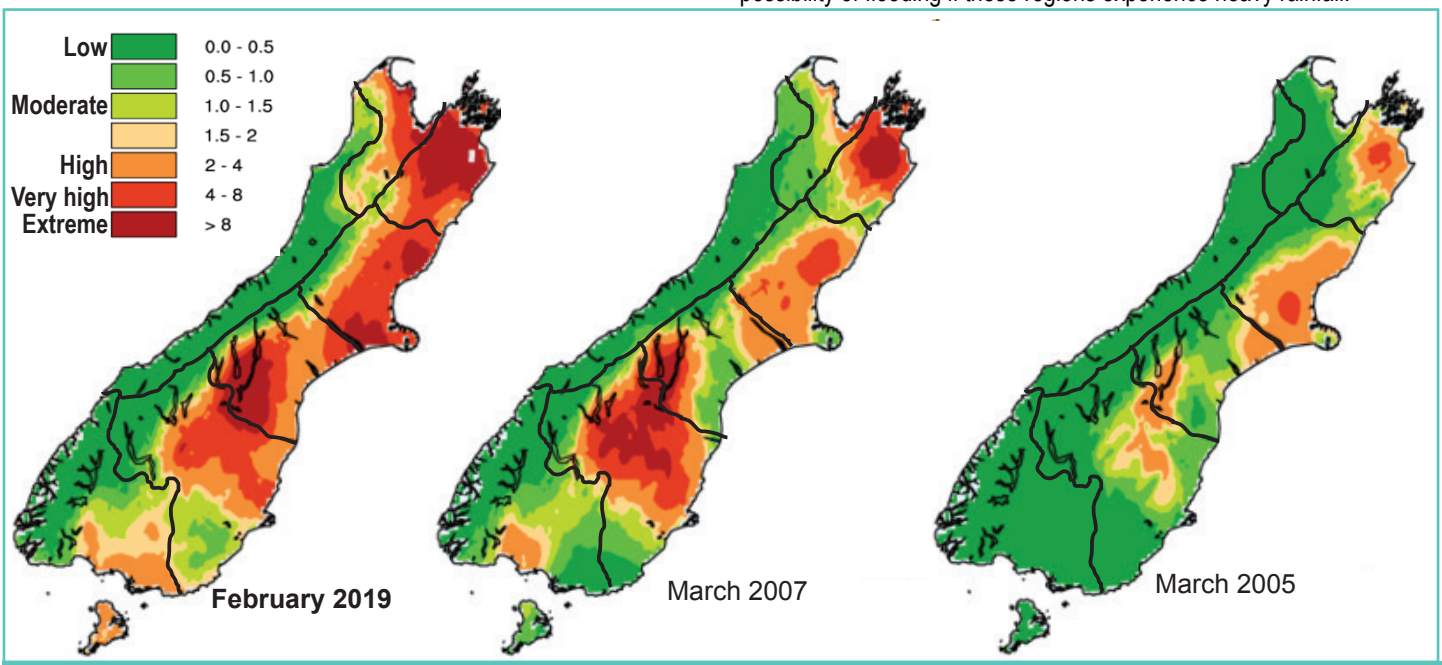

Figure 1. Monthly average Severity Rating for: current (left);
and during the 2006/07 (middle) & 2004/05 (right) Neutral years followed by a weak El Niño.

EXPECTED CLIMATE OUTLOOK:

The El Niño–Southern Oscillation (ENSO) is still currently considered neutral by Australia's Bureau of Meteorology. Sea surface temperatures in the Pacific Ocean have continued to warm over the past few months and have touched on El Niño thresholds. Some agencies have gone as far as labelling this a Pacific El Niño event. Therefore, the ENSO outlook remains at an El Niño WATCH.

Five of the eight international climate models indicate that over the next three months of autumn (March to May) there is a 76% chance predicted for near borderline or weak El Niño conditions. Four of the climate models indicate a 61% probability for El Niño conditions to during winter (June to August). The probability drops further to 48% for an El Niño developing or extending into spring. The long-range models still indicate the potential for a protracted El Niño event, where oceanic sea temperatures remain above average for more than a year. However, predictions made in early autumn tend to have lower accuracy.

In the short term, this marginal El Niño event is not expected to have severe effects on New Zealand, but it may influence the chances of ex tropical cyclones. ENSO is just one of several climate drivers that can influence New Zealand's rainfall and temperature patterns. Warm sea temperatures in the Tasman Sea and around the country have influenced the air temperature over summer (January and February). Over the next three months (March – May), above average ocean temperatures are also forecast, and will likely continue to influence the weather as we head into autumn. The weather around New Zealand is also likely to be influenced by the tropics to the north. When the tropics become the dominant driver of weather, easterly quarter winds are more likely, otherwise westerly winds are favoured. A warm Tasman Sea combined with an El Niño could result in warm, humid weather along with heavy rainfall events this autumn.

This month: March 2019

High pressure will remain dominant for the first half of March and, as a result, long warm dry spells are expected. March is known as a relatively dry time of year climatologically, and this is the time of year when temperatures begin to noticeably trend down. Below average rainfall and above average temperatures are expected to continue during the first half of the month, especially for eastern regions in the South Island. In the second half of the month, rain is on the horizon to offer some relief; however, there is uncertainty around whether this will eventuate. Westerly winds are also forecast over the lower South Island at the end of the month.

Further ahead: March - May (Figure 2)

For the next three months (March – May 2019), warm weather and long dry spells are likely to continue, especially for the beginning of the autumn season. New Zealand is expected to have warmer than average temperatures for all regions. However, cold snaps and frost are also likely to happen in cooler locations. Rainfall totals are expected to be normal or above normal for the West Coast, and near normal for the rest. Soil moisture and river flow levels are expected to be near normal for the South Island. New Zealand's air flow is likely to be influenced by the tropics and the Tasman Sea, which would mean easterly winds are more likely; otherwise westerly winds are favoured. The continuation of warm seas and El Niño conditions could result in warm, humid weather with an increased risk of heavy rainfalls.

Regional breakdown (Figure 2):

Temperatures are most likely to be:

- above average (50% chance) for Tasman, Nelson, Marlborough, Buller, West Coast, Alps and foothills, coastal Canterbury and east Otago, 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 (35%) or above normal (40%) 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 (30-35%) for the West Coast, Alps and foothills, inland Otago and Southland;
- near normal (40%) for Coastal Canterbury and east Otago.

Last month: February 2019

Looking back, February was a hot, dry month for many parts of the country. Again, the country was dominated by high pressure. Sea surface temperatures around New Zealand and in the Tasman Sea were well above average. It was the driest January/February on record for Nelson, with just 14mm being recorded at the start of the year. Blenheim also recorded is third longest dry spell on record (39 days). The long dry spell was ended near the last week of the month by a cool southerly change in the south and tropical moisture from the north of the country.

Soil moisture (Figure 3 & 4)

In the South Island, dry soils are found across northern and eastern locations (Figure 3). Very dry soils (red/orange colouration) are found in northern Buller, Tasman and Marlborough , parts of North and South Canterbury, Otago and Southland. In contrast, soils are near or

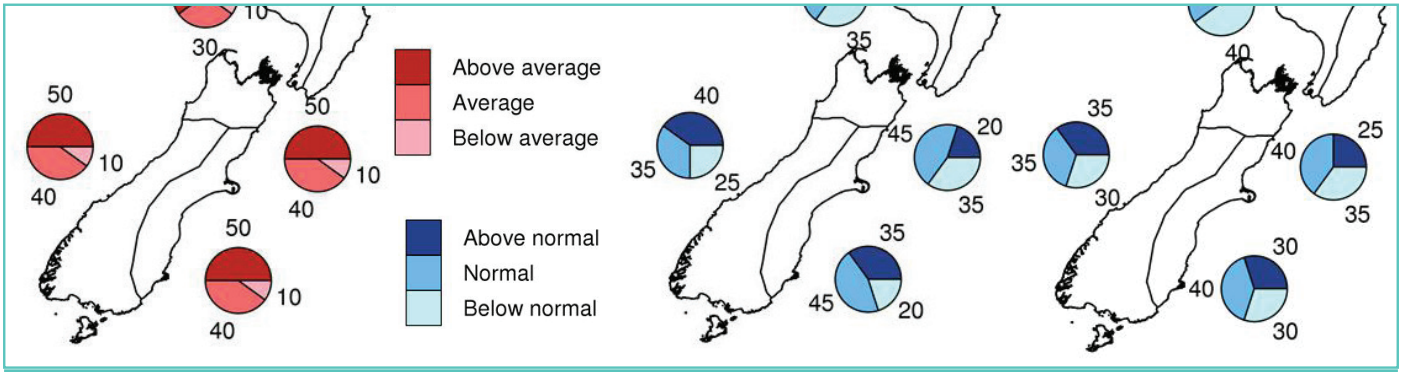

Figure 2. Outlook for March - May 2019: air temperature (left), rainfall (middle), available soil moisture (right). Source: NIWA.

at field capacity along the West Coast (from the Grey district to Fiordland).

The soil moisture anomaly map (Figure 4) shows that soils are much drier than normal (red) in the Tasman and Buller districts. Drier than normal soils are also found in parts of Marlborough, South Canterbury, Otago (Clutha) and Southland. Soil moisture levels are about normal for this time of the year (green) for parts of eastern Otago (Oamaru & Central Otago districts), North Canterbury and the West Coast (Westland to Fiordland).

NIWA's drought index (the NZDI) indicates that the Buller and Tasman districts and northern locations in Marlborough are currently in a meteorological drought. Dry conditions are also occurring in North Canterbury and parts of Otago (Central and Clutha districts). Continued periods of warm dry weather over March will result in soil moisture deficits further intensifying or moisture levels decreasing in locations that will miss out on rainfall.

Fire Codes and Indices:

For some locations where the BUIs may seem below levels considered extreme, dry fine fuels under forest canopies or scrublands, and grass pastures as they brown off, can still contribute to fast fire spread and larger 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.

Grass growth:

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've experienced summer drought, curing will have become more continuous in the dry phase of 70 – 100% curing.

For locations still experiencing prolonged warm dry weather, grasslands will continue to remain dry and appear straw coloured. Above 80% curing values, grass fuel moisture content is influenced by the environmental factors (humidity and temperature and wind speed). 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 may also have experienced abundant grass growth over the past few months, increasing the fuel loading, further increasing fire intensities.

As we approach the autumn months, grasslands will start to transition from a straw colouration back to green (low curing values). However, dead grass remaining from this or previous seasons can still contribute substantially to the amount of dead fuel in a grassland, so is important to include in your curing estimation. This previous season's dead grass is referred to as 'thatch'. Thatch is still capable of carrying a fire through green grass that would otherwise not burn. Even if a paddock has been harvested or grazed, there is often a few centimetres of dead grass remaining. It is often necessary to part the current season's grass to examine how much thatch is present underneath.

The influence thatch has is particularly important when curing levels reach around 30%-50%. In the absence of thatch, green grass would not necessarily be able to sustain fire spread. Typically, fires in these grasslands will be smoky, patchy in their progression, and lower in fire intensity with very small flame heights.

What would Neutral mean 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. Neutral weather patterns can lead to some extreme conditions – with snow following record-breaking warm temperatures, and an increase number of fires on week followed by gale force winds and floods the next.

Although ENSO events have an important influence on New Zealand's climate, it accounts for less than 25% of the seasonal rainfall and temperature. Under Neutral conditions, other climate factors play stronger roles in influencing New Zealand's weather. For the next three months, the warmer than normal coastal water temperatures will be a key driver of our weather.

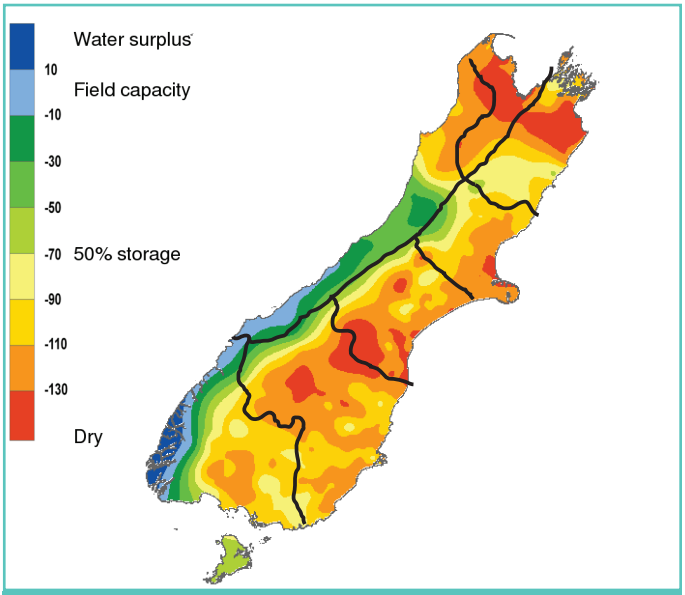

Figure 3. Soil moisture deficits as of 06/03/2019.
Source: NIWA.

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.

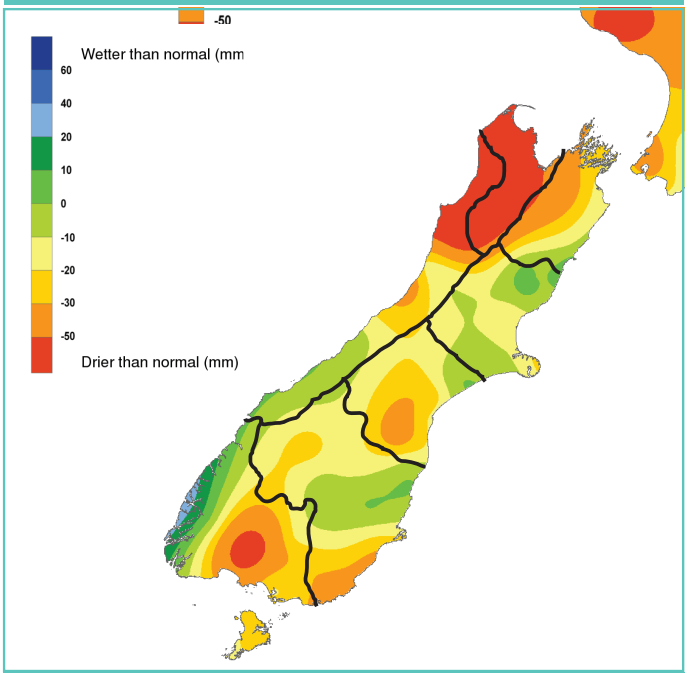

Figure 4. Soil moisture anomaly as of 06/03/2019.
Source: NIWA.

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.

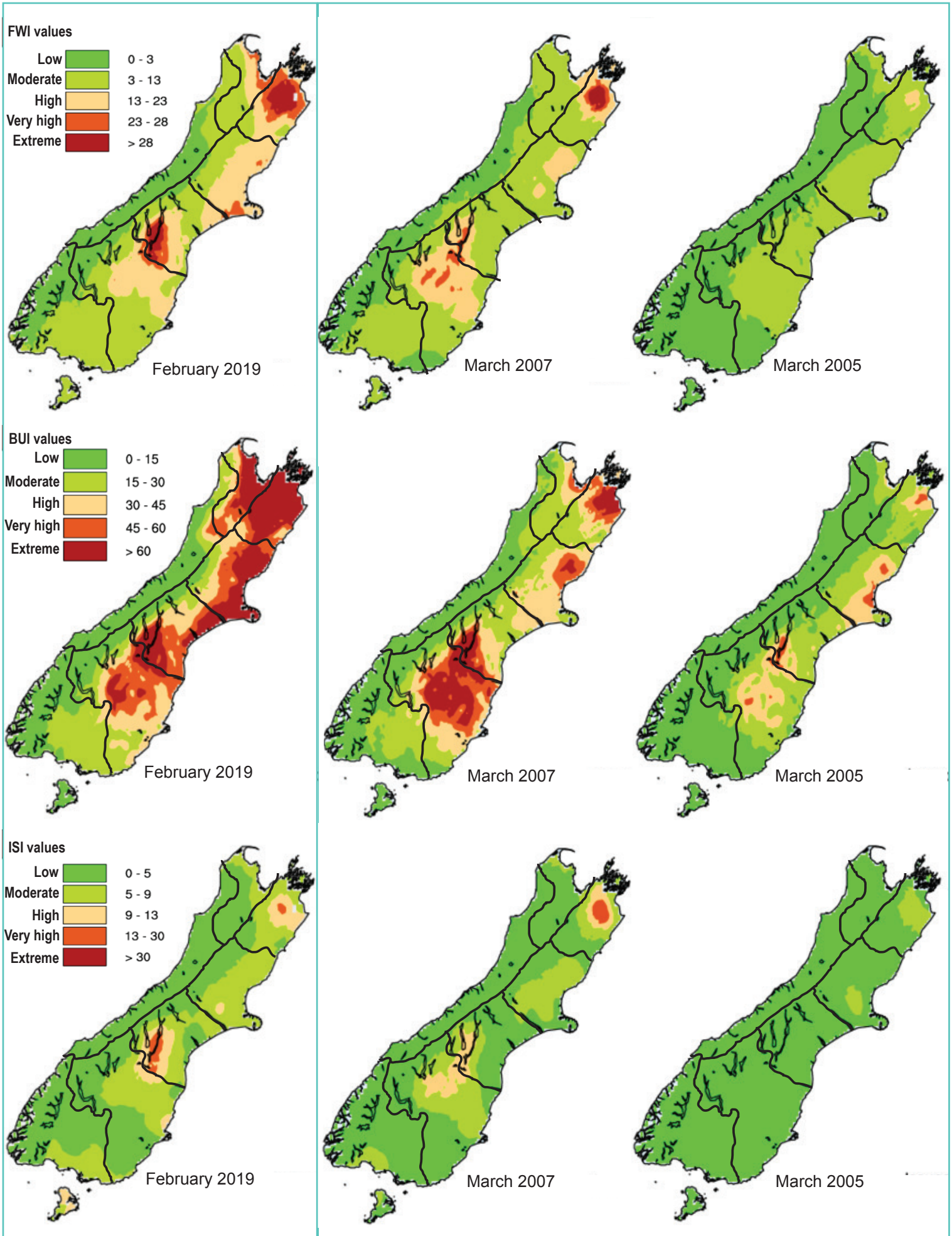

Figure 5. Current Monthly Average for the: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below).

Figure 6. Average Monthly values of: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below); and during the 2006/07 (left) & 2004/05 Neutral year followed by a weak El Niño (right).

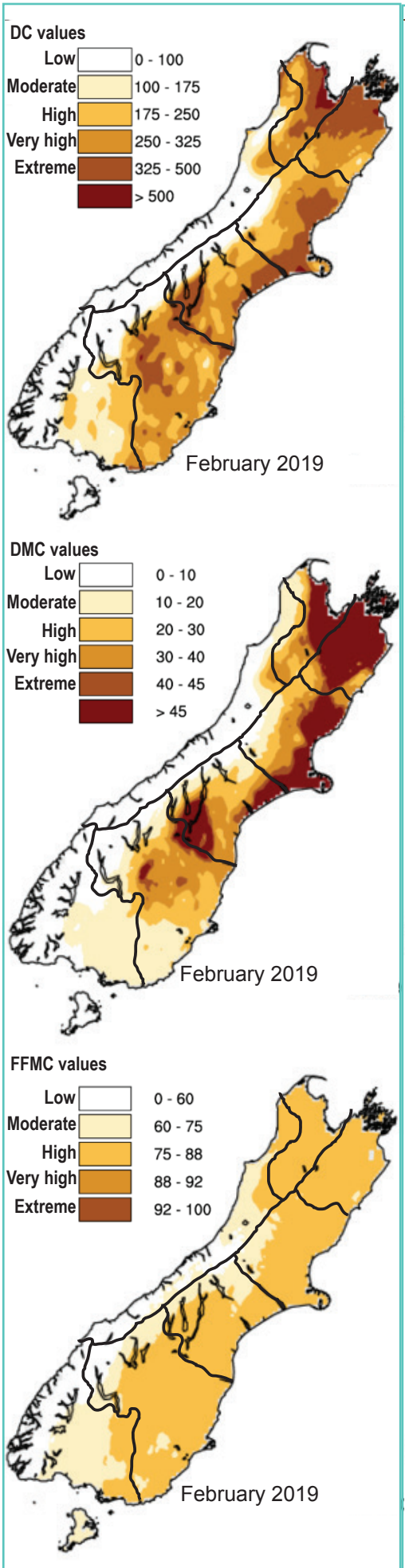

Figure 7. Current monthly average for the: Drought Code (top), Duff Moisture Code (middle) and the Fine Fuel Moisture Code (below).

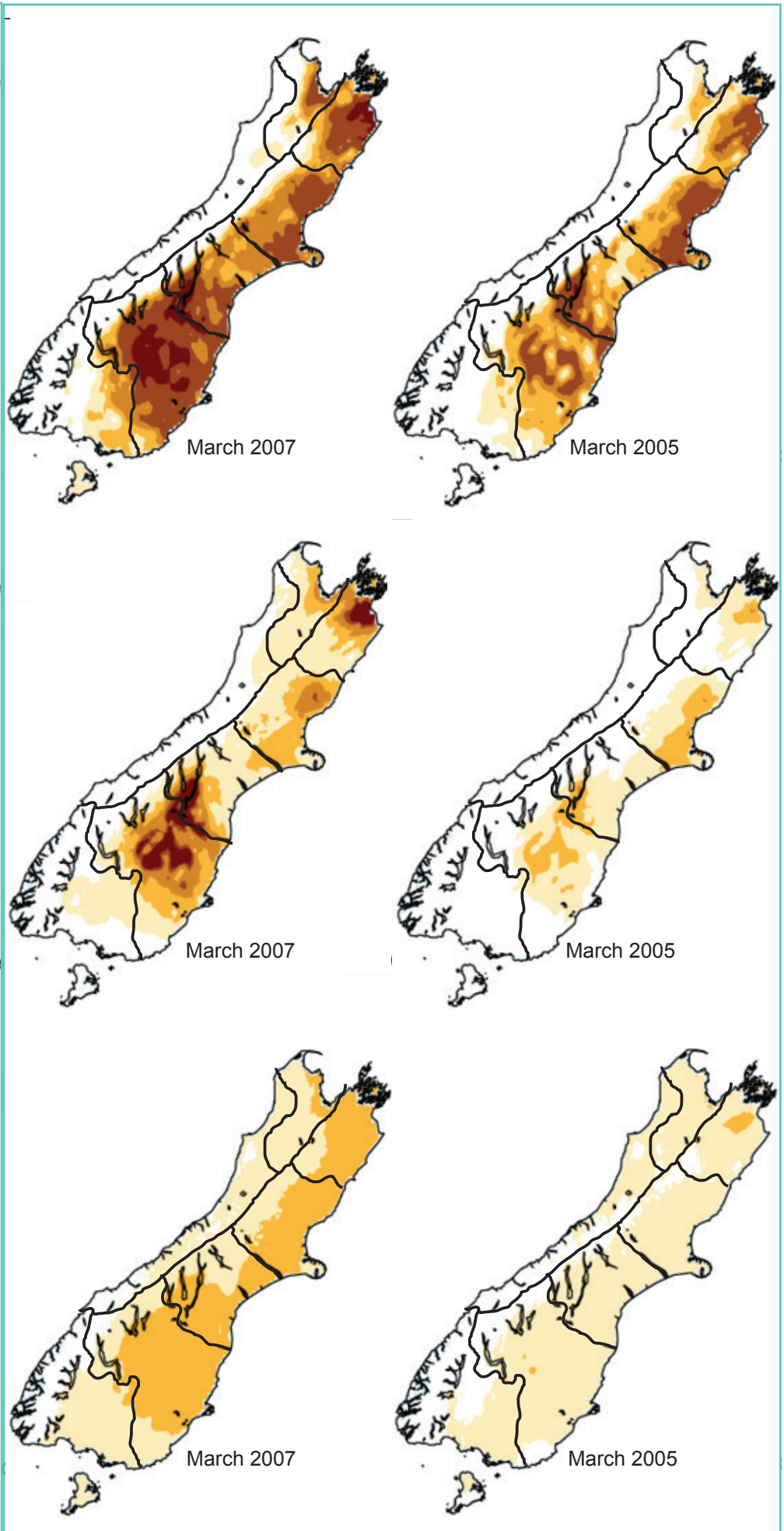

Figure 8. Average monthly values of: Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (below); and during the 2006/07 (left) & 2004/05 Neutral year followed by a weak El Niño (right).

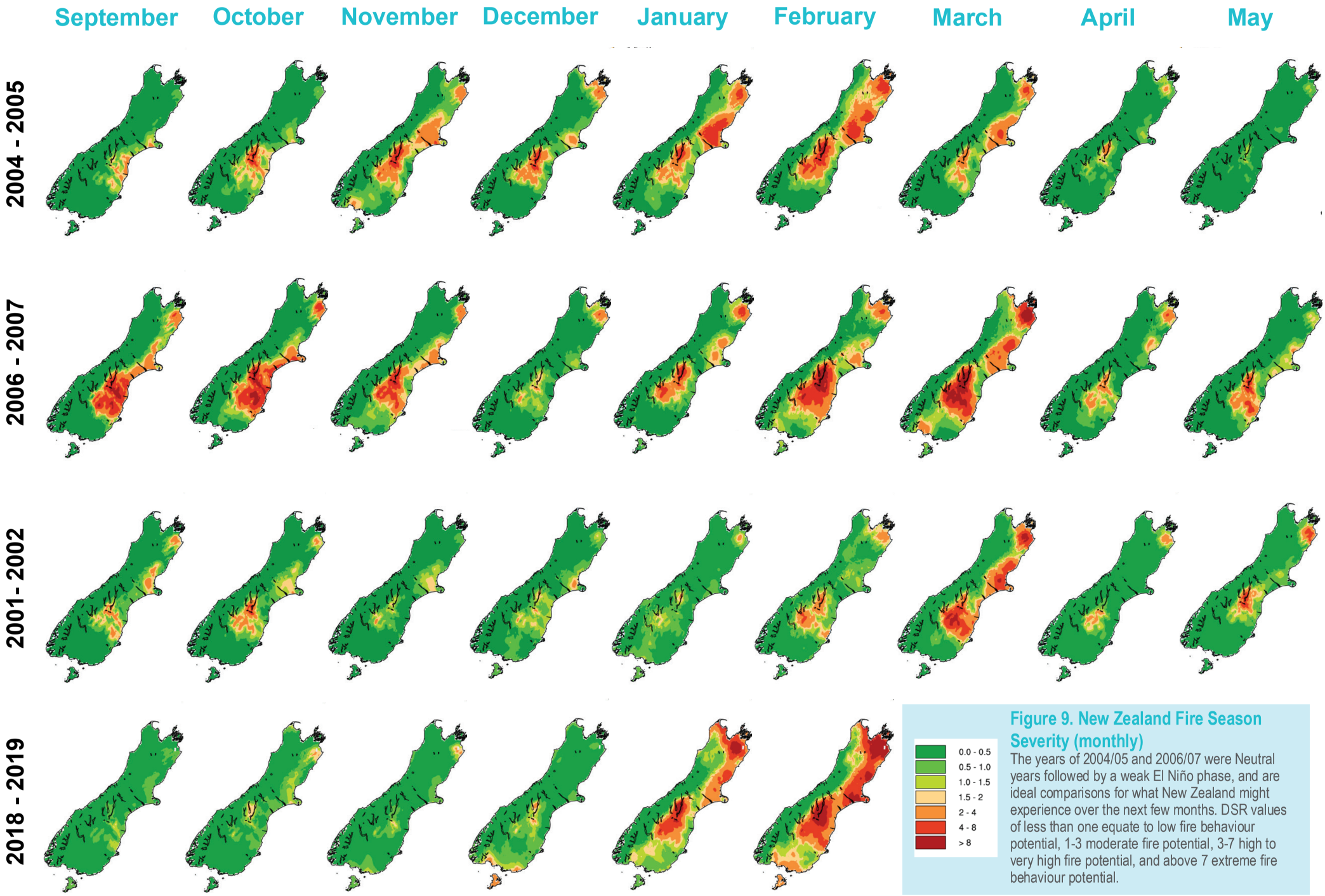

Figure 9. New Zealand Fire Season Severity (monthly)

The years of 2004/05 and 2006/07 were Neutral years followed by a weak El Niño phase, and are ideal comparisons for what New Zealand might experience over the next few months. DSR values of less than one equate 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:

The purpose of these monthly outlooks is to provide a heads up on the progression of fire danger as we transition from spring to summer and, later, into autumn. 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 (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 climate and fire weather).

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 in your patch and for your neighbours.

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 those who are interested in tracking fire season trends for all your weather stations, the graphs are still available monthly on the Scion Rural Fire Research website. If tracking on a more frequent basis (as opposed to the monthly analysis done here), you can 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.

0 - 1	Low fire behaviour potential
1 - 3	Moderate fire potential
3 - 7	High to very high fire potential
7 +	Extreme fire behaviour potential

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.

Acknowledgements:

Fire Danger interpretation was from information gathered from the Average Monthly Maps for: Severity Rating, FWI, BUI, ISI, DC, DMC, FFMC. 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 and Drought Monitor:
  www.niwa.co.nz/climate/sco & https://niwa.co.nz/climate/information-and-resources/drought-monitor
- Australian Bureau of Meteorology Climate outlooks
  http://www.bom.gov.au/climate/ahead/?ref=ftr

Front Cover Image: 2013 Selwyn Rd wildfire, Canterbury (V Clifford, Scion).