New Zealand Seasonal Fire Danger Outlook 2018/19

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Current fire danger situation & outlook:

Low to moderate fire dangers and fire climate severity currently exist in most areas of the South Island (Figures 1 & 5). The exception being Marlborough, where high to very high fire danger exists. This is reflected in the current FWI System codes and indices, which indicate that fuel moistures are high (Figures 5 & 7).

Soil moisture levels went from very dry in early November, to very wet. In the South Island, soil moisture levels are at or near field capacity for many locations (Figure 3). The exceptions being Nelson/Tasman, Marlborough, North Canterbury, and Central Otago, where soil moisture levels have decreased showing signs of drying (below 50% storage). Across the South Island, soils are much wetter than normal along the entire east coast, spanning from Marlborough to Southland (Figure 4).

One of the major climate drivers for New Zealand is the El Niño–Southern Oscillation (ENSO). The ENSO Outlook currently remains at El Niño ALERT. Weak El Niño conditions are occurring in the ocean. However, the atmosphere is not showing signs, and this lack of coupling between the ocean and atmosphere causes uncertainty in forecasting for the next three months.

For the month of December, the signal is for volatility in the weather, with periods of settled weather followed by unsettled conditions. Overall, monthly temperatures are forecast to run below average for Nelson and Marlborough, with near average temperatures expected elsewhere. A wetter than usual December is expected for the southwest of the South Island, with near normal totals elsewhere. However, expect a high degree of rainfall volatility, with a wet first and third weeks, and a rather dry second week.

This summer the weather is expected to be more variable, which contrasts to this time last year. Over the next three months (December 2018 – February 2019), New Zealand is forecast to experience higher pressure than normal, along with variable wind flows. Temperatures are forecast to be above average for all regions. Rainfall totals are expected to be near normal or above normal for the west of the South Island, and near normal for the rest. Near normal soil moisture and river flows are expected for all regions.

As we move into summer and head into the warmest part of the year, vegetation and soil moisture levels over the coming months will be affected, elevating the fire risk and contributing to deeper burning, and potentially faster moving, fires. In general, however, fire dangers and severity for December are expected to be low to moderate for most (Figures 1, 6 & 8). The exceptions being Nelson, Marlborough, Canterbury and Otago, where a drier and warmer than average three months would mean little chance of recovery for areas currently experiencing low soil and fuel moistures.

The fire season years of 2004/05 and 2006/07 are possibly good indicators for what to expect during a weak El Niño this coming fire season (Figure 9). Fire dangers and severity may likely increase in late summer. Some long-range models are signalling the possibility of a protracted El Niño event, which could extend the fire season into April or May for eastern locations. We may also be in for a similar season to last year, where rain events kept the fire danger and fire climate severity low, especially for early summer.

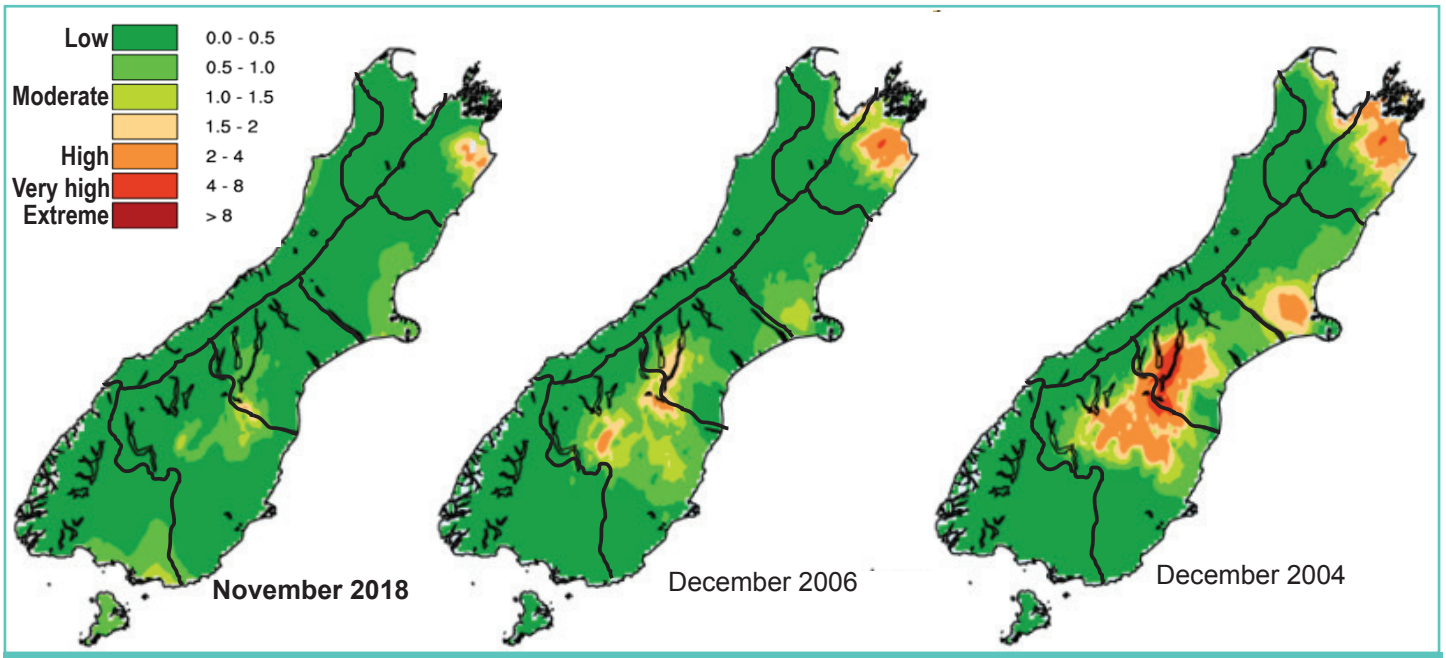

Figure 1. Monthly average Severity Rating for: current (left), last year (middle), & 2004/05 Neutral year followed by a weak El Niño (right).

EXPECTED CLIMATE OUTLOOK:

The ENSO (El Niño – Southern Oscillation) outlook remains at El Niño ALERT (which means there is about a 70% chance of El Niño developing this summer). The tropical Pacific Ocean continues to meet El Niño criteria. However, the atmospheric indicators have yet to show consistent signs. When the ocean and atmosphere act in unison and reinforce each other, this is called a 'coupling', and an El Niño event is considered to have fully formed. Currently, the uncoupled ocean and atmosphere increases the chance of variability in the weather over summer for New Zealand.

International climate models indicate that the tropical Pacific will transition towards El Niño over the next three-month period (94% chance over December 2018 – February 2019). The probability of El Niño conditions remains high throughout autumn (March – May 2019). Some long-range models are signalling the possibility of a protracted El Niño event, where El Niño could remain for a prolonged period through to the winter season, and possibly into the next fire season.

The impact on New Zealand's weather patterns may differ from what is typically experienced during a conventional El Niño event. It is not expected to be of a similar intensity to what was experienced during 1997-98 or 1982-83, and therefore different impacts are expected. This means we will likely see deviations from the usual south westerly air flow patterns typically experienced during traditional El Niño events. But ENSO is just one of several climate drivers that can influence New Zealand's rainfall and temperature patterns.

NIWA's tropical cyclone outlook (November 2018 to April 2019) indicates the risk for New Zealand will be near normal. This means at least one ex-tropical cyclone passes within 550 km of New Zealand each year. Last year New Zealand experienced three. Significant rainfall, damaging winds, and coastal damage can occur during these events, and reduce fire risk in affected areas. A protracted El Niño event could have an impact on delaying the tropical cyclone season.

This month: December 2018

For the month of December, the signal is for week-to-week variations in the weather, with periods of settled weather followed by unsettled conditions. High pressure and cooler southerlies are forecast for the second week of December, meaning most regions are set to see relatively dry conditions, except for potentially the Marlborough coast. After that, low pressures return to New Zealand, bringing unsettled weather in the week before Christmas (17-23 December), and westerlies over the South Island for the last week of the month.

Overall, monthly temperatures are forecast to run below average for Nelson and Marlborough, with near average temperatures expected elsewhere. A wetter than usual December is expected for the southwest of the South Island, with near normal totals elsewhere. However, expect a high degree of rainfall volatility, with a wet first and third week, and a rather dry second week.

Further ahead: December - February (Figure 2)

For the next three months (December 2018 – February 2019), higher pressures than normal are forecast across New Zealand. It is expected the country will experience more westerly wind flows. Temperatures are forecast to be above average or near average for all regions of New Zealand. Rainfall totals are forecast to be near normal for most, the exception being the west of the South Island (normal to above normal rainfall). Near normal soil moisture and river flow are expected for all regions.

Regional breakdown (Figure 2):

Temperatures are most likely to be:

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

Rainfall totals are most likely to be:

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

Soil moisture levels are most likely to be:

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

Last month: November 2018

Looking back, November's weather was variable. Until Looking back, November's weather was variable. Until recently, the trade winds have been generally near or weaker than average for the month of November. The month started out with Highs, but by mid-month a complex Low-pressure system brought about thunderstorms, hail, heavy snow, rain and flooding. These low-pressure systems were much lower than normal (situated near the middle of NZ). Frequent Lows over the Tasman Sea then made a come-back for the remainder of the month, bringing unsettled weather.

The end of spring brought wet weather to many parts of the country and increased the soil moisture levels in drier areas, while bringing too much rain for some, with Marlborough, Canterbury and North Otago all seeing heavy falls. The last week of the month was characterised by scattered thunderstorms, some of which

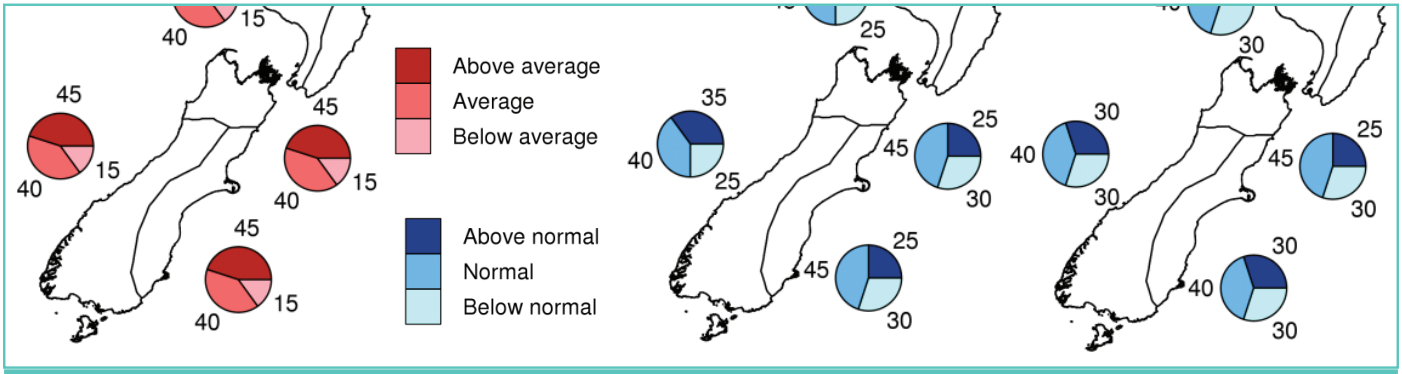

Figure 2. Outlook for Dec 2018 - Feb 2019: air temperature (left), rainfall (middle), available soil moisture (right). Source: NIWA.

caused localised heavy rain. Monthly rainfall totals along the east coast of the South Island were almost double the normal monthly amount for some locations. It was the wettest November on record at Dunedin Airport, and the fourth wettest November at Christchurch Airport. In contrast, it was a warmer and drier than usual November for the west and south of the South Island.

The first few days of November were unusually cold, followed by extremely warm conditions in the second week. This was followed by a bitter southerly during the third week of the month that caused temperatures to plummet nationally, before swinging back humid and mild at the end of the month.

Soil moisture (Figure 3 & 4)

Soil moisture levels went from very dry in early November, to very wet. In the South Island, soil moisture levels are at or near field capacity for many locations (Figure 3). The exceptions being Nelson/Tasman, Marlborough, North Canterbury, and Central Otago, where soil moisture levels have decreased and are showing signs of continued drying (below 50% storage).

Across the South Island, soils are much wetter than normal along the east coast, spanning from Marlborough to Southland (Figure 4). In addition, substantial soil moisture increases occurred across Marlborough and Canterbury due to significant rainfall. In contrast, soils that are drier than normal are found in Nelson and northern Tasman, and along the West Coast (Westport and Haast). Soil moisture levels for inland North Canterbury, Queenstown Lakes and Fiordland are about normal for this time of the year. NIWA's drought index (NZDI) also shows that dry soils remain in the Nelson/ Tasman district.

Grass growth:

Warm dry conditions trigger the maturing of grasslands and set the curing process in motion. Areas of lush green grass will begin to drop seed and start turning yellow over the next few months. Typically, grasses undergo curing in late spring/early summer, where the plant dies or becomes dormant following flowering and seed drop. When this happens, grasses lose their ability to draw moisture from the soil. Naturally, grass growth may slow, stop or become dormant until moisture is available. Normally, if a fire started in these fuels, fire spread would be difficult.

But over the past two months climatic conditions have continued to support growth (mild temperatures and high soil moistures), which have led to abundant grass growth and unusually green landscapes in many areas for this time of the year. Any burning will produce small flame heights and low intensities for easy suppression. However, once this fuel dries out due to the combination of warm temperatures, low rainfall and strong winds, the higher than normal fuel loads could contribute to increased fire intensities and difficulty of control.
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 sustain and carry a fire. These fires will typically produce small flame heights and spread in a patchy manner.

As we transition from spring into early summer, the potential for a fire to ignite and spread is increased as the curing process kicks off in these fuels (formation of seed heads and loss of seeds). Some landscapes may already have started to form a mixture of green and brown as grasses begin the curing phase. As grasses cure, the amount of dead material increases, heightening the potential for fire to ignite and spread. When grasses cure and fuel moisture content decreases, there is less heat required to ignite the grass. As a result, more heat is released as it combusts. Burning under these conditions can produce larger flame heights (2 m+), and fires can spread quickly, be very intense and much more difficult to suppress.

What would a weak El Niño mean for NZ?

The indications for the current weak El Niño event potentially developing suggest that it will not follow a typical El Niño climate pattern. New Zealand will likely experience deviations from the typical south westerly air flow patterns (to more southeast to northeast air flows), with the Southern Ocean continuing to influence weather across the country.

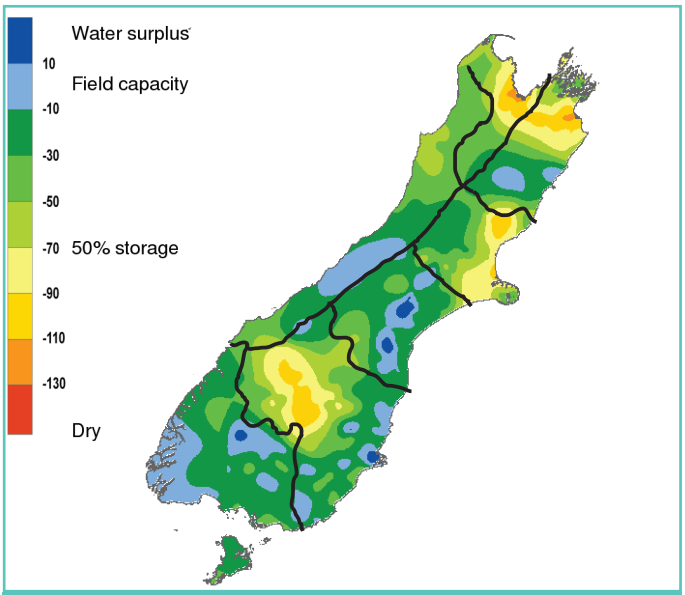

Figure 3. Soil moisture deficits as of 03/12/2018.
Source: NIWA.

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.

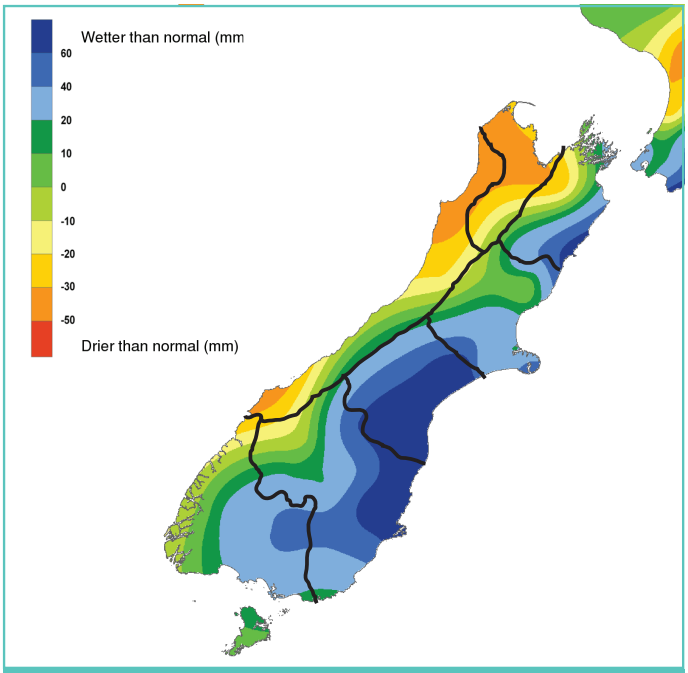

Figure 4. Soil moisture anomaly as of 03/12/2018.
Source: NIWA.

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.

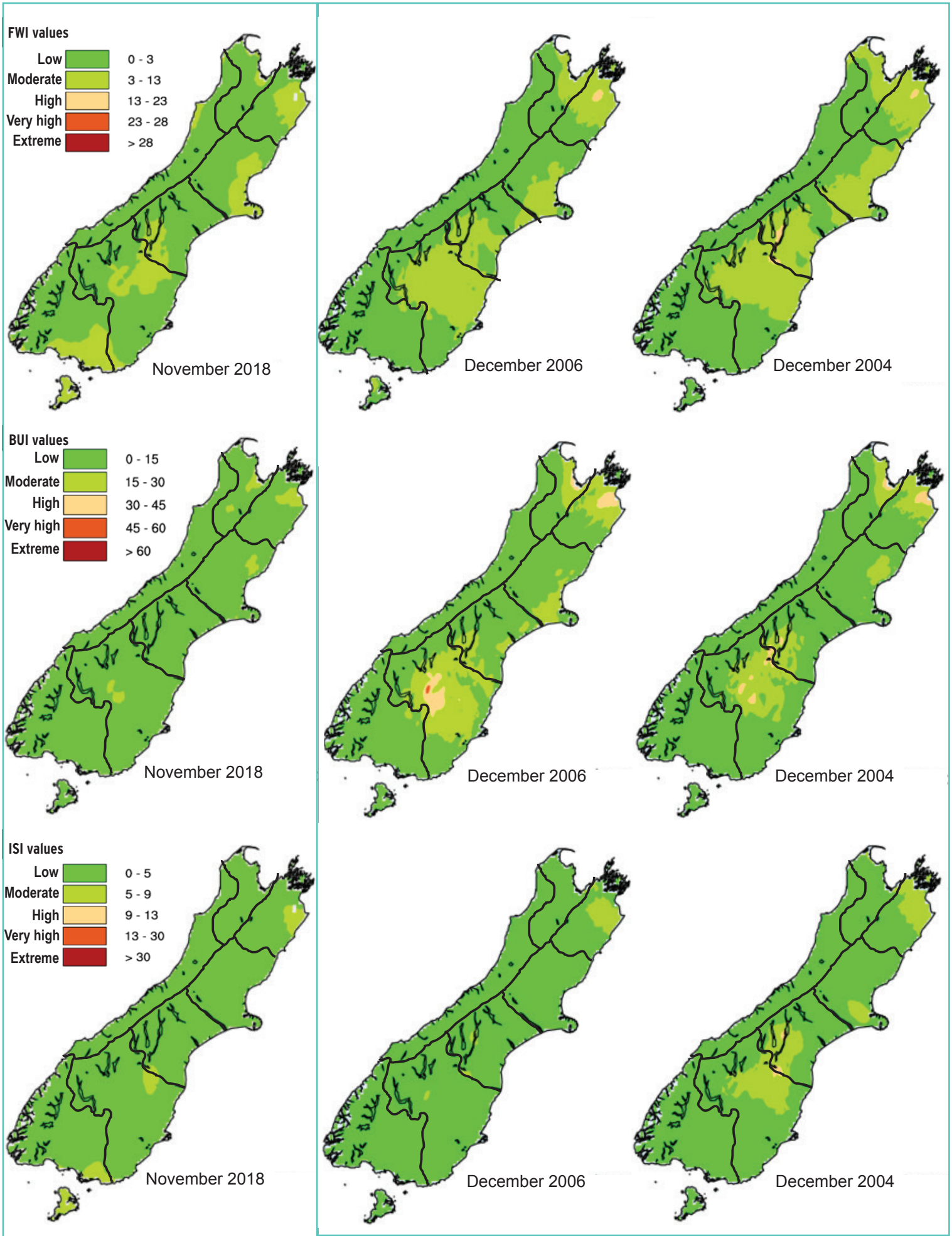

Figure 5. Current Monthly Average for the: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below).

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).

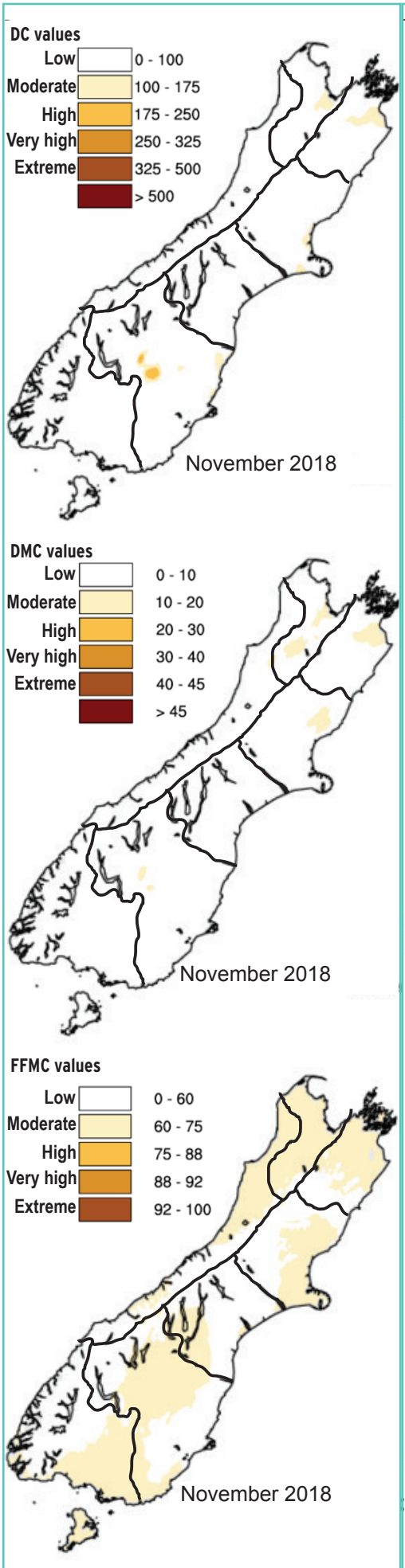

Figure 7. Current monthly average for the: Drought Code (top), Duff Moisture Code (middle) and the Fine Fuel Moisture Code (below).

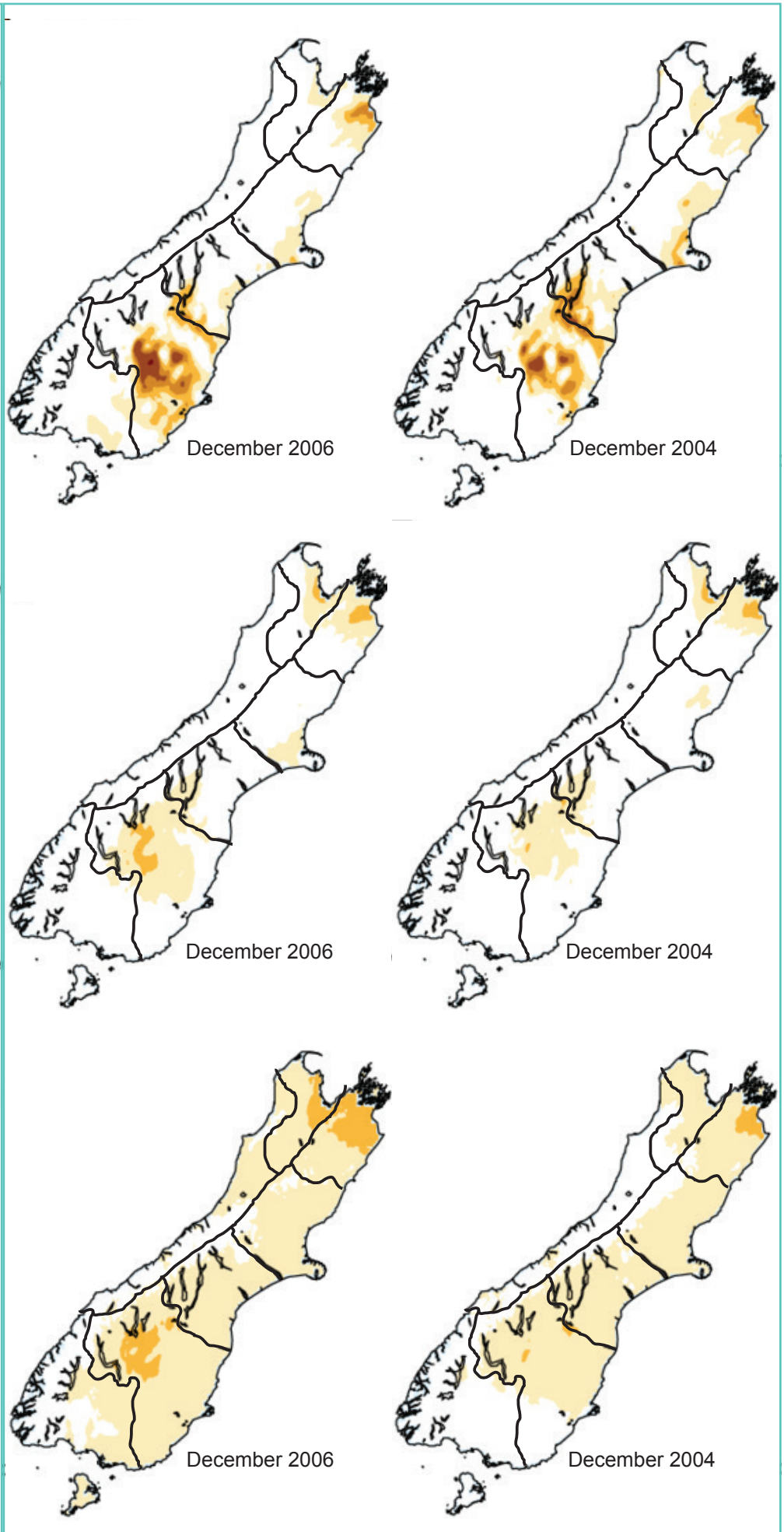

Figure 8. Average monthly values of: Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (below); and during the 2006/07 (left) & 2004/05 Neutral year followed by a weak El Niño (right).

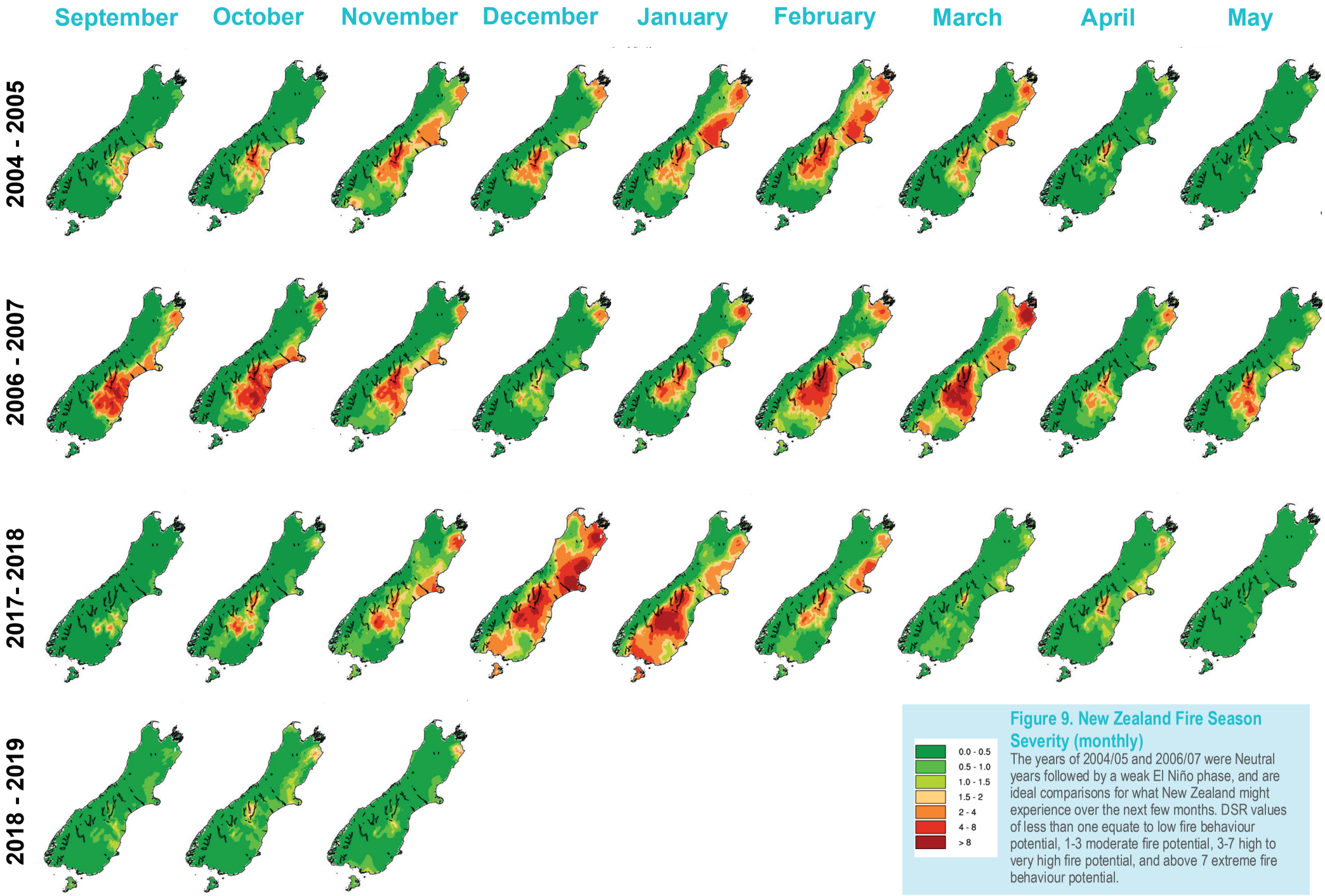

Figure 9. New Zealand Fire Season Severity (monthly)

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: www.niwa.co.nz/climate/sco
- Australian Bureau of Meteorology Climate outlooks http://www.bom.gov.au/climate/ahead/?ref=ftr

Front Cover Image:
2018 Cold-trailing at Esk Head fire (V Clifford, Scion).

If you are keen to submit a weather and fire related photo that will appear on the front page, please email:
- a high resolution image(s)
- with details on the location and the photographer's name and organisation
- to: Veronica.Clifford@scionresearch.com