greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Climate and water resources

Seasonal update:

Winter 2016 summary
Spring 2016 outlook

September 2016

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Overview

Winter 2016

The winter months were highly variable, with a mild and dry June and July and colder and wetter August. Occasional severe frosts and very cold temperatures were experienced towards the end of winter. As New Zealand is highly influenced by the oceanic temperatures, the relatively warm waters around the country played a significant role in bringing mild temperatures during the winter. The El Niño phenomenon in the Pacific Ocean has completely dissipated, and there was an expectation of rainfall returning to normal levels for most of the region over winter. However, the eastern Wairarapa remained one of the driest regions in the country, receiving only between 40 to 50% of the winter's average rainfall in some areas. Castlepoint had the lowest rainfall on record for winter for records starting in 1902, and Masterton had the second lowest winter rainfall (NIWA). Soil moisture deficit for the Wairarapa is worse than that observed at the same time last year, sitting well below normal. Satellite data confirms that a high dryness-related stress is already present for a large portion of the Wairarapa.

Reason for the mild temperatures and Wairarapa dryness

As the El Niño is finished it is unlikely that any residual influences can fully explain the mild and dry winter in the east. As mentioned before, New Zealand tends to receive most of its climatic influences from the oceanic temperatures surrounding the country. Currently the most obvious signal influencing the ocean is that of global warming, with a significant intrusion of warm waters into the Tasman Sea and around New Zealand. As the dry pattern in the east is consistent with the long-term climate change projections, there is reason to believe that the unusual persistence of the climate anomalies in the absence of El Niño is at least partially due to climate change. As such, NIWA has already prepared a statement to help farmers be proactive, recognising that rainfall patterns are getting less reliable, and will likely remain irregular (https://www.niwa.co.nz/climate/information-and-resources/drought). Unfortunately, this also means that our ability to predict rainfall for the next season is somewhat decreased, as climatic cycles are not behaving the way they used to.

Climate outlook for spring 2016

Based on the current behaviour and projection of the climate drivers (neutral ENSO likely with some chance of a weak La Niña), there is a tendency for rainfall to return to closer to average values, with a chance of still having a slightly dry east if La Niña develops. If La Niña does develop, the current guidance is that this is going to be a very weak event and likely the effects on eastern rainfall will be only minor. On the other hand, the tendency for warmer than average temperatures will continue in the whole region, as a result of the warm oceanic water to the north of New Zealand and the projection of more north-easterly flows affecting the country. These warm conditions will be interrupted by fairly cold, although short-lived, periods.

Contents

1. Climate drivers

1.1 El Niño – Southern Oscillation (ENSO)

The 2015/2016 El Niño has now dissipated. Figure 1.1 shows that the latest predictions suggest neutral phase will continue, with only moderate possibility of a weak La Niña into 2017.

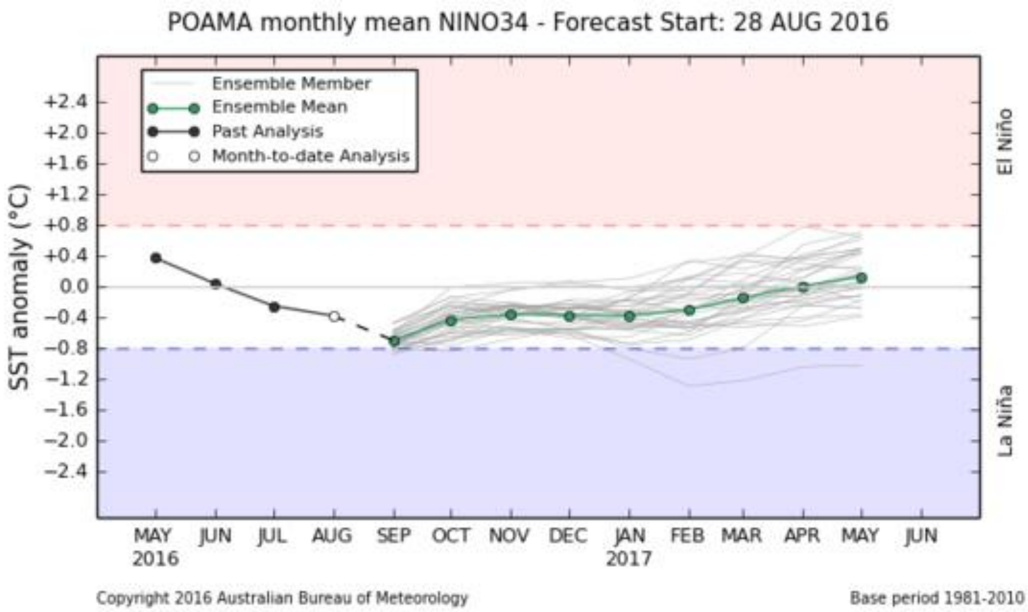


Figure 1.1: Latest ENSO projections until May 2017. The figure shows that conditions are predicted to be progressively neutral with a slight trend towards possible weak La Niña. Source: Australian Bureau of Meteorology.

1.2 Sea ice extent and oceanic temperatures

Sea ice extent is very important to New Zealand because of our relative proximity to Antarctica. The ice strengthens the cold fronts that affect New Zealand during the cold season, delaying the effects of global warming. The Antarctic sea ice extent is currently close to average around the New Zealand longitudes, meaning that its influence would be associated with near-normal intrusion of cold air, in the absence of other effects. Hence, fairly strong cold air intrusions from Antarctica have occurred during later winter and are still possible during spring.

In contrast to the normal behaviour of the sea ice, the latest sea surface temperatures (SST) show that the oceanic waters are warmer than average to the northeast of New Zealand (and about normal or only slightly cooler to the south). The SSTs are predicted to remain above average to the north during the next few months, providing additional moisture for the north-easterly air flows and a greater chance of warmer than average spring temperatures.

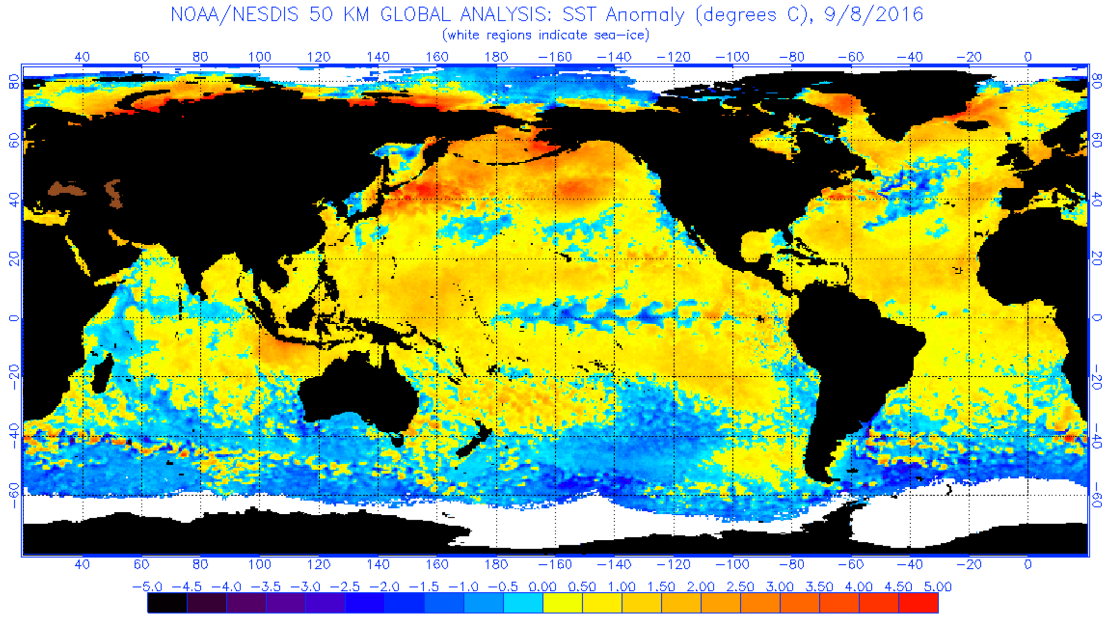


Figure 1.2: Sea surface temperature anomalies for 8 September 2016. Source: NOAA.

2. What is the data showing?

2.1 Satellite-derived drought stress indices (vegetation health)

Figure 2.1 shows the satellite-derived "vegetation drought-stress" index (associated with vegetation health) for the week ending 1 September 2016. As a result of the relatively mild and dry winter, the stress is high in the central-eastern and north-eastern Wairarapa. It is important to note that the satellite index gives an overview of "dryness" as experienced by vegetation, compared to the long term average. As such, this index is not a formal drought assessment as it does not take into account how dry the soil is (ie, underneath the surface).

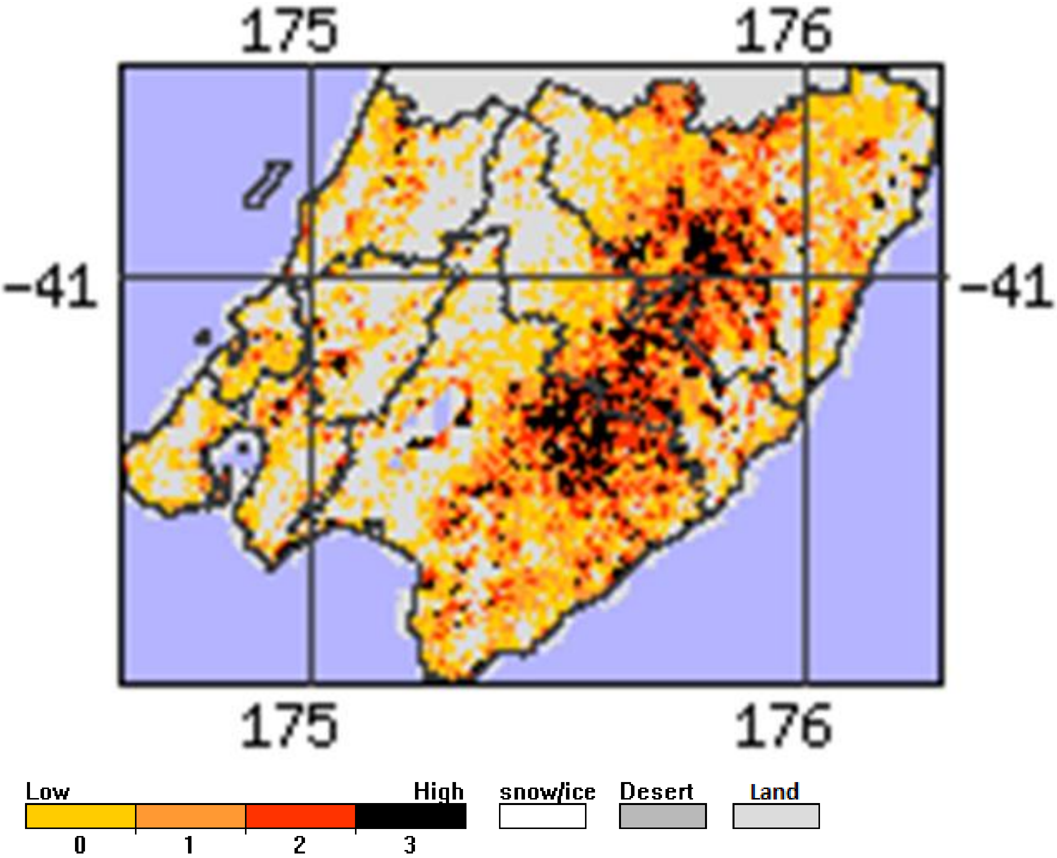


Figure 2.1: Satellite-derived "Vegetation drought-stress" index for the week ending 1 September 2016. Drought index scale (right): 0 (moderate or no stress), 1 (severe stress), 2 (extreme stress), 3 (exceptional stress). The index is relative to a 25 year period base climatology of how healthy (or green) the vegetation is looking. Source: NOAA/US, resolution 4km.

2.2 Soil moisture assessment

Figure 2.2 shows the latest soil moisture anomaly for the region, as of 10 September 2016. Drier than normal conditions are present for most of the Wairarapa (in yellow and orange), especially on the central-eastern coast, while the remaining of the region (green colours) has soils within the 'around average' interval (ie, between -10 and +10 mm). The areas identified as 'under stress' for vegetation health according to the satellite (Figure 2.1) coincide with the reduced soil moisture content in the Wairarapa, although the driest soils are observed closer to the coast.

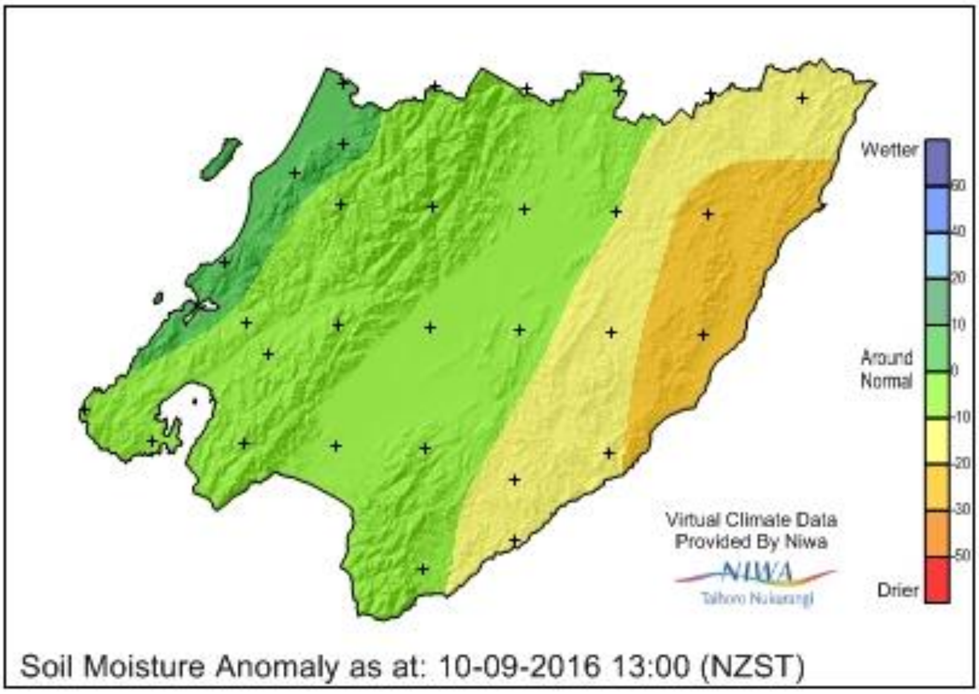


Figure 2.2: Soil moisture anomaly for 10 September 2016. Moisture levels below average are seen in the eastern Wairarapa. Source: GWRC, using selected Virtual Climate Station Network data provided by NIWA.

2.3 Regional rainfall

Figure 2.3 shows the regional winter rainfall expressed as a percentage of the long-term average. The much drier than normal conditions observed in the east help explain the increased dryness shown by the satellite, and the soil moisture anomalies. The asterisk indicates the location of the rainfall data used to produce the climate analogues rainfall projection (see Section 3).

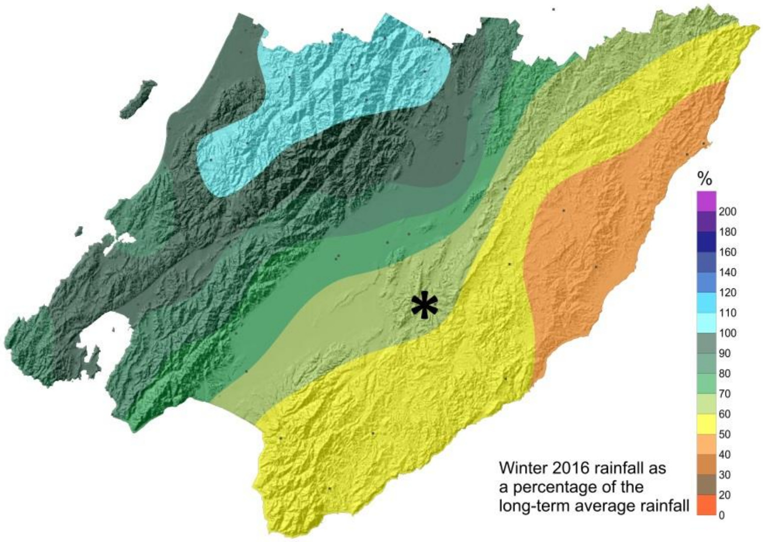


Figure 2.3: Rainfall for winter 2016 as a percentage of the long-term average. A large contrast is seen between near average conditions in the west and dry conditions in the Wairarapa, particularly on the north-eastern coast. The asterisk shows the rainfall monitoring site at Waikoukou, Longbush, used for the climate analogues rainfall projection (see Section 3). Source: GWRC.

2.4 Observed rainfall and soil moisture conditions for selected sites

Figure 2.4 shows the location of selected GWRC rainfall and soil moisture monitoring sites. Plots of accumulated rainfall and soil moisture trends are provided in the following pages.

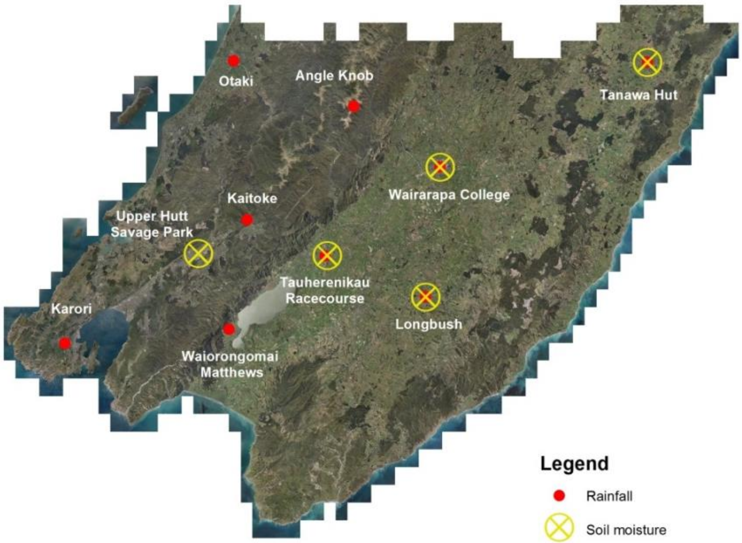


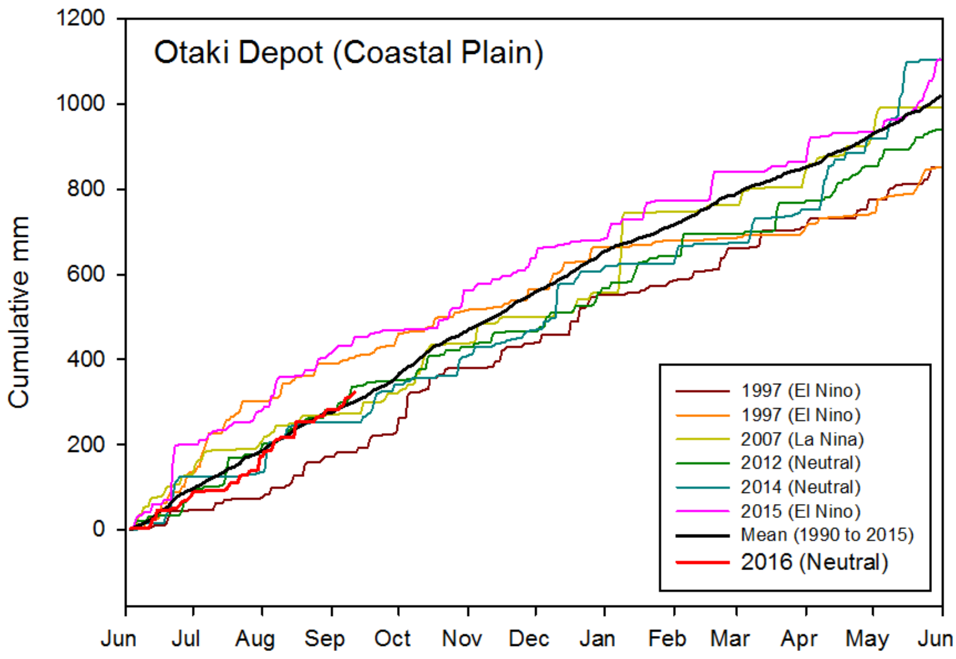
Figure 2.4: Map of GWRC rainfall and soil moisture monitoring locations

2.4.1 Rainfall accumulation

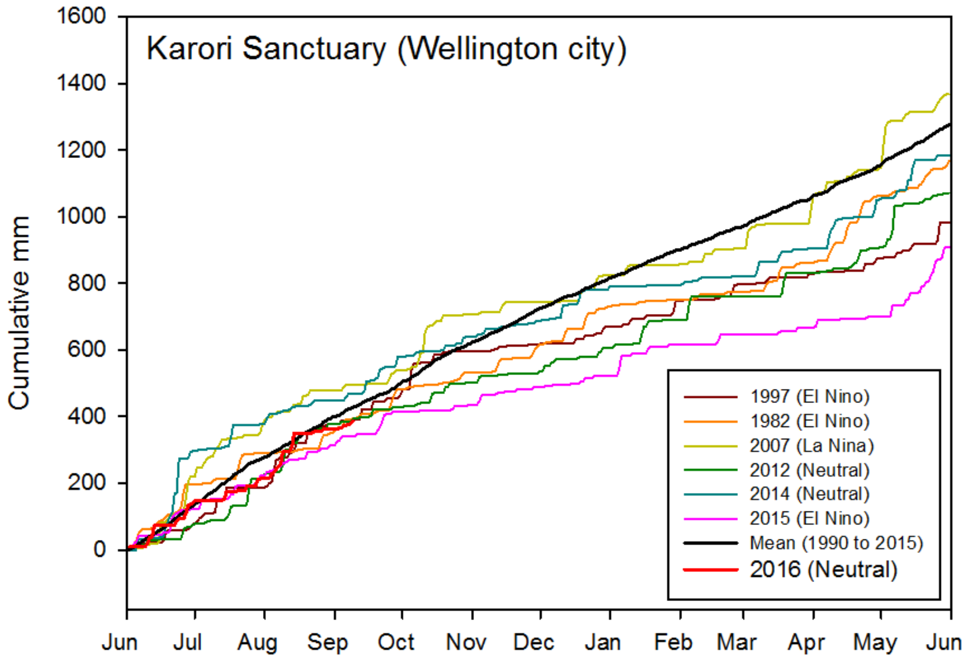
The following rainfall plots show total rainfall accumulation (mm) for the hydrological year (1 June to 31 May) for several years. For comparative purposes, cumulative plots for selected historic years with notably dry summers in the Wairarapa have been included, as well as the site mean. Many of the GWRC telemetered rain gauge sites in the lower lying parts of the Wairarapa (ie, not Tararua Range gauges installed for flood warning purposes) have only been operating since the late 1990s so the period of data presented is somewhat constrained to the past two decades. For each historical record plotted, an indication of ENSO climate state (El Niño, La Niña or neutral) at that time is also given. GWRC does not operate a rain gauge in the southern-most parts of the Wairarapa Valley that is suitable for presenting data in this report. This means that we cannot be confident that the rainfall patterns seen elsewhere extend to this part of the region other than the satellite and VCN data already presented.

Overall, accumulations for the winter months (JJA) for the hydrological year so far have been about normal in the western part of the region and the Tararua Range. However, the significant rainfall deficit in the Wairarapa is clearly shown in the accumulation plots for Waiorongomai, Masterton, Longbush, Tauherenikau and Tanawa Hut.

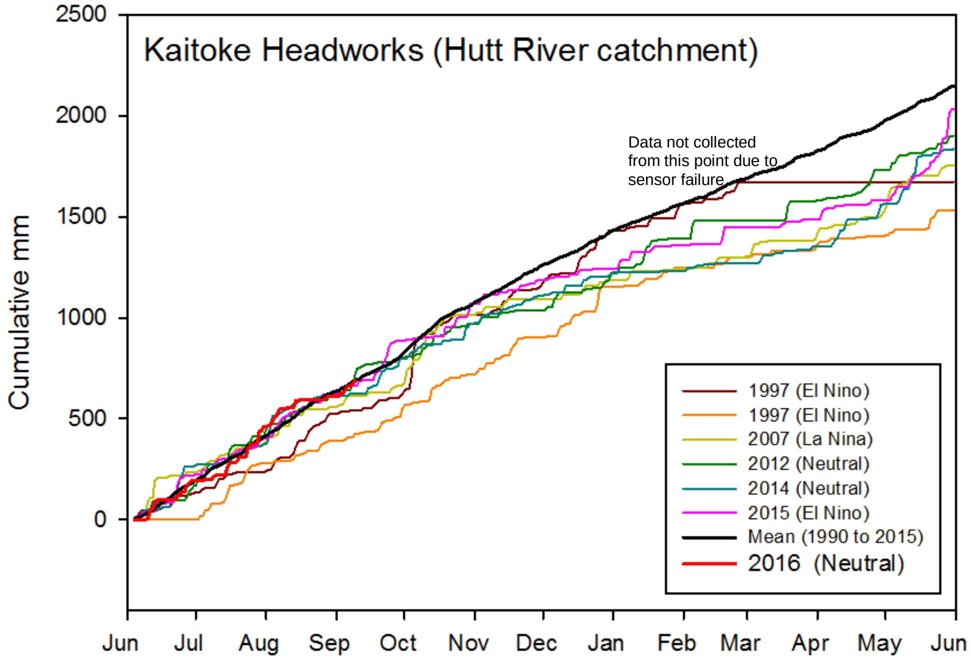
Kapiti Coast

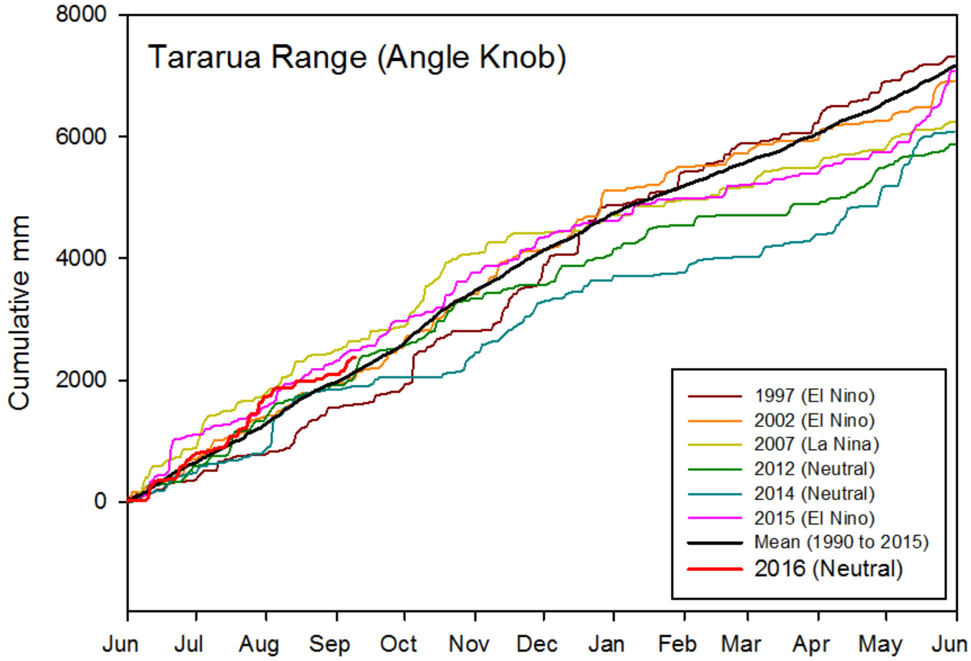


Southwest (Wellington city)

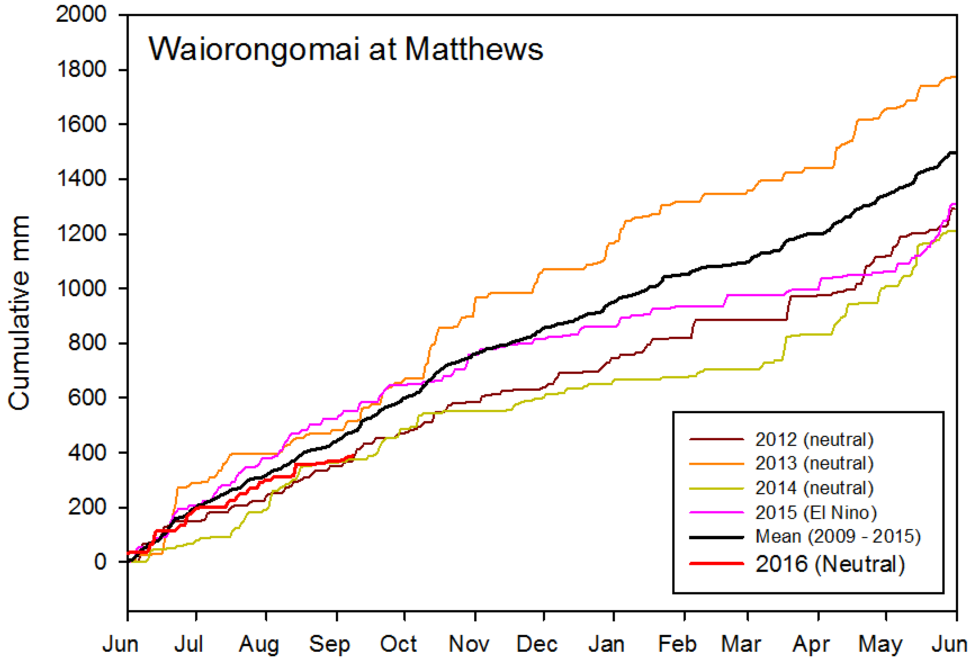


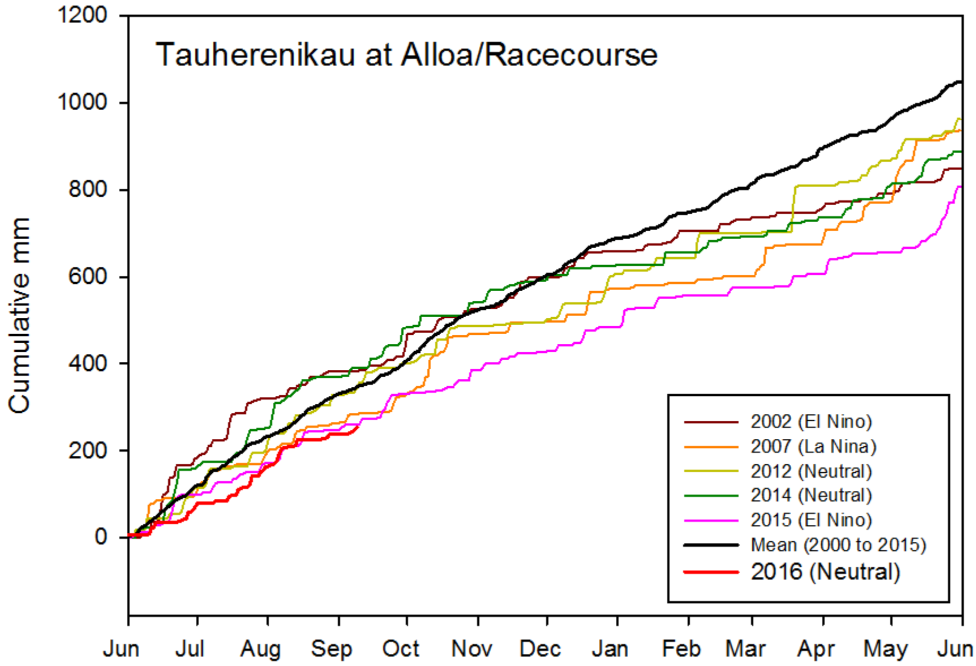
Hutt Valley and Tararua Range

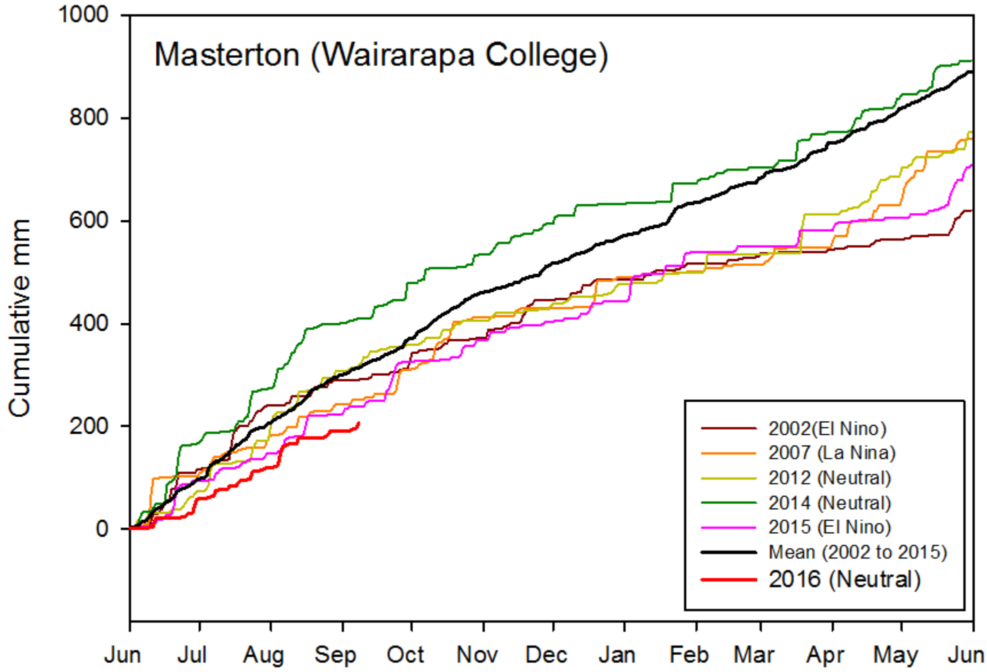




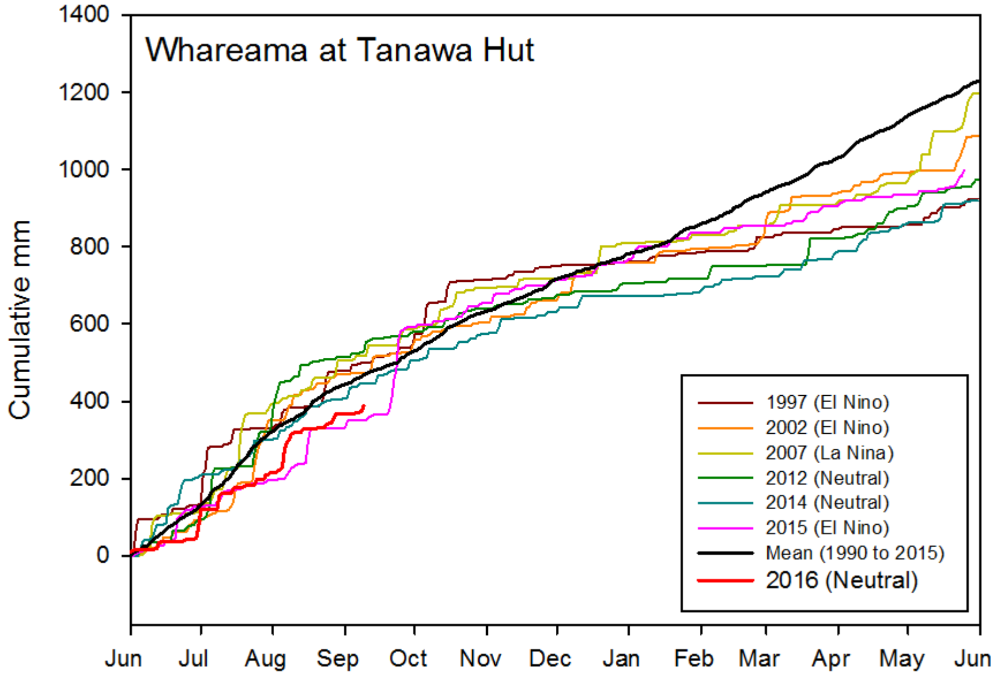
Wairarapa

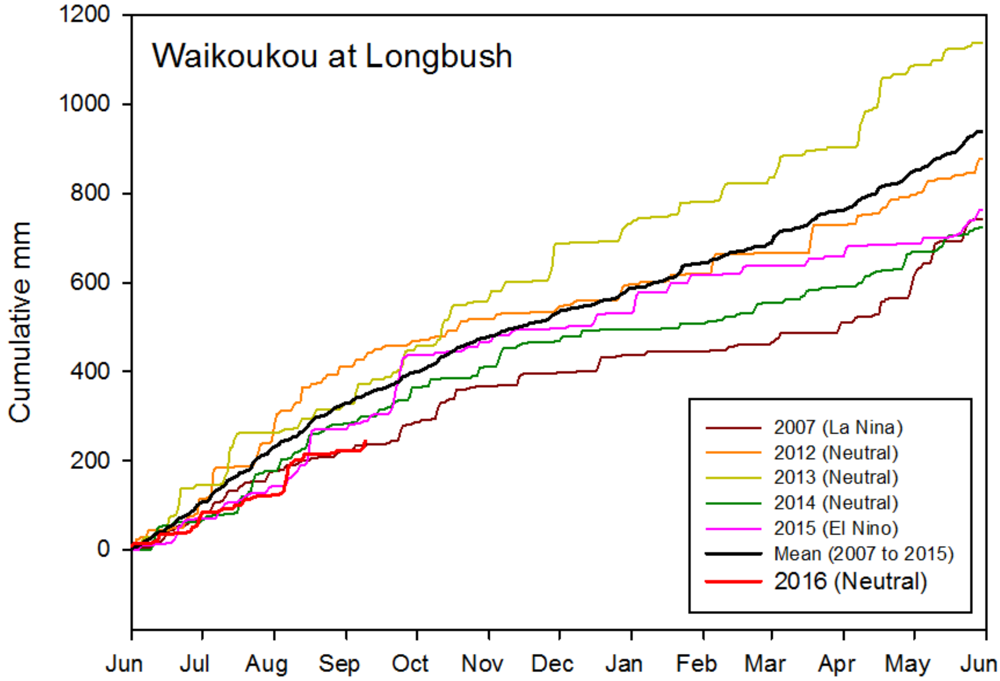

Waiorongomai at Matthews
Cumulative mm
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
2012 (neutral)
2013 (neutral)
2014 (neutral)
2015 (El Nino)
Mean (2009 - 2015)
2016 (Neutral)


Tauherenikau at Alloa/Racecourse
Cumulative mm
1200
1000
800
600
400
200
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
2002 (El Nino)
2007 (La Nina)
2012 (Neutral)
2014 (Neutral)
2015 (El Nino)
Mean (2000 to 2015)
2016 (Neutral)



Note: Rainfall data for the site 'GWRC Masterton' was used to generate the rainfall accumulations for 2016 rather than the Wairarapa College site due to a suspected recording error at the latter. The two sites are closely correlated.



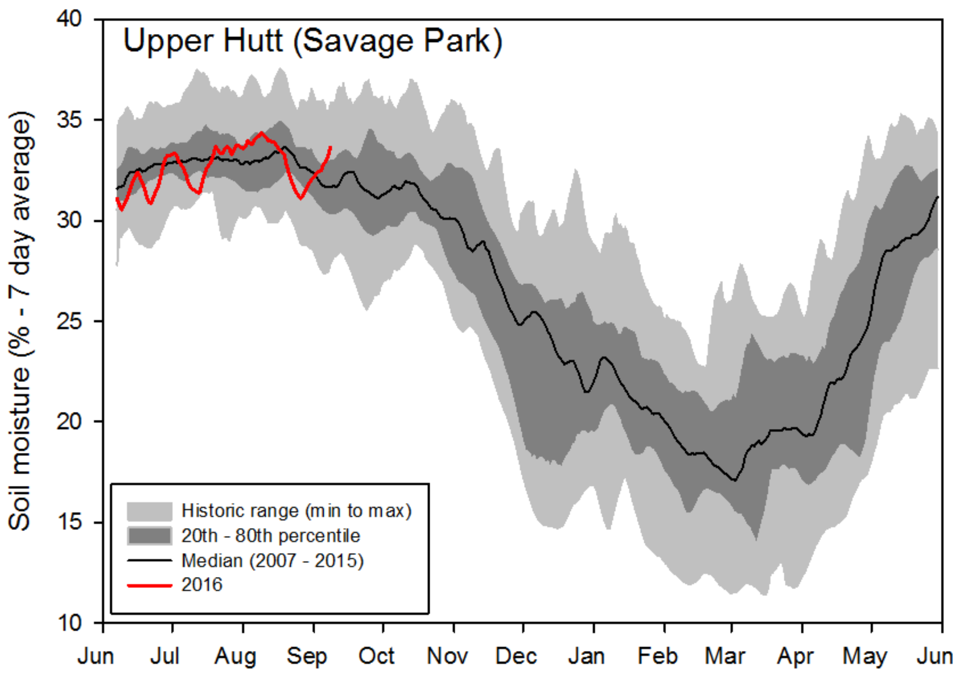

Waikoukou at Longbush
Cumulative mm
1200
1000
800
600
400
200
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
2007 (La Nina)
2012 (Neutral)
2013 (Neutral)
2014 (Neutral)
2015 (El Nino)
Mean (2007 to 2015)
2016 (Neutral)

2.4.2 Soil moisture content

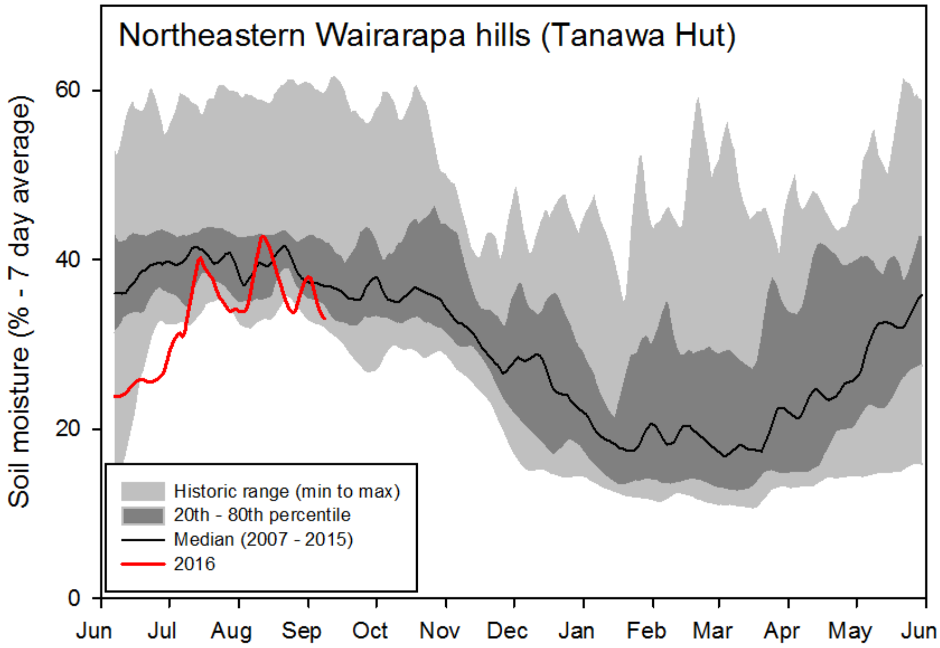
The soil moisture plots show seven day rolling average soil moisture (%) for the hydrological year (1 June to 31 May). An envelope plot of the historic range of data (and site mean) is also provided to give an indication of how the current soil moisture compares with that for a similar time of the season in past years. While the soil moisture plots are useful for tracking change within the current season and comparing relative differences between years, they do not provide the absolute moisture content (%) as many of the GWRC soil moisture sites have not yet been fully calibrated.

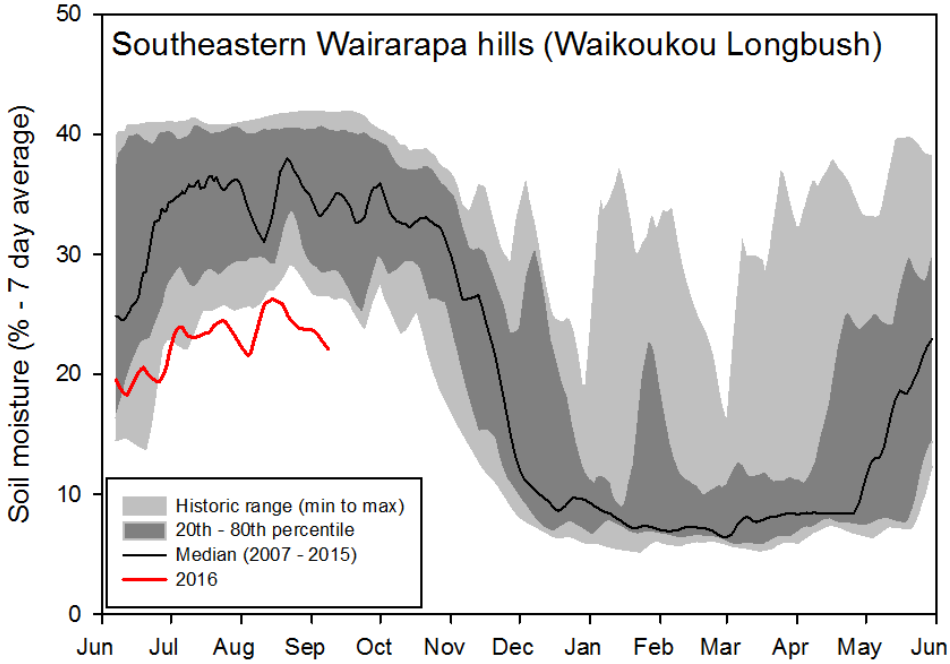
Soil moisture levels in the western part of the region (as indicated by the Upper Hutt site) are around normal for this time of year. However, soils are unusually dry in the Wairarapa, and exceedingly so in parts of the eastern Wairarapa (eg, Waikoukou at Longbush). The envelope plots for Longbush and Tanawa Hut also highlight how dry soils were at the end of summer/autumn and how this impact has been compounded by the subsequent lack of winter rainfall.

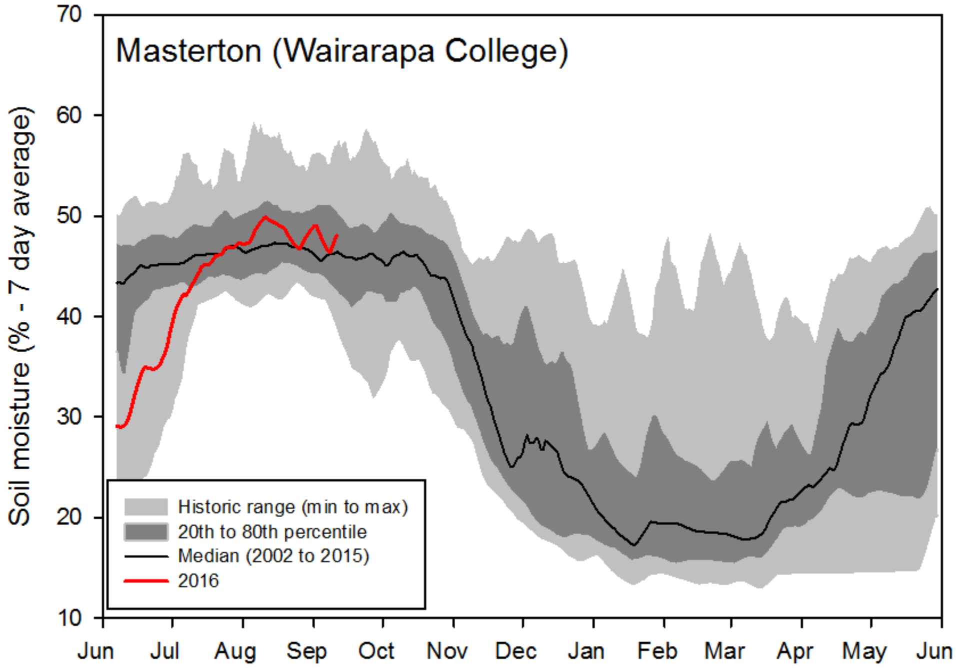
Hutt Valley

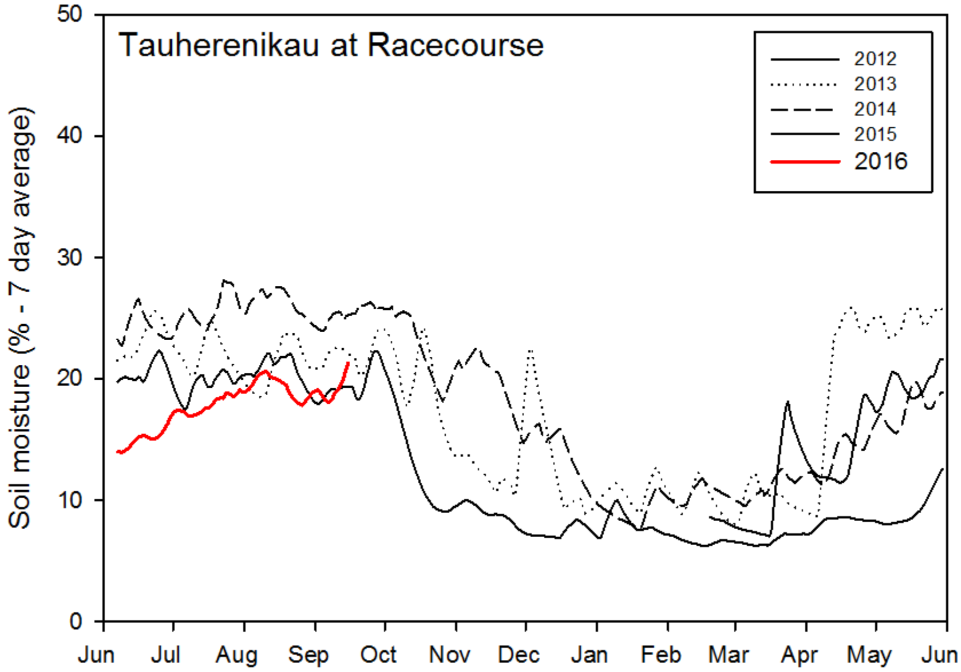


Wairarapa


Northeastern Wairarapa hills (Tanawa Hut)
Soil moisture (% - 7 day average)
60
40
20
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Historic range (min to max)
20th - 80th percentile
Median (2007 - 2015)
2016


Southeastern Wairarapa hills (Waikoukou Longbush)
Soil moisture (% - 7 day average)
50
40
30
20
10
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Historic range (min to max)
20th - 80th percentile
Median (2007 - 2015)
2016


Masterton (Wairarapa College)
Soil moisture (% - 7 day average)
70
60
50
40
30
20
10
Historic range (min to max)
20th to 80th percentile
Median (2002 to 2015)
2016
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun


Tauherenikau at Racecourse
Soil moisture (% - 7 day average)
50
40
30
20
10
0
2012
2013
2014
2015
2016
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun

3. Outlook for spring 2016

- Neutral ENSO is likely, with some chances of a weak La Niña developing;
- Warm sea surface temperatures to the north of New Zealand increasing chances of warmer than average air temperatures;
- Short-lived periods of fairly intense cold air outbreaks likely;
- Frosts likely in Wairarapa due to dry soils;
- Variable rainfall, around average for several areas but irregular distribution and leaning towards drier than average in central Wairarapa;
- Statistical rainfall projection for central Wairarapa: 57% to 94% of 1980-2010 average, with 75% most likely (see next page for details).

Whaitua[1]	Variables	Climate outlook for spring 2016
Wellington Harbour & Hutt Valley	**Temperature:**	Above average, greater variability of mild and cold temperatures.
	Rainfall:	Around average, long dry periods alternated by heavy rainfall events likely.
Te Awarua-o-Porirua	**Temperature:**	Above average, greater variability of mild and cold temperatures.
	Rainfall:	Around average, long dry periods alternated by heavy rainfall events likely.
Kāpiti Coast	**Temperature:**	Above average, greater variability of mild and cold temperatures.
	Rainfall:	Around average, long dry periods alternated by heavy rainfall events likely.
Ruamāhanga	**Temperature:**	Above average, greater variability of mild and cold temperatures. Higher chance of frost events due to dry soil.
	Rainfall:	Below average in the central-east, but heavy easterly rainfall events possible. Most likely range for central-eastern area based on climate analogues (57% to 94% of the 1981-2010 average, with 75% most likely – see Figure 3.1)
Wairarapa Coast	**Temperature:**	Above average, greater variability of mild and cold temperatures. Higher chance of frost events due to dry soil.
	Rainfall:	Below average, but heavy easterly rainfall events possible. Most likely range for central-western area based on climate analogues (57% to 94% of the 1981-2010 average, with 75% most likely –see Figure 3.1)

*See http://www.gw.govt.nz/assets/Environment-Management/Whaitua/whaituamap3.JPG for whaitua areas

Statistical rainfall projections for central Wairarapa via climate analogues

This is a new, experimental product that gives the likely rainfall range for the current season based on 'climate analogues'. In this technique, a long and reliable rainfall time series (ideally 100 years of data) is used as a reference to find how much it rained during years in which the ENSO and oceanic temperatures around New Zealand behaved similarly to what is actually happening in the current year (in this case a transition from strong El Niño to neutral or weak La Niña). Below we give details of the 'analogue' years used, the area of validity and the previous scores. The analogue years will change from time to time depending on the behaviour of the climate drivers.

Likely SON rainfall range: **57% to 94% (75% most likely)** of the 1980-2010 average (see Figure 3.1).

Current analogue years: 1942, 1947, 1954, 1973, 1978, 1983 and 1998.

Area of validity: This projection has been prepared based on long-term rainfall data for Waikoukou (Longbush). The station is strategically located in central-eastern Wairarapa, where rainfall can be regarded as an average of inland conditions (see Figure 2.3). As such, the projected range should be valid for most of the area south of Masterton and eastern of Lake Wairarapa, excluding the coast.

Previous Scores: JJA predicted: 63% to 98% (80% most likely), same climate analogues years as for SON; JJA actual observation: 68% of the 1981-2010 average. Hence, the observed conditions for JJA fell within the predicted range using climate analogues and the prediction was successful.

Note to users: If you have historical rainfall data measured in your property within the area of validity, you can calculate the most likely (actual) rainfall in mm by directly applying the percentage range to your own long-term average. If you live outside the validity area, you can still calculate the average (or ideally the median) and standard deviation of the observed rainfall during previous years using at least four of the seven provided climate analogues, to determine your own likely range for the current season. This projection is a mere statistical guidance and assumes that previous years' rainfall behaviour will more or less repeat, which may not be necessarily true. GWRC accepts no responsibility for the accuracy of these forecasts.

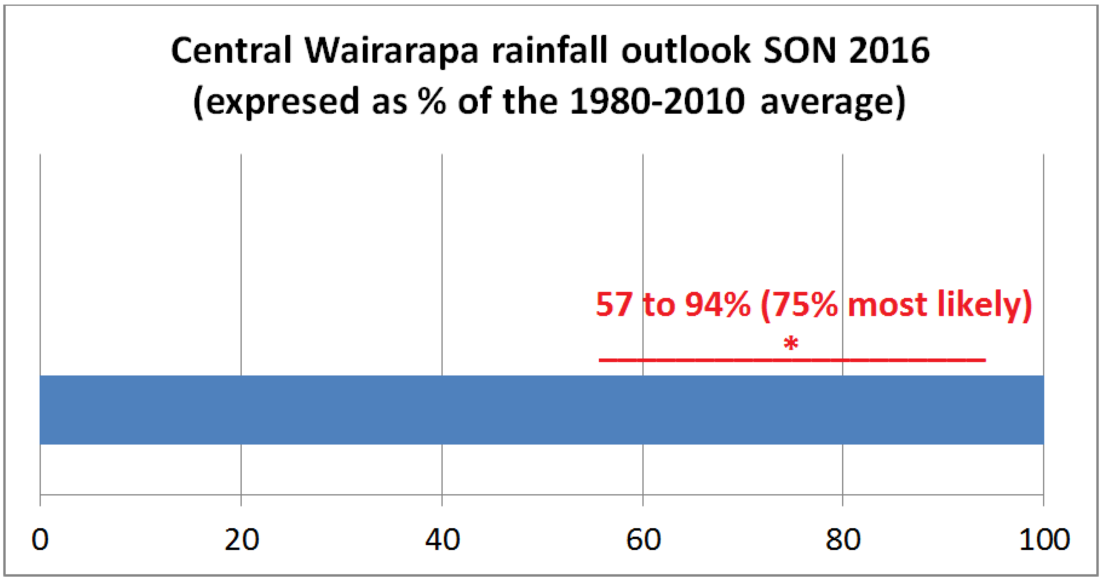


Figure 3.1: Climate analogue statistical rainfall projection using data for Waikoukou, Longbush (see Figure 2.3 for exact location on the map), expressed as percentage range of likely spring rainfall compared to the 1980-2010 average.

Acknowledgments

We would like to thank NIWA for providing selected VCSN data points for the calculation of the regional soil moisture map, and the National Oceanic and Atmospheric Administration (NOAA/USA) for making available the satellite-derived drought indices.