greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Climate and water resources Seasonal update

Winter 2017 summary
Spring 2017 outlook

September 2017

Alex Pezza, Mike Thompson, Mike Harkness and Jon Marks
Environmental Science Department

For more information, contact the Greater Wellington Regional Council:

Wellington
PO Box 11646

T 04 384 5708
F 04 385 6960
www.gw.govt.nz

Masterton
PO Box 41

T 06 378 2484
F 06 378 2146
www.gw.govt.nz

September 2017

www.gw.govt.nz
info@gw.govt.nz

Overview

Winter 2017

Following from a highly unsettled summer and autumn, the wet and changeable weather continued throughout winter in the Wellington region. The temperatures were slightly colder than normal in June and July and warmer than normal in August. Rainfall in the eastern Wairarapa was slightly below average, in contrast to the wet pattern elsewhere. The rainfall distribution was also very irregular, with the driest June on record on the Kapiti coast contrasting with heavy downpours in July and August, including the second wettest Wellington day at the airport since 1958. In the central Wairarapa much of the seasonal rainfall was shaped by a single July event, which alone brought about half of the total seasonal accumulation. This erratic behaviour seems to be getting more common in the region, and is in agreement with climate change predictions.

Climate drivers

The El Niño - Southern Oscillation (ENSO) phenomenon has been neutral and is projected to remain so at least until the beginning of next year. The Southern Annular Mode (SAM) has been predominately positive, with a large high pressure anomaly to the southeast of New Zealand associated with weaker westerlies and increased northerlies, bringing more humid air over the country. Sea ice extent around Antarctica has been a near record low for this time of the year, and the sea surface temperatures (SST) around New Zealand have been warmer than normal. Therefore the overall situation has been variable conditions with increased moisture available due to the warm waters surrounding the country and the northerly winds. Several climate models from international climate forecasting centres are predicting the warm waters to persist around New Zealand. The models are also predicting the establishment of a blocking high south-east of New Zealand with a similar pattern to the one observed during winter continuing, increasing the chance of more northerlies over the North Island, with a circulation similar to a “mini La Niña”, even though the ENSO is forecast to remain in the neutral range.

Climate outlook for spring 2017

Based on the neutrality of the climate drivers and the warm waters around New Zealand with increased northerlies, we expect the unsettled climate pattern to continue throughout Spring. The odds favour warmer than average conditions and variable rainfall, tending to be on the wet side in the west and drier in the Wairarapa, but mostly depending on individual events that can bring large amounts of rain in a short period of time.

Contents

1. Climate drivers

1.1 El Niño – Southern Oscillation (ENSO)

The ENSO phenomenon has been neutral (slightly on the cool or La Niña side), and is expected to remain so at least until the beginning of next year (Figure 1.1). Most international models agree with the neutral pattern shown by the Australian model POAMA depicted in Figure 1.1, although bordering weak La Niña conditions.

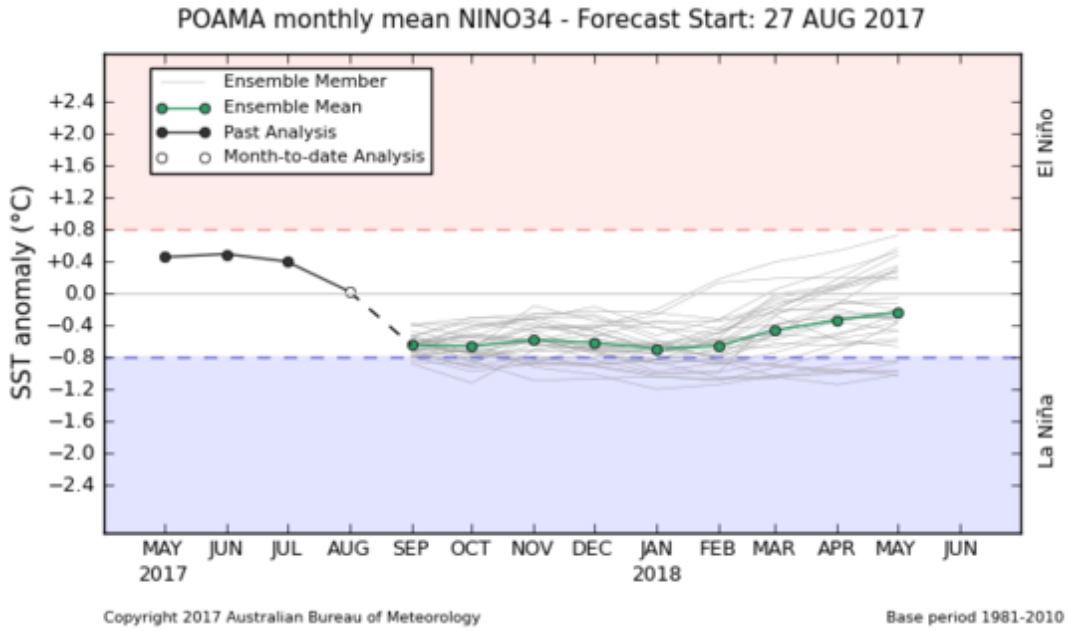


Figure 1.1: ENSO projections until May 2018 show conditions are tracking around neutral based on the Australian model. Most international models also indicate neutral conditions. Source: Australian Bureau of Meteorology.

1.2 Sea ice extent and oceanic temperatures

The Sea Surface Temperature (SST) anomalies and the total sea ice extent (in white) are shown in Figure 1.2 for 7 September 2017. The Antarctic sea ice extent continues to track well below average for this time of the year especially south of New Zealand, with the August value being amongst the lowest on record over the period 1979-2017. The SSTs remained above average around New Zealand during winter and seem to be getting progressively warmer, although with some oscillating patches of colder than average water influencing the east coast at times. In the Equatorial Pacific a slight cool tongue is observed, even though the ENSO indicators remain neutral (the SOI index has been only slightly positive since mid-July). Most climate models are predicting warmer than average waters to persist over the next few months around New Zealand, with a possible “mini La Niña” pattern in the equatorial Pacific that is not expected to reach true La Niña strength. Therefore, any ENSO related influence would be only very minor.

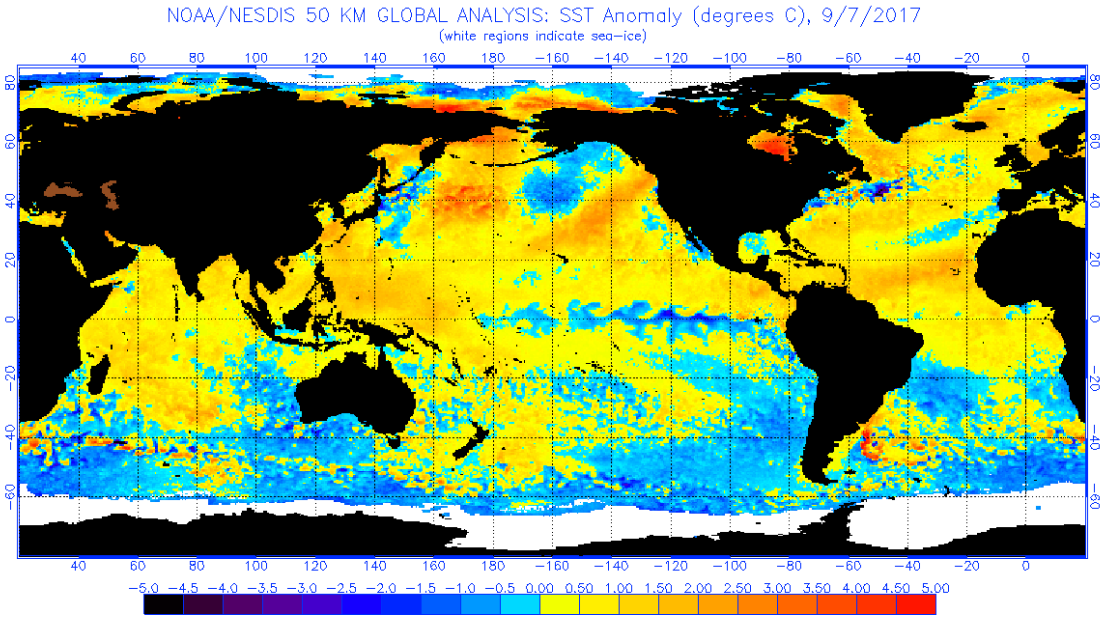


Figure 1.2: Sea surface temperature (SST) anomalies for 7 Sep 2017. Sea ice coverage is shown in white. Colder than average waters are seen in the high latitude belt around Antarctica (just north of the sea ice), while warmer than average values are seen around New Zealand. A mini La Niña pattern is also seen around the Equator, although all ENSO indicators remain neutral. Source: NOAA.

1.3 Southern Annular Mode (SAM)

The SAM is the natural pressure oscillation between mid-latitudes and the Antarctic region. Normally positive SAM is associated with high pressures around the north island of New Zealand, keeping the weather stable and dry/cloud-free (especially in summer), whereas the opposite is expected when the SAM is in the negative phase. Figure 1.3 shows that the SAM was more on the positive side in winter, with a very strong high pressure southeast of New Zealand (indicated by 'H') and low pressures around Antarctica. This area of blocking high pressure was far from New Zealand and had only a small influence in blocking the flow, albeit with increased northerlies and increased moisture over the country during the last season.

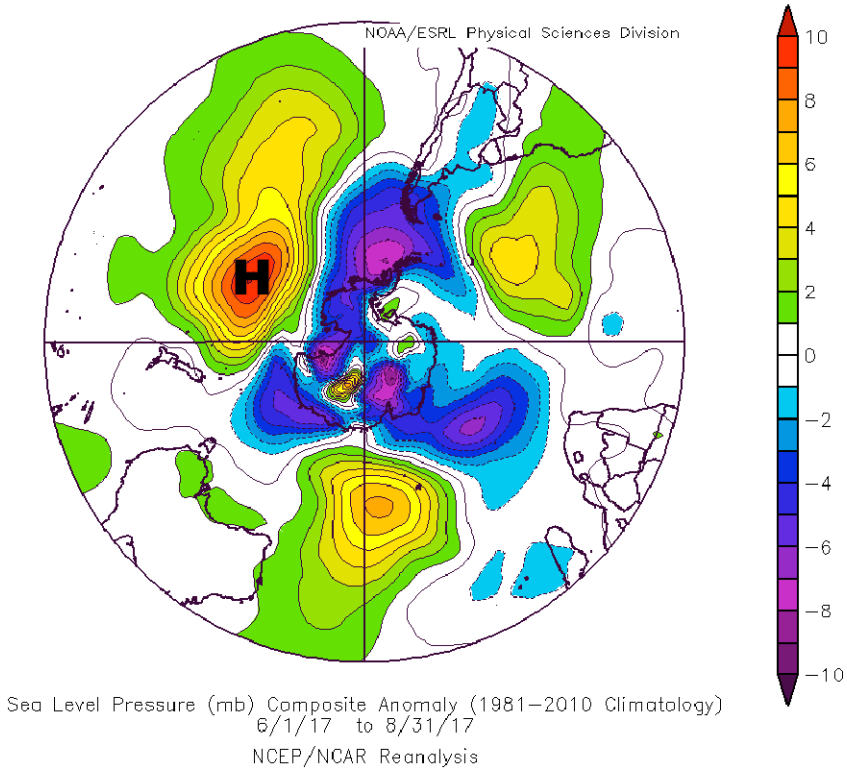


Figure 1.3: Sea level pressure anomalies for JJA 2017. The H indicates the area of blocking high pressure east of New Zealand that helped bring more northerlies over the North Island. Source: NCEP Reanalysis.

2. What is the data showing?

2.1 Regional temperature

Figure 2.1 shows the minimum and maximum temperature anomalies (against the 1981-2010 reference period) for the region based on all monitoring sites available from GWRC, NIWA, Metservice and New Zealand Rural Fire Authority (all meteorological stations indicated by dots). We can see an interesting pattern with cooler than average minimum (night-time) temperatures from the west coast to central Wairarapa, and cooler than average maximum (daytime) temperatures in parts of the Wairarapa. This helps explain why winter felt cold for many, although August was generally warmer than average. Figure 2.1 also shows a few areas with above average temperatures including Wellington and the northern ranges, although the excessive rainfall and lack of sun have "won over" the temperature, making it feel colder than what it was.

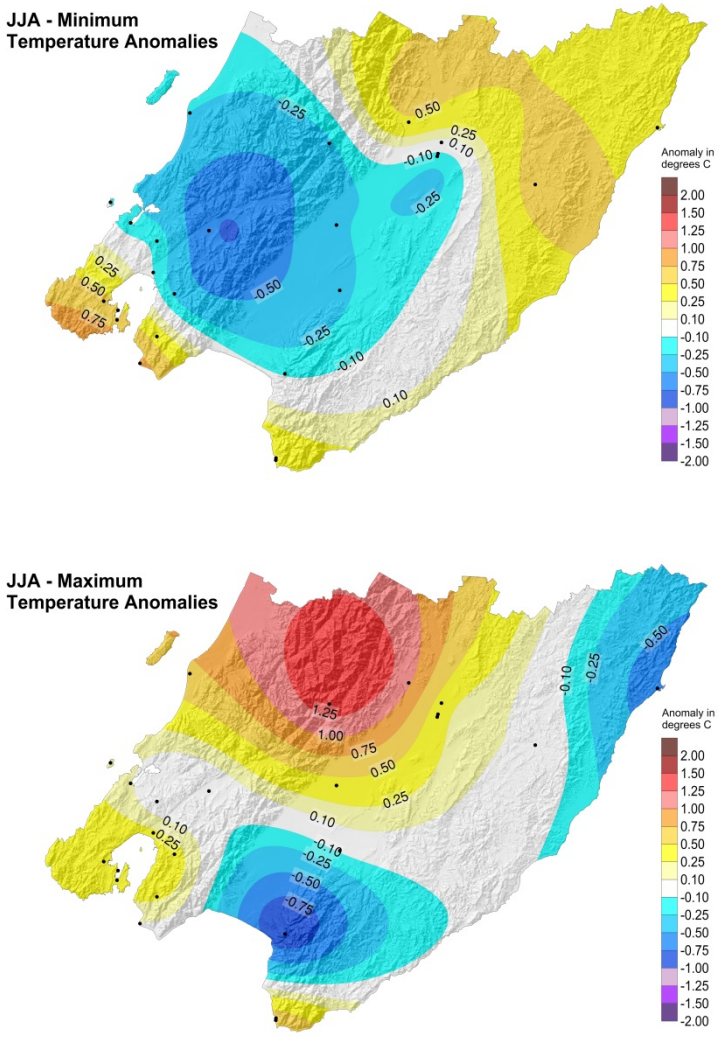


Figure 2.1: Daily Average Min and Max temperature anomalies for JJA. All anomalies calculated against the 1981-2010 reference period. Source: GWRC, using station data from the GWRC, NIWA, MetService and NZ Rural Fire Authority networks.

2.2 Regional wind

Figure 2.2 shows the mean wind anomalies (against the 1981-2010 reference period) based on a similar network of stations as shown for temperature. We can see an interesting pattern with overall weaker winds than normal in the southern part of the region and normal or slightly stronger than normal in the northern part of the region. As discussed before, the climate drivers were favourable for slightly weaker westerlies than normal, but this new map makes it possible to see small variations within the region, responding to local topographic features that could not be derived by global reanalysis models. It highlights the importance of having a reasonably high density of reliable measuring stations.

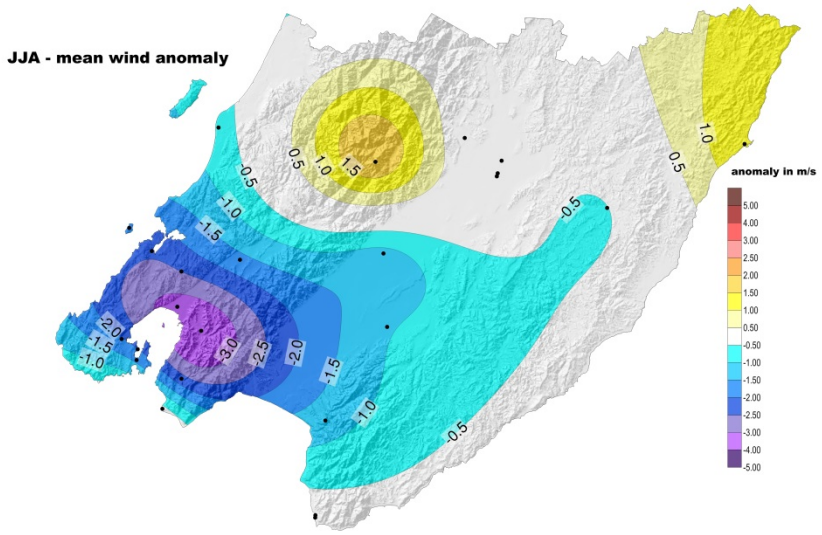


Figure 2.2: Daily mean wind anomalies (in m/s) for JJA. All anomalies calculated against the 1981-2010 reference period. Source: GWRC, using station data from the GWRC, NIWA, MetService and NZ Rural Fire Authority networks.

2.3 Regional soil moisture assessment

Figure 2.3 shows the soil moisture anomaly map for the region at the end of winter, as of 31 August 2017. Most of the southern part of the region shows above average soil moisture. There is no area of soil water deficit observed anywhere in the region at present, as a result of the above average rainfall during the last three consecutive seasons.

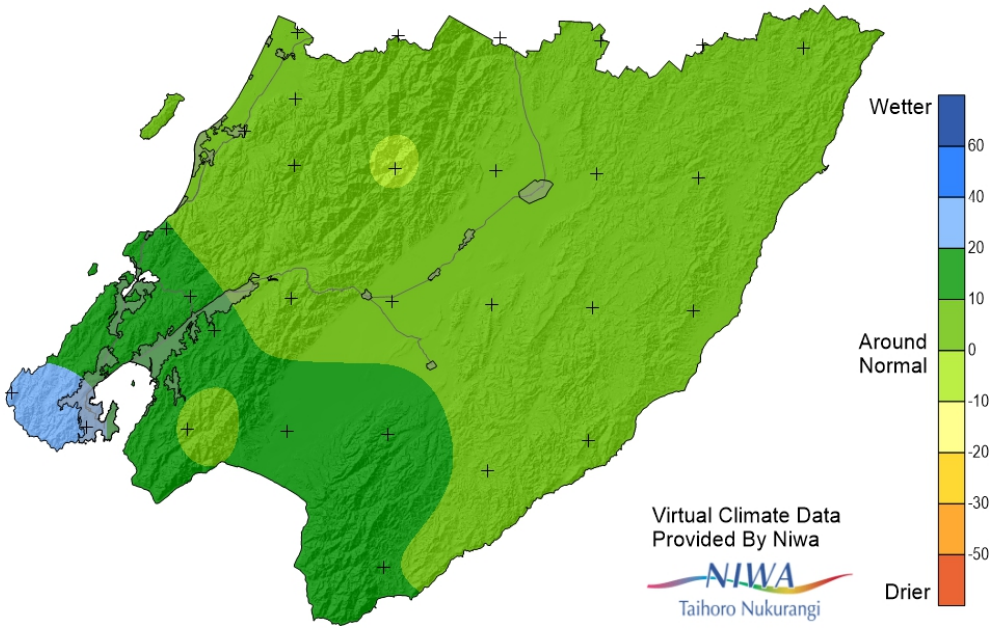


Figure 2.3: Soil moisture anomaly for 31 August 2017. Moisture levels show above normal conditions for most of the region, especially in the south. Source: GWRC, using selected Virtual Climate Station Network (VCSN) data kindly provided by NIWA. Note that this data is indirectly calculated by modelling and interpolation techniques, and does not necessarily reflect the results obtained by direct measurements. This map should only be used for a general indication of the spatial variability.

2.4 Regional rainfall

Figure 2.4 shows the regional winter rainfall expressed as a percentage of the long-term average. Most of the region shows greater than average rainfall totals with only the north-eastern Wairarapa showing totals below average.

The asterisk shows the location of the reference rainfall station (Waikoukou farm) used to produce the climate analogues rainfall projection for the Wairarapa (see section 3). The farm had about 110% of the 1981-2010 rainfall average over the winter period.

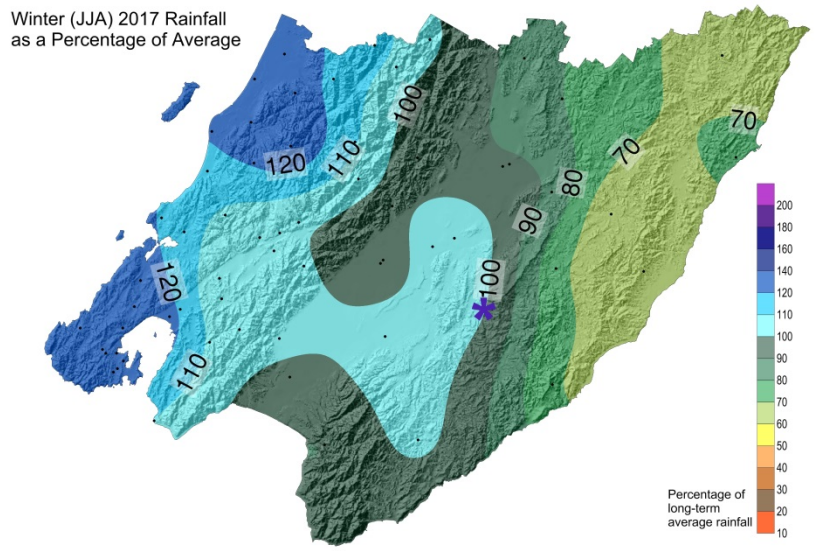


Figure 2.4: Rainfall for winter 2017 as a percentage of the long-term average. Above average rainfall is seen for most of the region, except the north-eastern Wairarapa. The asterisk shows the location of the rainfall time series at Waikoukou, Longbush, used for the climate analogues rainfall projection (see Section 3). Source: GWRC.

2.5 Observed rainfall and soil moisture conditions for selected sites

Figure 2.5 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.

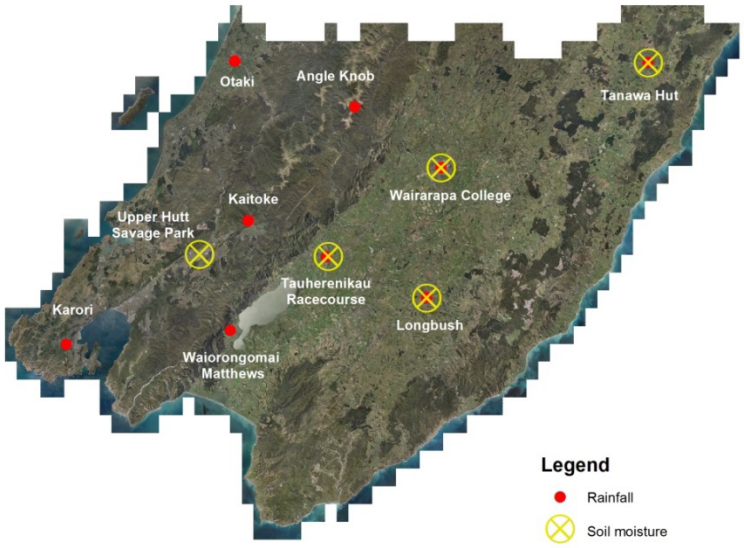
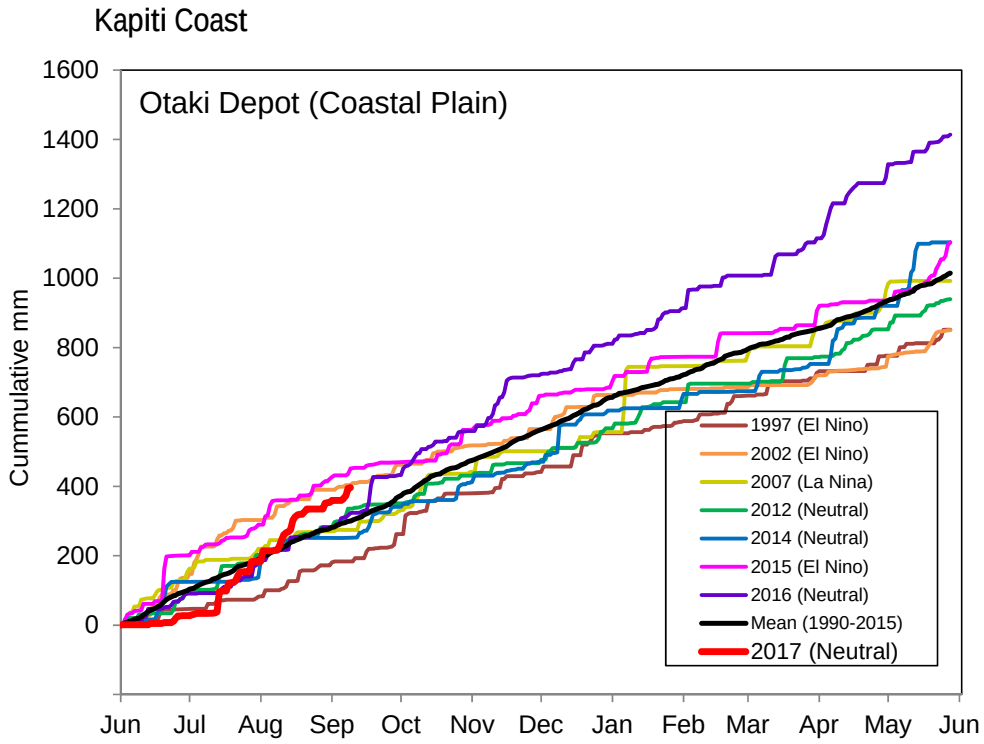


Figure 2.5: Map of GWRC rainfall and soil moisture monitoring locations

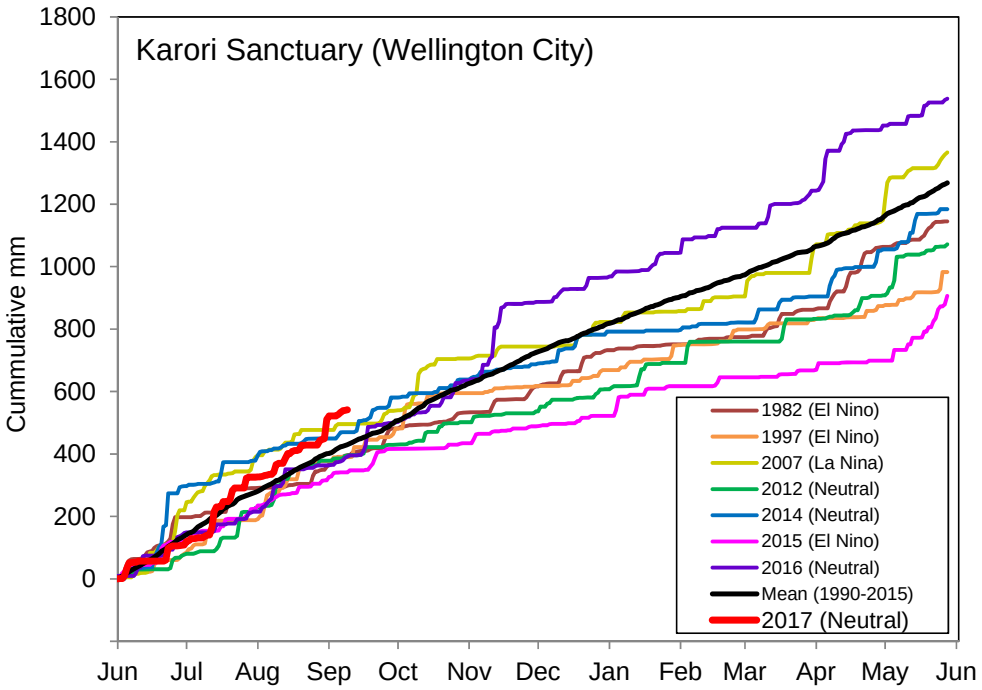
2.5.1 Rainfall accumulation for hydrological year (1 June to 31 May)

The following rainfall plots show total rainfall accumulation (mm) for the hydrological year 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 average. 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 limited to the last 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.

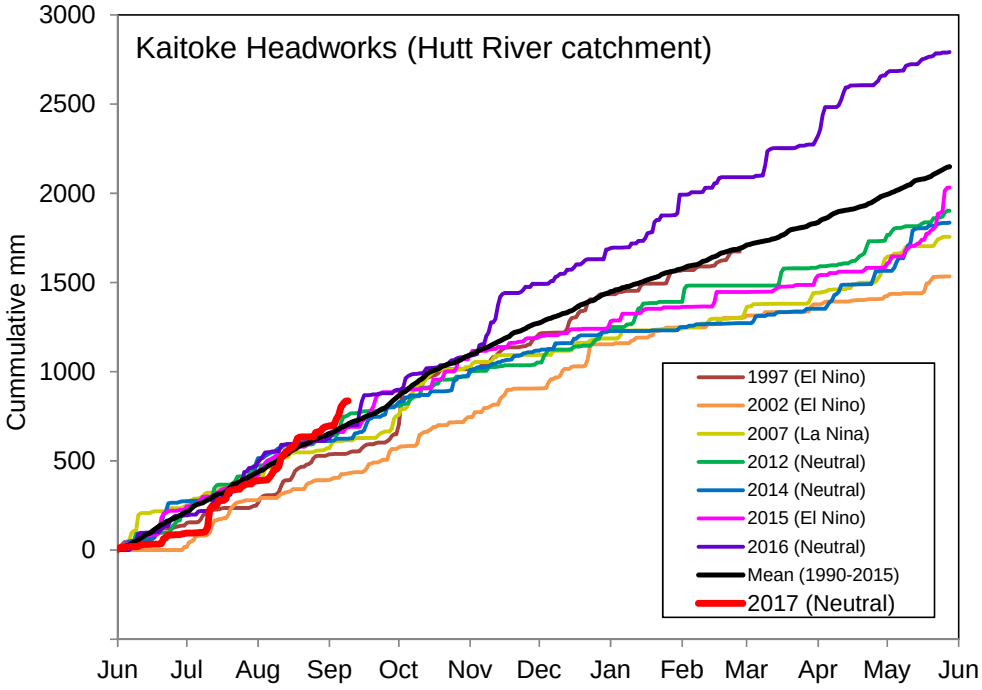
Overall, accumulations for the year that has just started (ie, June 2017 to May 2018, labelled 2017 on the plots) have been normal to above normal in the west and in the Tararua range and normal to below normal in the east Wairarapa. In the Wairarapa, about half of the winter rain fell in one event towards the middle of July. This pattern, where a large event determines the average, is becoming the norm in the Wairarapa, and agrees with climate change predictions for the region which highlight the increasing irregularity of rainfall patterns.

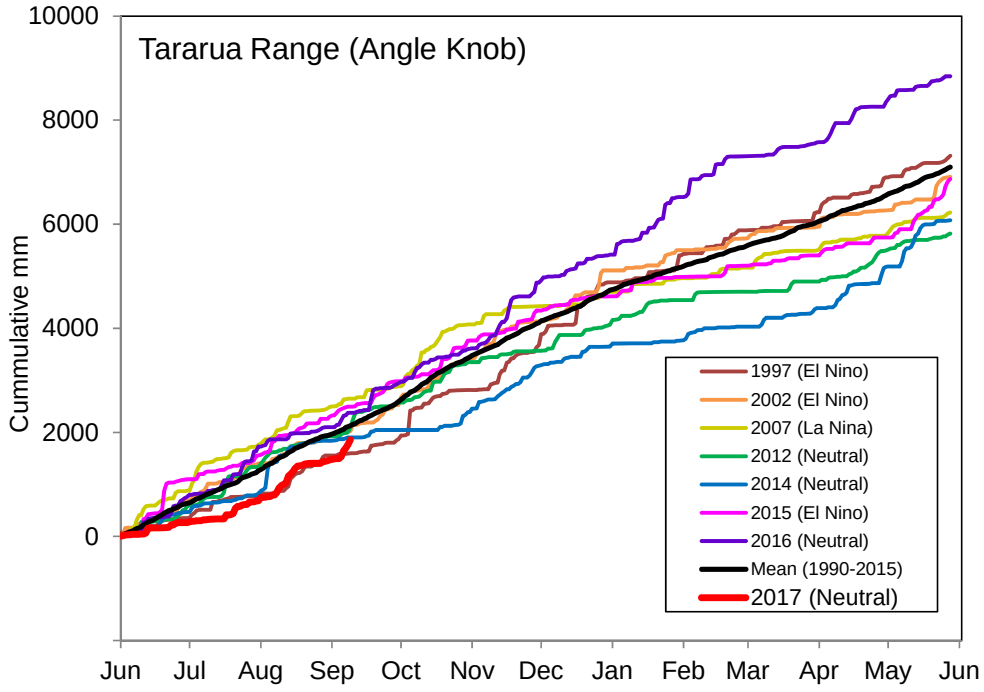


Southwest (Wellington city)

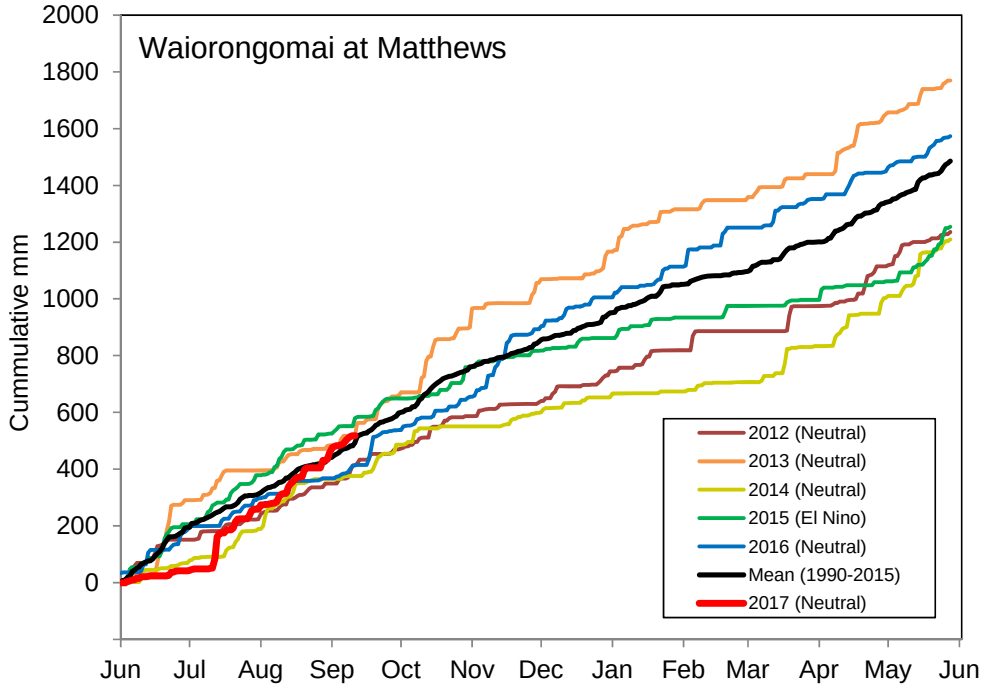


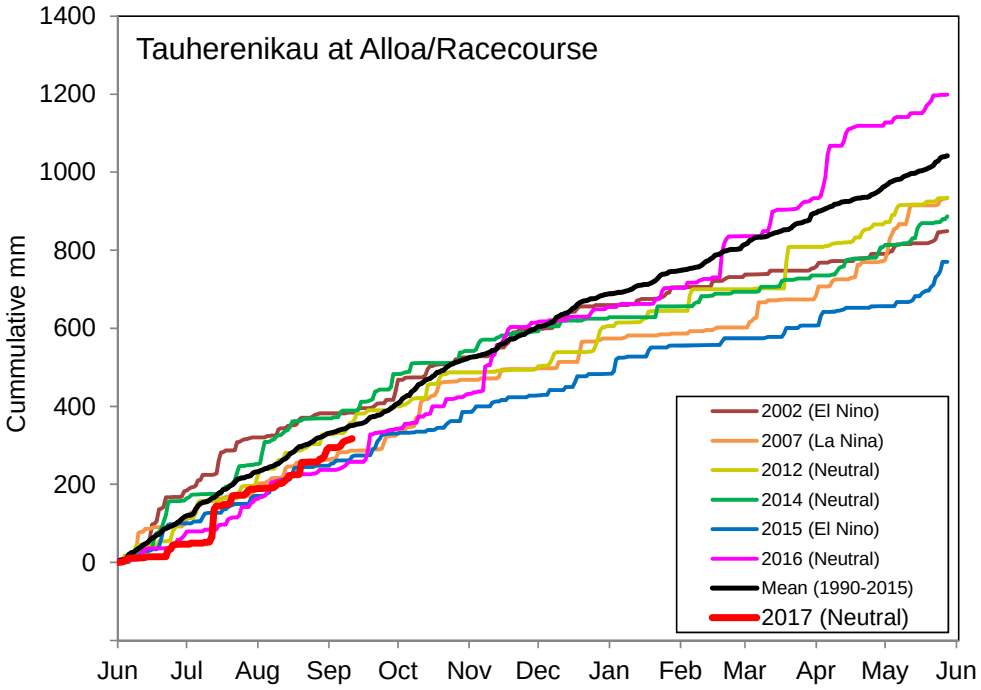
Hutt Valley and Tararua Range

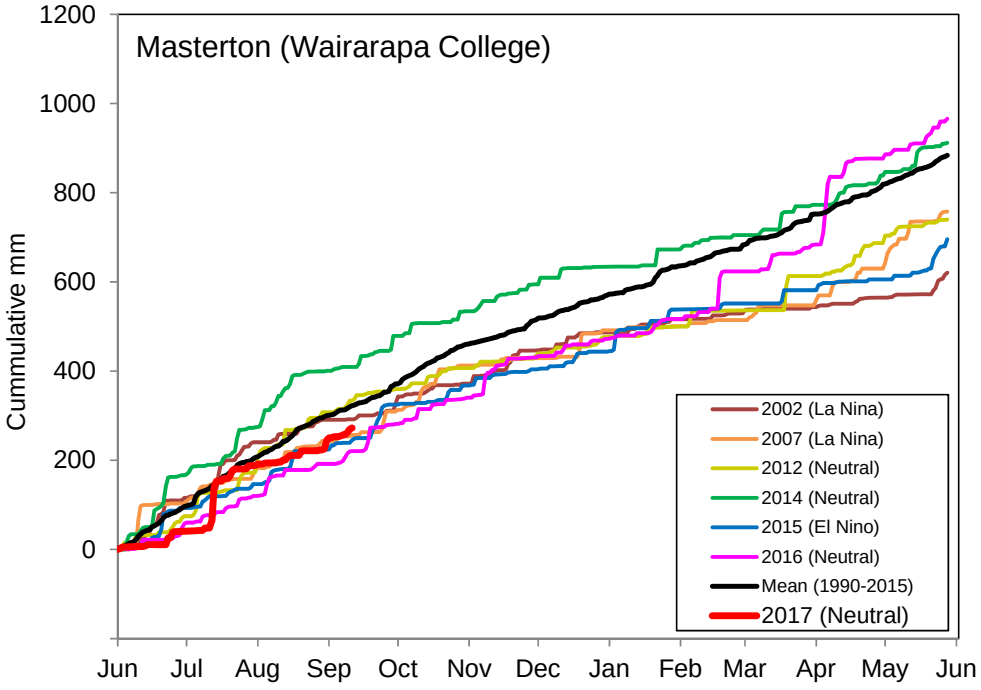


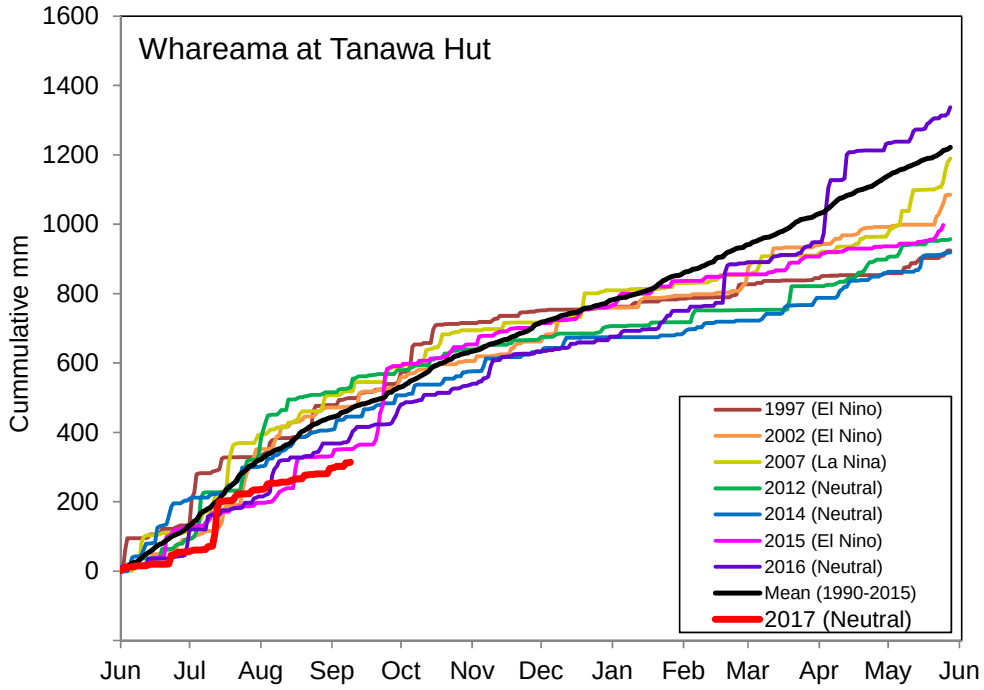

Tararua Range (Angle Knob)
Cummulative mm
10000
8000
6000
4000
2000
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
1997 (El Nino)
2002 (El Nino)
2007 (La Nina)
2012 (Neutral)
2014 (Neutral)
2015 (El Nino)
2016 (Neutral)
Mean (1990-2015)
2017 (Neutral)

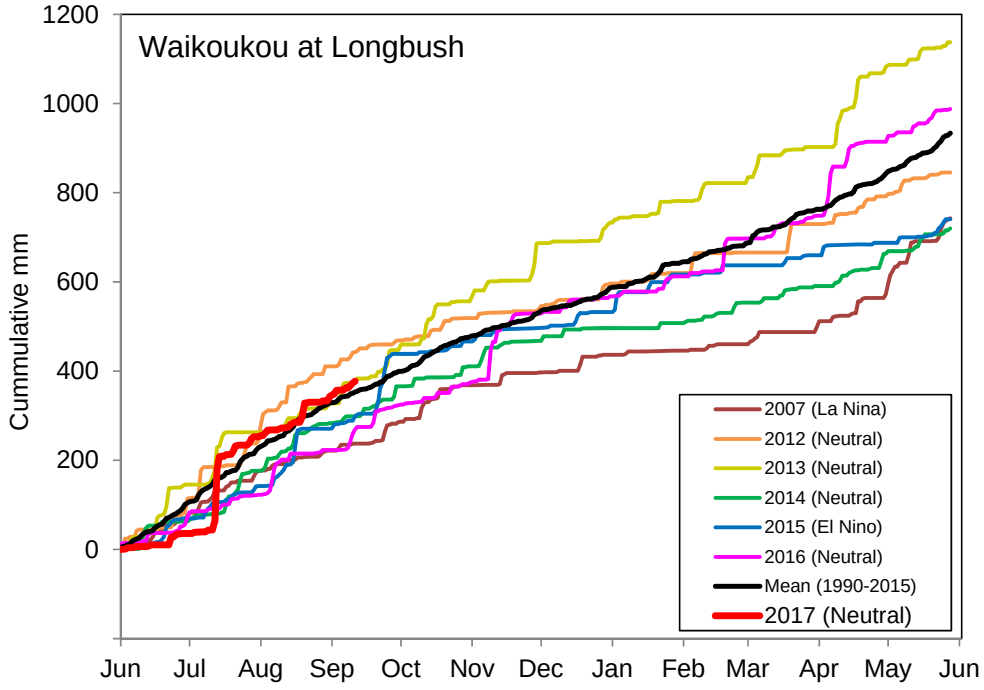
Wairarapa


Waiorongomai at Matthews
Cummulative 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)
2016 (Neutral)
Mean (1990-2015)
2017 (Neutral)


Tauherenikau at Alloa/Racecourse
Cummulative mm
1400
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)
2016 (Neutral)
Mean (1990-2015)
2017 (Neutral)


Masterton (Wairarapa College)
Cummulative mm
1200
1000
800
600
400
200
0
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
2002 (La Nina)
2007 (La Nina)
2012 (Neutral)
2014 (Neutral)
2015 (El Nino)
2016 (Neutral)
Mean (1990-2015)
2017 (Neutral)





2.5.2 Soil moisture content (1 June to 31 May)

The soil moisture plots for selected individual locations will be updated in the next climate briefing covering spring. For a regional view refer to section 2.3. No areas of significant moisture deficit were observed throughout the region over the last season.

3. Outlook for spring 2017

- ENSO likely to remain neutral, with a slight flavour of a mini La Niña possible, but with very little influence;
- Sea surface temperatures mostly warmer than average around New Zealand with increased moisture available for heavy rainfall events;
- Fewer and weaker frosts due to elevated air and soil moisture;
- Slightly weaker westerlies, possible enhanced northerlies with warmer than average temperatures;
- Around average rainfall, some dry spots in the Wairarapa and wetter in the west. Total accumulation likely determined by a few extreme weather events

Whaitua*	Variables	Climate outlook for spring 2017
Wellington Harbour & Hutt Valley	Temperature:	Above average, weaker frosts due to elevated soil moisture.
	Rainfall:	Average or above.
Te Awarua-o-Porirua	Temperature:	Above average.
	Rainfall:	Average or above.
Kapiti Coast	Temperature:	Above average.
	Rainfall:	Average or above.
Ruamahanga	Temperature:	Average or above, weaker frosts due to elevated soil moisture.
	Rainfall:	Average or below. Dry periods alternated by heavy rainfall events. Chance of below average according to climate analogues for the central-eastern area (Longbush): 65 to 111% of the 1981-2010 average, with 88% most likely – see graph below
Wairarapa Coast	Temperature:	Average or above.
	Rainfall:	Average or below. Dry periods alternated by heavy rainfall events.

*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 analysis that gives the likely rainfall range for the coming 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. 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: 65% to 111% (88% most likely) of the 1981-2010 average (see Figure 3.1). Confidence: LOW (no perfect analogue, weak climate drivers and climate change signal).

Current analogue years: 1959, 1967, 1980, 1984, 1996, 2004 and 2011. The current analogue years represent transition years without a strong ENSO signature.

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 2.4 under main body of report). 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: 126% to 141% (134% most likely), using different analogue years; JJA actual observation: 110% of the 1981-2010 average. Hence, the observed conditions for JJA were above average as predicted, even though they **fell outside** the predicted range using climate analogues.

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 the climate analogues provided, to determine your own likely range for the current season. This projection is a statistical guidance and assumes that previous years' rainfall behaviour will more or less repeat, which may not be necessarily true, even less so in light of climate change. Hence, these projections should be used with caution and as general guidance of where the climate might be heading. The forecast should be interpreted together with the text discussed in the whaitua tables above. GWRC accepts no responsibility for the accuracy of these forecasts.

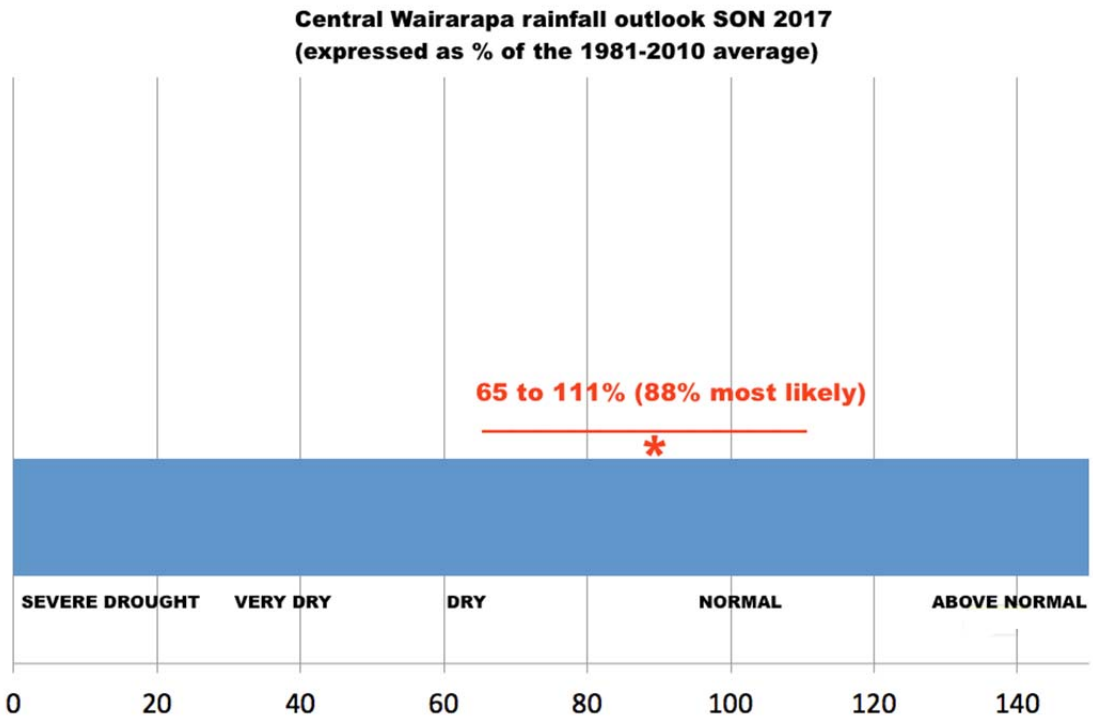


Figure 3.1: Climate analogue statistical rainfall projection using data for Waikoukou, Longbush (see Figure 2.4 for exact location), expressed as percentage range of likely seasonal rainfall compared to the 1981-2010 average. Due to the erratic behaviour of the climate drivers as well as the impacts of climate change there is low confidence in the most likely value for this prediction.

Acknowledgments

We would like to thank NIWA for providing selected VCSN data points for the calculation of the regional soil moisture map.